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Cumulus Working Papers

Schwäbisch Gmünd

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FOREWORD Yrjö Sotamaa

Crossing boundaries – Sharing the global knowledge and the global responsibility

The time of the birth of Cumulus was marked by the fall of the Berlin Wall, a great euphoria of freedom and the birth of a "New Europe". Cumulus was born to promote the ideals of democracy, equality and freedom of movement. Importance of education for a balanced social and economic development and a wish to strengthen the role of culture in global development have brought us together.

The history of Cumulus and its various activities tells of a strong mission, which includes four basic aspects. Cumulus wishes to develop a powerful global network of talented individuals and dynamic institutions, which can work to

- Promote the talent of the youth and creativity
- Support improvement of quality of education and the development of research in art and design
- Make societies and industry aware of the importance of culture, art and design in building sustainable societies, creative economies, innovative regions and a better everyday life for all people.

Cumulus was born in 1990 by "six missionaries" and has grown in 2007 to an International Association of over 120 excellent institutions from all parts of the world. Cumulus is today to most important international organization of art and design universities.

Cumulus has organized 18 international conferences, tens of projects, exhibitions and events and continues to do so. In future we will meet in Kyoto, Shandong, Zurich, Melbourne, Shanghai, Colorado and many other exciting places of the world. The conference in Schwäbisch Gmünd has close to 300 participants from 38 countries. Globality is an essential part of all our activities.

An International Association

By becoming global Cumulus can better help all its members to fulfil their tasks through sharing best practices and the best knowledge with each other. Sharing is not decreasing any ones own resources, on the contrary, every one gains something new and important. Knowledge grows through its use.

We should use the resources of Cumulus and its members to address the major global challenges: creating ageing wellness, protecting the environment, solving problems of transportation and expanding the benefits of mobile life created by new technologies. We should also work together to make design research an essential part of the activities of all member institutions and the fundament of future education.

We should also learn to better understand the differences of the cultures of the world and through this better use the global resources to support sustainable development.

These are ways to strengthen global responsibility in building high level education and in building sustainable creative societies.

I wish to thank heartily rector Christina Salerno, her team and students for organizing an excellent conference in Schwäbisch Gmünd. I also wish to congratulate Christian Guellerin, the new Cumulus President and wish him and the new Executive Board every success. The future of Cumulus is in good hands.

Yrjö Sotamaa Rector, Professor
President of Cumulus 2001–2007

FOREWORD Christian Guellerin

This network is easy to access and easy to be part of…

And nowadays within our complex world, simplicity is a revolutionary trend…

I am truly honored to have been elected President of Cumulus and I am thankful for the trust you have put in me.

As praiseworthy Yrjö Sotamaa stated, Cumulus has become one of the major international structures promoting creation, design and education.

This network revolves around values such as democracy, humanism, free participation and friendship. This collaborative platform offers each one of us an extraordinary means to exchange students, teachers… to compare our practices and our work with a view to improving ourselves. Exchange is the driving force of learning, and learning is the *sine qua non* for progress.

Cumulus is an extraordinary medium to communicate and to share, and we greatly appreciate its policy based on optional participation. Indeed, each member is free to offer a lot if he/she wants to or to make more humble contributions if his/her means are scarcer. This network is easy to access and easy to be part of… and nowadays within our complex world, simplicity is a revolutionary trend.

We have a great deal of work to do and many a challenge to take up in order to foster the expansion of Cumulus, of our structures and to promote creation… But, above all, we need to reflect and act together upon the world we will live in tomorrow. Gathering the strengths of 124 institutions, Cumulus acts as a spur and a showcase for research initiatives focusing on tomorrow, on the future, on progress…

During the last general assembly, I already presented several lines of directions our work should follow – research, professionalism and promotion of the work of students. However, this should not be considered as a program. A true program needs to be shared by all.

Composed of 10 elected members, this board is a fine blend between former and new members. Our team is a good and highly energetic one. The election of members from Australia, the USA and China to our board bears witness to the efforts made by Cumulus to open up to the "global" world, a trend that the previous board has definitively made into a key element of our network's growth.

Our responsibility is heavy since we have reached a time when creation, design and communication are evolving at an extremely fast pace, a time when every line we write today might be outdated tomorrow… Being a creative professional amidst such troubled times is a tremendous mission…

Today we are 124. Tomorrow we will be 150. And in three years there may be 250 of us … I am convinced that we will reach this aim if we stick to the sense of responsibility and the wonderful enthusiasm that have guided our steps so far.

Congratulations to all of you for what you have done, what you do and what you will do… for Cumulus.

Christian Guellerin General Director
President of Cumulus

PREFACE Peter Stebbing and George Burden

Educate and design to the extent of the available knowledge

In his keynote presentation at the 2007 Cumulus Conference Prof. Dr. Hans Peter Meinzer told the 300 design educators and practitioners that "*…if I were ill then I would like to be treated to the full extent of the available knowledge*." Surely this is what we would want not only from medicine but also from design and education?

However, it seems that designers can rarely agree even amongst themselves on what design actually is. Prof. Bürdek, for example, when reviewing a conference proceedings commented that "*Over and over again designers ask themselves what on earth design actually is and how it should be defined – seeing it caught between art and technology for example. And then they go back and start all over again at the beginning. This means that any progress made by the discipline is doomed to proceed at a snail's pace*."

If we adapt and adopt Prof. Meinzer's wish for design education and practice, then the unequivocal message of this Conference is that we must try to educate and design "*…. to the extent of the available knowledge*." Doing less than this will certainly waste our limited human, material, and natural global resources.

In keeping with our Conference's title of *'Crossing boundaries'* we were pleased to note that a much more holistic picture of education and practice is now emerging among Cumulus members. Throughout the conference very few speakers, including the invited 'non-designers', limited themselves to talking about the transfer of knowledge from only one discipline to another but truly demonstrated the multi-disciplinary nature of their teaching or practice.

They demonstrated that both design, which is primarily composed of a few cognitive modules such as problem definition, research, analysis, synthesis, development, realization, evaluation, etc., and education for this calling works within an extensive network of relationships with different levels of complexity. In other words, the design problem exists in an 'ecology' of relationships between the user, the context, and beyond. These layers of complexity reflect our own organic organization and the environment on which we depend. A designer should thus, for example, be aware that users' perceptual-aesthetic responses to any design are partially determined at the neuronal level, that users also feel the need to identify with a group at a psycho-social level, and that they will also be influenced at a cultural level. Furthermore, at all levels unconscious factors will be influencing users and those affected indirectly by the design.

What does Prof. Meinzer's wish, if we accept it, mean for design education? We believe that the following conclusions can be drawn from the general message of all the conference speakers:

Designers and design educators must be scientifically literate. Clearly, they can hardly become scientists in their own right, but they should be able to access and interpret the latest relevant scientific knowledge and developments for application to their work. This is essential if we are to conserve our limited resources.

Designers and design educators must have a "T" knowledge profile. They should be specialists in at least one area but with the capability and communication skills of a generalist so that they can both understand the depth of knowledge while being able to move easily across different areas to access and combine knowledge creatively to achieve innovation.

Designers and design educators must be good team players. With their "T" knowledge profiles members of a team must be encouraged to help each other to bring their relevant and specialist knowledge to bear on design and educational issues.

Designers must be culturally literate. They should be able to recognize that every culture has developed because of the creative thought processes inherent in its language and lifestyle.

Consequently, designers must possess the humility to perceive and admit that every culture is a won-

derful educational and creative resource. This same humility will lead to the tolerance and understanding that are the necessary prerequisites for good teamwork. This humility is best acquired by international practice, experience, and debate.

Finally, designers and educators need to be more than just good communicators and team members. They must learn to be good choreographers of knowledge for dealing with design and educational issues. This is because we can now recognize that design issues exist at nodes within a complex network of relationships. The designer is becoming, if you will allow it, an ecological choreographer of knowledge.

As the Editors for the Review Committee we would like to thank all those who contributed keynote presentations or papers to the Conference and thus did so much to make it successful. We also thank all those who so willingly and actively participated in the Reviewing process. Many of you had the difficult task of writing and reading a language that was not your mother tongue. As Englishmen living and teaching in Germany we acutely appreciated the linguistic difficulties involved. Our editorial policy has been to respect totally the content of the papers and to try merely to streamline the English and we apologize to any authors who consider that in performing this task we have overstepped our responsibility or failed to achieve complete fluency.

As the organizers of the Cumulus Conference 2007 we would also like to commend two features that future conference organizers might consider continuing:

Poster session. We introduced the poster session because, as an established method of presenting work at scientific conferences, it encourages peer discussion of ongoing projects and research, promotes debate, encourages networking, etc.,

Student session. We strongly recommend that students be specifically invited to present papers in a student session at future conferences. Not only would this widen the educators' knowledge and opinions of the spectrum of design and design education but would also provide a very rich educational experience for the students, who will learn about the process of submitting a peer-reviewed paper and enjoy the experience of making a presentation to a critical audience and defending their views among experts.

We would like to commend those students who contributed and presented papers at this conference. It was a major experience for them and their abstracts are published here.

Prof. Peter Stebbing
Prof. George Burden

Literature

Bürdek, B.E., 1998, *Marginal notes on the debate on design and theory*, Formdiskurs, Zeitschrift für Design und Theorie/ Journal of Design and Design Theory, no ii, vol 5, pp 108–110.

Keynote abstracts

Ellen Wagner

Learning by design

In today's hyper-intensive, complex world, learning is seen increasingly as the catalyst for creating new knowledge across disciplines and communities of practice. Supporting learners at the point of need, whatever media and devices they use, makes it possible for more people to engage with ideas and information than ever before. But this vision of transferring knowledge will not be achieved simply as a result of serendipity or good intentions. We explore the increasingly important role of design as the means of achieving both personal and organizational value from learning, and offer suggestions for encouraging more meaningful cross-disciplinary collaborations.

Ellen Wagner is senior director of worldwide e-learning solutions at Adobe Systems, working with product teams across the company to help set the strategic direction for e-learning solutions for corporate education and training, customer enablement, field readiness, and also for solutions for post-secondary and K-12 education. She joined Adobe in 2005 following the acquisition of Macromedia, where she was senior director of worldwide education solutions. Earlier, Ellen was a tenured faculty member at the University of Northern Colorado, chair of the university's Educational Technology Program, coordinator for Instructional and Research Technologies, Academic Affairs, and director of the university's Western Institute for Distance Education. Much of her work explores experience design for learning, and she has published over 80 articles and book chapters on learning and instructional design and has presented at many international, national, and regional conferences

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Jan Teunen

A patch of cloud – About fragmentation and wholeness

Universities are worldly representatives of the universe. Because of globalisation and information technology many institutions are no longer connected to the cosmos and as a result not only those in charge, but also the students they are responsible for, find themselves in a thicket where orientation is difficult. Open spaces must be created as the precondition for clear-sighted progress and for the acceleration of the great worldwide change process. Students represent the future, and future artists and designers can play a leading role in the re-design of society, provided, of course, that they do not adopt the fragmentary thinking common in many universities. Breaking everything up is false; it is an incoherent way of thinking. Universities are facing a crossroads. Boundaries must be crossed. Hear! Hear!

Jan Teunen left his native Netherlands to work in Germany. He founded Teunen Konzepte GmbH in 1991 to act as a Cultural Capital Producer *"helping companies to cultivate themselves"* and was dubbed "Europe's Marketing Magician" by ID magazine. Working for several international companies, he is passionate about creating a balance between economic and ethical responsibilities, convinced that without this equilibrium corporate culture cannot ensue. As editor or author of at least 20 books and publications he has been invited to speak at most of the leading European design schools. He has been a juror at many design competitions and was on ICSID's Roster of Experts (Design Promotion). He is a keen collector of contemporary art and also promotes and sponsors cultural activities.

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Christian Berg

Networking as a syndrome – Impacts of a global trend and implications for design

Networking is one of the most important trends today. Mainly driven by technologies of transportation as well as information and communication, networks are present in almost every aspect of our lives. "Globalization" is one of the results. Networking sets the framework for rapid economic growth and increased mobility and trade, but also for an alarming environmental degradation, for the depletion of resources, and societal conflicts. Having presented some of these developments, the lecture will outline implications for design.

Christian Berg has recently become Product Manager for Sustainability at SAP AG, Germany. Before that he worked as Senior Researcher for SAP Research, exploring the potential of IT solutions for corporate social responsibility (CSR) and a sustainable development. Previous assignments include the work as business consultant for CSR and the European leadership of an interdisciplinary academic program. Christian Berg is a lecturer of environmental science and sustainability at Clausthal University of Technology and at the University of Design, Schwäbisch Gmünd. He is a founding member of the Think Tank 30 of the Club of Rome. He holds degrees in physics, philosophy, theology, and engineering and is author of several articles and books.

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Hans Peter Meinzer

The inside view – Looking inside Seeing inside

The radiological data from Computer Tomography (CT), Magnetic Resonance (MR), and even Ultrasound (US) are available as many parallel slices. These volumes today are presented as series of images in a light box, but the computer "sees" pixels, whilst humans see entities. We will explain how the next generation of radiological software will present the real 3D/3D+t data volumes, thus facilitating diagnostics, surgery planning, and support the execution of minimally invasive surgery. We are working with an interdisciplinary team to visualize and present information about the interior of the body and its organs in a form that makes instant sense to a human being. We are also developing ways of making it immediately available and clearly and precisely understandable to surgeons while planning and carrying out operations. Whilst the problems of appropriate 3D visualization have been solved, the difficulty of assigning pixels to entities like liver, lung, heart etc., is still challenging.

Hans Peter Meinzer is a professor at Heidelberg University and heads the Department of Medical and Biological Informatics at the German Cancer Research Centre in Heidelberg. He has undertaken research on the simulation of complex cell-systems. His main interest is focused on the diagnostic analysis of computer tomographies (CT), Magnetic Resonance Imaging (MR), and ultrasound (US). Using these radiological volumetric data he and his group segment and visualize the 3D/3D+t presentations of the internal objects in the body such as liver, pancreas, lung, heart, brain in support of the planning and execution of surgical procedures (navigated smart instruments).

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Ortwin Renn

Sustainable development: The need for a synthesis of analysis, meaning, and design

There is now worldwide consensus that the world's economies and societies are in urgent need of a sustainable path of development. The question of how to initiate and implement such a transformation is still open. One of the important requirements for making sustainability the guiding principle of global development is trans-disciplinary cooperation among and between the sciences, humanities, and the creative arts. The synthesis of analytical insights, cultural reflection, and proactive design provides the necessary basis for the creation of the knowledge necessary to facilitate the transition towards a sustainable path. This lecture will shed some light on the various options that promise to provide such a needed synthesis.

Ortwin Renn is chairman of environmental sociology at Stuttgart University. He directs the Interdisciplinary Research Unit for Risk Governance and Sustainable Technology Development (ZIRN), University of Stuttgart, and the non-profit company DIALOGIK, a research institute investigating communication and participation processes in environmental policymaking. He has held professorships at Clark University (Worcester, USA) and the Swiss Institute of Technology (Zurich), and since 1997 has directed the Centre for Technology Assessment, Stuttgart. His primary interests are in risk governance, political participation, sustainable development, and technology assessment, and he has published over 30 books and 200 articles.

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Manfred Spitzer

Neuroscience and creativity

Creativity is like beauty – you don't know what it is, but when it is there you see it immediately. There are many stories about creative moments, starting in Greece with Archimedes exclaiming "Eureka" as he made important discoveries to today's problem solvers. Creative solutions often appear without any effort while we are *not* thinking about the problem. "Sleeping on a problem", not thinking about it consciously, will often let us work it out while sleeping and dreaming, to wake up with the question answered. The brain appears to incubate problems and questions, working on them quietly and automatically without conscious effort, using unconscious processes. The solutions are not thought out *by* us but *for* us. The nature of these results makes it difficult to study them, but studies of humans and rats have demonstrated them quite convincingly. While we sleep the brain analyzes, copies, reprocesses, and places information in long-term storage in the cortex. These processes also help with learning. Brain research has started to focus on creativity only recently, and it is important that we keep going, not least because of our desire to be creative.

Manfred Spitzer studied medicine, psychology, and philosophy in Freiburg, and gained a doctorate in medicine and philosophy in 1985. Qualifying as a psychiatrist later, he became assistant medical director at the Psychiatric Clinic in Freiburg from 1990–1997. Three research periods as visiting professor in Harvard and the University of Oregon established his work at the boundaries of neurobiology, psychology, and psychiatry. Since 1997 he has been medical director of the newly founded University Clinic for Psychiatry in Ulm, concentrating on cognitive neuroscience and the psychopathology of thinking, evaluating, learning, decision-making, and acting, using multimodal neuro-imaging to localize brain activity and pathological changes. As a member of the Education Board of Baden-Württemberg from 2001–2005, he founded the Transfer Centre for Neuroscience and Learning (ZNL), an institute for brain research and teaching in Ulm, in 2004.

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Joachim Krausse

Nature has no departments – Remembering Buckminster Fuller's "comprehensive anticipatory design science"

In all our interdisciplinary work we try to bring things together that have previously been taken apart. We find, however, that those parts that we are assembling, be they objects or concepts, do not really fit, and we fail to build up a whole. Fifty years ago Buckminster Fuller, the US inventor, architect, and design philosopher, conceived of design as a comprehensive rather than a specialist activity. As an integral research and development approach, the programme aimed at the investigation of human trends and the needs of the global society. Fuller called for solutions out of "design ingenuity", and initiated a worldwide student research programme, the "World Design Science Decade" to improve the global use of natural resources. What happened to this extraordinary initiative? Can we learn from it today?

Joachim Krausse graduated in philosophy, literature and sociology in Berlin and received his PhD from the University of Bremen and is professor of design theory at the Anhalt University of Applied Sciences, Dessau. He has curated exhibitions, directed television documentaries on housing and living for the German television (WDR) and published widely on theory and history of architecture, design and technical culture. He has edited several books of Buckminster Fuller's writings and co-curated the international exhibition "Your Private Sky – R. Buckminster Fuller", and is a collaborator of the architectural magazine ARCHplus.

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KEYNOTE SPEECH **Joyce Palmer**

The eternal triangle

I want to begin with some challenging fundamental questions and leave you with some equally challenging and fundamental questions. The main topic of the presentation is to share with you what has been happening in the UK and the role of the eternal triangle. Has the UK defined a European model for the sustainable future of design education and the design industry in a global economy?

In the UK, design education, design industry and the government are currently engaged in a unique collaborative project to identify and analyze the key factors to ensure that buyers and consumers worldwide will view UK design education and the design industry as the epicentre of high value creativity and design-led innovation. My role in this project is to represent design education at university level within the UK.

Is the eternal triangle between UK design education, the design industry, and the government the ideal partnership? The eternal triangle is discovering a common language born of years of Quality Assurance Reviews and audits to ensure and enhance standards in design education. Is the UK government the cuckoo in the nest?

The reason for my cynical question will become clear as I share the myriad of goals, objectives, and targets emanating from the government and which shape the nature of UK design education.

Design is an international language in which cultural differences and boundaries can disappear. Designers who work in the UK come from virtually every country in the world. They thrive in a creative climate that has been described as the design studio of the world. What makes the UK such a fertile environment for creativity – a greenhouse for risk-taking and innovation? Design education, design industry, and the UK government are searching for a common language. If you change the way you work, you will change the way you think.

The rationale behind the eternal triangle was explained by Gordon Brown, then Chancellor of the Exchequer, when he said, "In the last eight years Britain's knowledge-intensive sector had grown twice as fast as the overall economy – highlighting the extraordinary creative talent that Britain pos-

sesses. We have a unique opportunity to build on this extraordinary promise and ensure Britain becomes the world leader in creative industries."

After analyzing the financial contribution made by the creative industries to the UK economy Gordon Brown and the government have made a commitment to working with designers and design education in attempting to identify why designers play such a key role in innovation, the sustainable future and direction of companies both in the UK and within a global economy. We need to plan for a new design industry for a competitive economy, the continuing rise of the creative industries, and for the role of design in enhancing competitiveness, innovation, and performance.

A new wave of design innovation is fuelling a creative renaissance in the UK. Businesses large and small are beginning to embrace creativity and are prioritizing creativity as one of the ain criteria for employment. Design is no longer viewed as the act of modifying spaces, places, and products – it has been recognized as an intellectual engagement with the larger issues that affect all of our lives and futures.

Professor Bob Hayes, of the Harvard Business School, recently asserted, "Fifteen years ago companies competed on price, now it's quality, tomorrow it's design." Creativity has never been more important to a nation. It is the key to economic and social survival and prosperity in this rapidly changing world. It inspires and changes thing for the better and improves the quality of our lives.

The triangle was created in 2004 by the formation of the Design Skills Advisory Panel comprised of 26 designers, educators, and representatives of key design organizations. Important roles were given to the Design Council and to the Creative and Cultural Skills Council, the government arm of the triangle with a specific focus on the acquisition of skills (this formulation causes tension between education and training establishments). "In the 21st century our greatest natural resource lies in our people and their potential, which is both vast and largely untapped. The acquisition of skills can unlock that potential." as Lord Leitch said in the 2006 Leitch Report.

The Design Skills Advisory Panel was tasked with determining the potential future role of design education and the design industry.

The purpose of the debate is to engage the design education community with the work of the Design Skills Advisory Panel, to involve academic colleagues in the development of the education-based recommendations, and to ensure that the recommendations from the Panel are relevant, feasible, and desirable within an educational context. The intended outcome of the debate is to develop an effective workforce development plan which will see the design industry and design education working in collaboration, and to identify the role of design education in ensuring that the design industry continues to develop and excel.

The development of skills is an essential part of a government strategy for developing the UK economy and a significant investment is being made in future workforce skills. New initiatives are being led by, and carried out in collaboration with, industry.

The Panel set up a research and consultancy methodology which included 'Design a new design industry' Design Skills Consultation 2006, an online questionnaire between 8 May and 1 November 2006, qualitative consultations between 2005 and 2007, research into supply and demand for design skills in 2005, the Creative Blueprint Research in 2006, an employer skills survey, and Design in Britain.

This comprehensive research undertaken in 2005 with 2500 studies, including workshops, focus groups, and interviews, from across the industry resulted in a 'Design a new design industry' consultation paper being published in 2006. A further 1000 designers, design managers, teachers, students, and stakeholders have been involved during the last year. This has all helped to shape our early ideas into a clear plan of action.

The journey of discovery has involved ferocious and passionate debate on all sides, territorial battles, power struggles, political interference, marriages, divorces, and eventual love affairs! The challenges for the design industry have been to make a comprehensive analysis of the industry itself, with its strengths and weaknesses, top assess the potential for sustainable growth, and to identify the main threats to the design industry and the UK economy. The evidence accumulated and analyzed presented clear messages about the current and potential future strengths, weaknesses, and skills gaps that needed to be prioritized and addressed across all sectors of the design industry.

Mapping the UK design industry shows that it is the largest in Europe, employing over 185.000 designers and generating an £11,6 billion turnover in 2005. Its contribution to exports was over £550 million. More than 50% of design businesses in the UK are working in communications with digital and

multimedia applications, and notable recent areas of growth are in interaction, service, and strategic design. The UK design industry has 77.000 designers working in-house teams, 103.000 in consultancies or freelance. Another 12.450 consultancies employ a further 384.300 non-specific design staff.

Sitting on the periphery of all this are thousands of highly talented sole practitioners who frequently have set up their business on a shoestring budget and are surviving on their wits, networking skills, and a sheer passion for design. Profiling the consultancies shows that a large proportion, 85%, of small design businesses employ fewer than five people, and there has been a rapid increase during the last five years. These businesses are characterized by rapid change and employ a very flexible and mobile workforce.

Design plays a role in everything we do. It underpins everything, from the services with which we interact, through the products that we buy and use, the spaces in which we live and work, to the experiences we make and enjoy. There is still a great potential for growth. The absolute value of design-led innovation has been recognized. The added value created by the design process by connecting technology and innovation with real user needs has been understood, and the increasing contribution of designers to the application and commercialization of scientific research has been noted.

An important result of the eventual debate was the inevitable and unavoidable question – where do we go from here? It is a little like the situation facing Cumulus at this stage in its development.

Several focussed models of innovative practice were identified. The Design Council and the British Design and Innovation (BDI) project 'Proposition into Profit' played major roles. Design was recognized as a strategic resource in business; designers are often working well beyond the paradigm of responding to a simple design brief, and there is an attendant rise of consulting in the areas of strategic design and innovation.

The evolution of design is in part due to increased demands from consumers for more personalized, desirable, efficient, and sustainable products and services. It is also the result of the initiative and creativity of designers themselves, who have developed beyond their mid-20th century role as the shapers and stylers of products to become initiators and pre-emptors of corporate activity. This has resulted in a paradigm shift in the perception of our value as designers by society and business. The integration of human factors into the development of our environment, our transport systems, our hospitals, our support and service industries has profiled and highlighted the value of lateral thinking – of thinking the unthinkable and achieving the impossible.

There could, however, be threats to the UK economy if the design industry cannot respond to these new challenges. The UK's historically strong performance in innovation could lose its momentum weakening compared with other developing economies because of a lack of consistent strategic development of intellectual property rights, patent applications, and the creation of new products. The threat of general global competition has widespread implications.

Currently we are amongst the world leaders in scientific research, with more citations than many other countries. However, we lack consistency in exploiting our creativity and innovative potential. 40% of designers cited globalisation as the most important trend affecting the UK, but only 12% of consultancies and 23% of in-house teams perceive significant competition from outside the UK.

Environmental awareness is enlarging its profile. Environmentally aware clients are increasingly seeking design solutions that respond to customer and consumer demand for greener products. Design education is responding with undergraduate and graduate design courses that address important elements of sustainable design.

There is a notable increase in prospective students requiring confirmation at point of interview that courses will address issues of environment and sustainability. As tuition fees continue to rise, students will have a much greater say in, and influence on, curriculum content as paying customers. The Cox Review played a significant role, consulting extensively with the design industry and senior academics in design education, identifying a window of opportunity for the UK to respond to increasing overseas competition, and highlighting design as the catalyst for sustainable business development.

On pressing issues like sustainability, design has the potential to make a profound contribution, supporting businesses to create environmentally sound and desirable alternatives to existing services and products – enabling changes in patterns of materials usage, production, consumption, product disassembly, and recycling. A significant number of

large companies like Electrolux, Unilever, and Nike are already using design to address sustainability.

The challenges for design education in complying with the strategic aims of the Higher Education Funding Council lie in widening participation, enhancing excellence in learning, teaching, and research, and enhancing the contribution of higher education to the economy and society at large. The Schwarz Report on widening participation calls for measurable progress towards participation in higher education of 50% of those between 18 and 30 by 2010, the stimulation of new sources of student demand and the according adjustment of supply, and the improvement of opportunities for all students through lifelong learning.

Risk factors involved here centre upon an insufficient demand for places from 18 to 30 year-olds, a potential insufficient increase in representation of currently under-represented social groups, and the failure of the supply of places created to meet the targets failing to match the demand from students in terms of levels, mode of delivery, or location. When enhancing excellence in learning and teaching the key aim is to ensure that all students participating in higher education benefit from a high quality learning experience that fully meets their needs and the needs of society.

Institutions of higher education are now required to respond to Quality Assurance Agency reviews, OFSTED inspections, and institutional audits. They must review learning and teaching strategies in line with the changing nature of students while delivering a more flexible curriculum, and deliver this quality education within an annually decreasing budget!

Palpable tensions currently exist within UK design education, which has become target driven in response to prescribed goals and objectives emanating from the government. Educators are expected to be business-oriented in addition to being design educators. Institutions are also required to strive toward membership of the Higher Education Academy, to create centres for excellence in teaching and learning, and to ensure that all new teaching staff in higher education will hold an agreed national professional teaching qualification. Teaching has become professionalized; performance reviews of the majority of staff are undertaken on an annual basis and objectives and targets are set which must be met.

There are potential risks that teaching quality and standards will decline because of the recruitment and retention of quality staff, and that the national capacity for learning and teaching will not match the demand from students in terms of level, mode of delivery, or location of courses. There is already an inevitable drain of highly qualified and experienced colleagues who rail against the perceived loss of academic freedom. There is a noticeable rise in the use of business-oriented younger colleagues who see themselves as managers of education.

The key aims of enhancing excellence in research are to develop and sustain a dynamic research sector that holds a strong position among the world leaders, and to make a major contribution to economic prosperity and national wellbeing while expanding and disseminating the knowledge base. There is inevitably tension between high-profile research-active staff and those tutors who develop and deliver the curriculum to students. There are serious dilemmas for practice-based institutions and debates are ensuing about the role of practice in research and the securing of research funding. It is increasingly important to support the 'reflective practitioner'.

There is a risk that institutions will be unable to recover the full economic costs of research from funding agencies and sponsors. There are risks associated with ensuring sustainable research clusters and infrastructures within institutions. The quality of research might well decline as institutions struggle to recruit and then fight to retain high-profile research staff. The last of the HEFCE (Higher Education Funding Executive) strategic goals relate to the enhancement of the contribution of higher education to the economy and society. The key requirements are for institutions to develop and enhance their engagement with national, regional, and local businesses and communities, and to collaborate with other national and regional agencies to develop a permanent funding base in support of planned target setting.

The significant risk factors facing design education today are the potential lack of consistency, coherence, or effective collaboration between the sources of funding for economic and social contributions to higher education, the willingness of businesses and the wider community to express informed demand for the resources of higher education, and the ability of higher education institutions to develop and sustain strategies that respond sufficiently well to demand.

If one reflects on the extensive portfolio of objectives and targets imposed on higher education and the subsequent setting of targets of achievement often linked to financial resources, it is clear that the UK education system has become a complex business driven by the agendas of successive governments. In practice, no sooner have you set your institutional strategic plans to score the requisite number of goals by one set of rules, than the rules change, the goalposts are moved, and the whole game is up in the air again.

The ladder of design education experience is founded on design education in schools, where art and design and design and technology are embedded in the curricula. Design and technology boasts a higher number of university graduates than all other subject areas. It is the only subject area that guarantees aesthetic, 'hands-on' learning integrated with its more theoretical aspects, and is also structured to support the acquisition of key transferable skills, which include generating ideas, solving problems, and successful communication.

All of this links to the articulation of students into design degree courses. However, there are weaknesses in design education in schools. There is a low level of funding for the provision of design and technology, and the quality of the curriculum in some schools is poor. Responses to design and technology project briefs can be linear and prescribed, and there can be a lack of rigour in the process of research and in the development of innovative ideas. The quality of delivery of design courses in schools varies greatly and results are mixed. There is a perceived lack of creativity and willingness to take risks. Art departments are being lost, and with them the opportunity to experiment and manipulate a range of different materials.

Research and analysis has identified priorities. In recognizing that design skills are valuable transferable skills yet are currently undervalued, the Design Skills Advisory Panel will promote the value of design and raise its status in schools, support teacher training and continuous professional development, and connect the design curriculum more closely with professional practice. These are relatively modest and thus apparently achievable goals. The key overarching aim is to create a network, structure, or support framework of joined-up thinking and shared goals.

In recognition that students require a wider range of professional skills and that increasing numbers are currently obscuring specialist pathways, the Panel will support and enable institutions of higher and further education to collaborate more effectively with professional practice, will support the development of new skill sets, and provide multi-disciplinary experiences for design graduates. In recognition that designers need continuing professional development the Panel will engage with the design industry in a higher profile promotion of design and its importance, participate in the development of high-level professional skills, and establish professional standards to achieve greater cohesion and collaboration across the industry.

There are several outcomes of the eternal triangle. It is proposed that the design industry establish a UK Design Academy to be a catalyst for excellence in professional practice and professional development. The Design Academy should lead the strategic collaboration between design education, the design industry, and the government to facilitate coherent formulation of policy, and help create a framework of professional practice.

The next steps for the process in the year ahead comprise the detailed planning needed to turn ideas into reality, the formulation of expanded descriptions of the end product services, and the setting up, piloting, and launching of products and services.

The proposed management structure consists of four steering groups: Group 1 – UK Design Academy, Group 2 – professional practice framework, Group 3 – universities, and Group 4 – schools.

For design education at the university level the tasks are the development of a formal network of institutions involved in designing and offering innovative multi-disciplinary curricula, identification of the role of the Design Council and the Higher Education Funding Executive (HEFCE) in achieving the aims, and the creation of a formal scheme of visiting professors. A web-based data bank to promote educational links between design, business, technology, teaching, learning, and research, and also a web-based career and course information service must be established.

At the school level the Government will need to fund a programme of designers to work with schools to connect teachers and pupils with practising designers, businesses, and higher education. The Government will need to fund the creation of a design mark for schools to acknowledge excellence in design teaching, and must fund a strategic profession development scheme for teachers to underpin design excellence in school education.

And finally comes the fundamental question for design educators: what distinguishes the excellent from the ordinary in design? Is it being a global creative discipline of artistic and poetic origin? Is it being the perfect marriage of creative thinking applied to technological innovation? Is it that good design is clear thinking made visible?

When considering creativity and success, successful companies will look not only to design or research and development as specific creative areas, but will seek to promote creativity in all aspects and parts of the organization. Education, creativity, design processes, and business performance are inextricably intertwined. If you change the way you work, you will change the way you think.

The single most important message to emerge from these two years of extensive research and consultation is that design in its broadest sense impacts upon, and is central to, all that we do, all that we experience, and informs how we engage with our respective worlds.

It crosses boundaries. It can, if we want it to, remove boundaries.

Design education can be a powerful catalyst for change, if we can be successful in, as Albert Einstein said, "seeing what everyone else has seen and thinking what no-one else has thought".

Where do Cumulus, as a rapidly expanding organization, and its members sit philosophically on the issues of the eternal triangle or the unholy alliance? Are we a catalyst for change or simply a non-coherent group of enthusiasts? Are we preaching to the converted? Are we talking to ourselves, simply reinforcing our historical perceptions of the role of design?

Should we have a powerful political voice to influence our respective governments?

In a single decisive question, what is the future vision for Cumulus? More of the same is not an option. Doing nothing is not an option. Bigger is not necessarily better unless we can define and communicate successfully and effectively who and what we are.

This paper was first delivered as a keynote speech at the Cumulus Conference in Germany on 16 June 2007.

Joyce Palmer is Director of the School of Design at the Arts Institute at Bournemouth, working in a European design industry context, leading a design school, and participating in Government-led initiatives on the future potential of UK design in a global economy. She is the Higher Education representative on the Design Skills Advisory Panel of the Design Council and the Creative Cultural Skills Council, member of the Department of Trade and Industry's Cox Review on 'Creativity in Business', President of the Scientific and Technical Board of the International Project Centre (UN affiliation), Chair of the UK National Association of Silversmiths and Jewellers in Design Education, member of the German Fulbright Commission Design Panel, and is also a Subject Reviewer and member of the Subject Benchmark Group for Art and Design with the UK Quality Assurance Agency. She has presented and published many papers internationally on radical and innovative design.

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Jess Maertterer

The mathematics of aesthetics

Introduction

For many designers the title "Mathematics of Aesthetics" appears to be paradoxical. Some may even mix up the meaning and think it is about the "Aesthetics of Maths". Of course there is also aesthetics in maths, but it needs a lot of insight to see the beauty and elegance in the generality and clarity of mathematics. In the book "A Mathematician's Apology", G. H. Hardy expressed the belief that these aesthetic considerations are, in themselves, sufficient to justify the study of pure mathematics. **[2]**

This paper is about mathematics for designers and how it can be applied within the imaginative and reflective process of creation. Unfortunately, creative people tend to have a very negative attitude towards mathematics. The reason for this prejudice might be the conventional mathematical education, which does not address their field of interest in an appropriate way. Consequently, they develop a mental block which encrypts mathematical equations and bans formal logic from their intuitive design process.

Definitions

Mathematics, is one of the oldest sciences, and evolved through the use of abstraction and logical reasoning, from counting, calculation, measurement and the study of the shapes and motions of physical objects. The word "mathematics" comes from the Greek "mathema", which means study and learning. To use mathematics means to describe concepts by abstract structures, with the aim of understanding the basic rules and to formulate new logical conjectures. **[2]**

Aesthetics is the study or philosophy of beauty based on sensory or sensory-emotional values. Aesthetic judgments might vary based on individual arguments concerning the emotions, intellectual opinions, will, desires, culture, preferences, values, subconscious behaviour, conscious decision, training, instinct, or some complex combination of all these. **[3]**

Objectives

Since aesthetics is highly individual, this is not an attempt to develop a systematic theory or algorithms to create general aesthetics, even if a lot of fundamental mathematics is widely accepted to be aesthetic.

The approach here is to find mathematical abstractions for individual aesthetics. By drawing conclusions from our emotions we can arrive at a qualitative basis for design. Often the abstract mathematical view leads to new concepts, new variations or allows intuitive ideas to be verified.

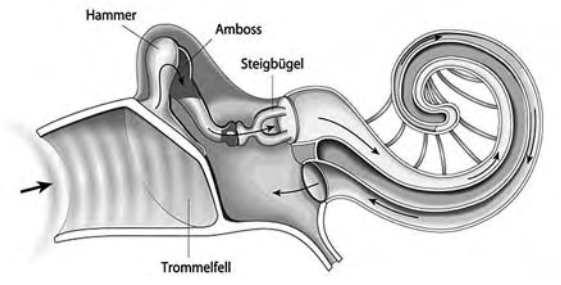
The problem is how to teach such a complex enterprise? Simple examples are always a good way to communicate abstract subjects, so we go back in history to a remarkable example which demonstrates the concept of the maths of aesthetics and also explains some fundamental knowledge.

Fundamentals

Pythagoras (560 ~ 480 BC)

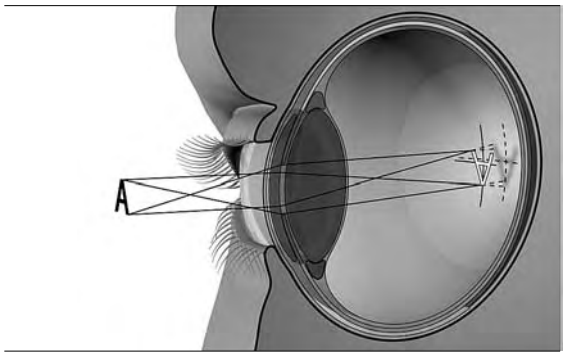
Harmony by Pythagoras

One of the legends about Pythagoras recounts how he was walking through his village when he came to the blacksmith's shop. He noticed that the noise of the various hammers sounded pleasing, but one particular hammer was somehow disruptive and did not fit the melody of the others. On closer investigation he found that the hammers were of different weights: 2, 4 and 6 pounds, but the fourth hammer was of a weight that did not fit in with the sequence. Pythagoras made further investigations with a simple stringed instrument and came up with the theory of Harmony. Since then harmony has been mathematically defined by the simplicity of proportions. The simpler the ratio the more harmonic it is.



Logarithmic system of cochlea and auditory nerve

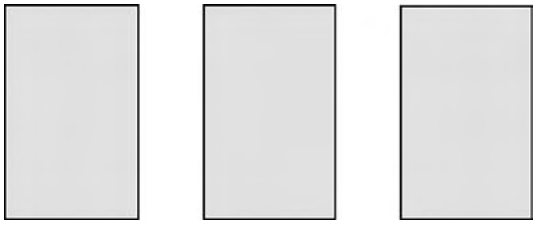
Today these ratios are known to us as musical intervals which are called: perfect unison (1:1), perfect octave (2:1), perfect fifth (3:2) and perfect fourth (4:3) and so on... The acoustic harmonies and their mathematical definitions are generally accepted to be aesthetic. The reason for this is due to the nature of human acoustic perception and the anatomy of the inner ear because the cochlea and the auditory nerve represent a logarithmic system. Thus sound, composed of harmonic frequencies, results in simple information patterns. Therefore it is the construction of the inner ear which provides humans with the qualitative perception of acoustic harmony. The sonic range or frequencies which can be heard is approx. 20 Hz ~ 20,000 Hz which is a range of more than 9 octaves.



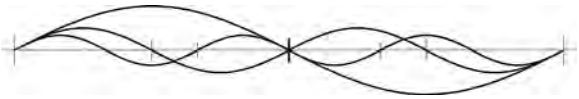
Visual Perception

In the context of design and visual perception the term harmony is also used as a synonym for balance, accordance, simultaneity and the intuitive recognition of order. The eye does not have the ability to recognize visual proportions in such a qualitative manner as the ear. The visible spectrum ranges approximately from a wave length of 380 – 750 nm which is equivalent to less than one octave. Any aspect ratio of frequencies or spatial dimensions can therefore only be approximately estimated.

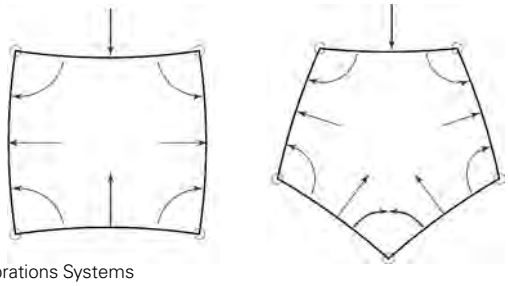
The human sensory-emotional system is very complex and harmony is not a direct measurement for aesthetics. In order to prove this let us use a typical mathematical method by focussing on the extremes: think about a piece of music which is just a single note. By definition this would be the most harmonic song – but too much harmony is pretty boring. It is just like a uniformly coloured surface. A good composition needs dissonance or contrast to create tension which can then be resolved into harmony again.



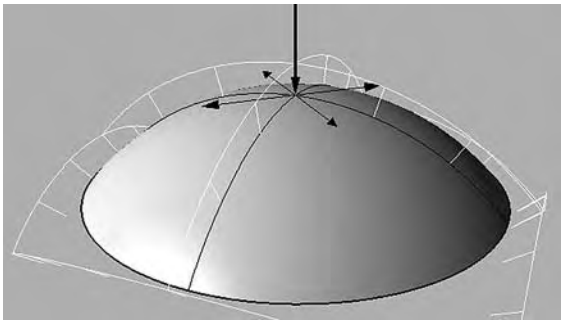
Rectangles with Proportions 8:5, 13:8 and Golden Ratio



Resonance Frequencies



Vibrations Systems



Distribution of Forces

Some designers refer to the golden ratio as a guide for good design. Actually the golden ratio is the most irrational (least harmonic) ratio. But it is really hard or practically impossible to identify a real golden rectangle out of a series of similarly sized rectangles with relative harmonic proportions like 8:5 and 13:8, because with visual perception we can just estimate the ratio of the lengths. It is an interesting fact that an aspect ratio that cannot visually be distinguished should be mathematically so different, that the one cannot be defined with any elements of the other. This is not a side effect but the definition of an irrational number. There-fore the use of the golden ratio for aesthetic reasons appears to be somewhat esoteric. However, there are technical reasons where it makes perfect sense to use the golden ratio or other irrational proportions.

Properties of Shape

RESONANCE AND VIBRATION

Musical instruments for example have very special proportions for body design which creates the timbre or acoustic character of its sound. Of course this is a very special field of design, but vibration is an issue with many objects like architectural buildings, bridges or electric power tools. In most cases vibration is undesired. Vibration can be reduced when an object's elements have minimal common natural frequencies, which can be achieved for example, by choosing proper proportions for the dimensions. Vibration can also be suppressed by geometric systems like those shown in this diagram. The odd number of elements results in compensating for the vibration forces. Therefore this principle is relevant in the context of rotational symmetry for wheel rim design.

The form of a shape has a significant influence on its stiffness. Think about a plane piece of sheet metal. It is pretty unstable and can easily be bent, but once a surface has compound a curvature similar to a sphere, then the forces can be distributed in all directions and it becomes very rigid.

THE SPHERE

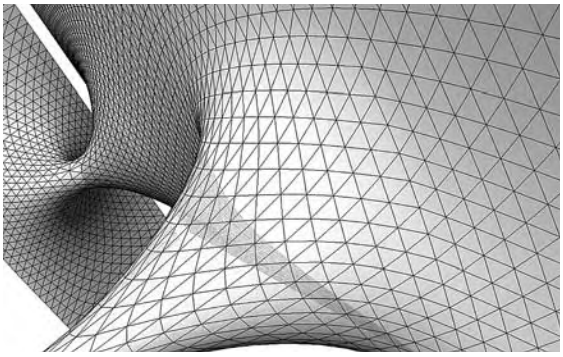
A sphere also has other special properties in addition to providing the best distribution of forces. OK, we all learn as children by playing with a ball that a sphere rolls and we intuitively apply this knowledge within the design process. So if we want something to sit flat on the ground then we do not use a convex curved base surface. Now, that seems trivial and indeed it is just as easy to intuitively apply other knowledge as well.

For example, a sphere also is the shape which possesses the maximum volume with a minimum surface area. Once you know that and you are going to design a low energy building then you would rather tend to improve the ratio of volume/superficial area by increasing the number of corners to approximate a sphere instead of making a building with a triangular base.

Well, this should not be new to anyone, but it appears different if we look at this fundamental knowledge within the design process. Therefore, I illustrate many of these fundamental things in the context of design in my basic lessons:

- **Ellipse**, Slice Planes, Orbit of Planets
- **Ellipsoid**, Whisper Domes
- **Catenary**, chain curve, cable supporting structures
- **Involutes**, string winding curves, gear wheels
- **Parabola**, Light Reflectors, Satellite TV
- **Optics,** Reflection and Refraction, lighting design

Over time the field of mathematical activity expanded and lead to the **science of formal systems**. Now there are many major branches like Algebra, Analysis, Calculus, Differential equations, Category theory, Combinatory, Geometry, Logic, Number theory, Set theory, Optimization, Probability, Statistics, Topology and Trigonometry. Most of these branches are so complex that a single person rarely knows everything about it.



Minimal Surface and Topology Gridding

I introduce some remarkable examples to the students so that they can get an idea of what it is all about and begin to realize the relevance of mathematics for design because there are design challenges which cannot be solved without the creative use of mathematics.

Mathematics and Architecture

I have developed software to model NURBS surfaces from mathematical equations **[4]** for advanced design projects.

Professor Andrew Saunders and myself are teaching architectural students at the Rensselaer Polytechnic Institute N.Y. in an advanced level design studio dealing with differential geometry. It is on this course that students use the software I have developed to explore parametric surfaces with Rhinoceros 3D.

DESCRIPTION OF THE DESIGN STUDIO

PREMISE

The studio focuses its investigations on exploring: recent advancements of surface theory in mathematics; architecture's return to material practices; industrial shifts from mass standardization to mass customization; and new socio-economical programmatic relationships.

PRECEDENT

The studio begins by teaching the role of surface, material and geometry in the practice of early 20th century reinforced concrete pioneer Luigi Nervi, and also other contemporaries such as Eduardo Torroja, Eugene Freyssinet, Robert Maillart and Felix Candela. In addition to these architect/engineers the studio will also look at other peripherally related designers such as Erwin Hauer and Naum Gabo.We explore how their use of surface, material and geometry allowed them to negotiate between infrastructure and architecture. Due to the extreme costs of labor and the exhaustion of the construc-tible geometries, in particular the development of surfaces (those that have linear generating lines in order to construct traditional wood form work), these practices ceased to evolve and gave way to new investigations of light-weight membrane structures.

DIFFERENTIAL SURFACES

Particularly relevant to this studio course, is the work of Alfred Gray who wrote *Modern Differential Geometry of Curves and Surfaces* with mathematica, a complete manual used to visualize and construct surfaces based on differential equations. In the 19th century surface theory was a very important area of mathematics both in research and teaching. Earlier mathematicians had made extensive use of models and drawings. However, due to recent computational developments mathematical trends showed an increased return to surface theory facilitated by computational investigation. Students learn how to construct and control these formula driven surface geometries in order to speculate on their value as architectural devices. Students also explore the flexibilities provided by the mathematical formulas in

order to embed multiple parameters of architectural performance within the geometrical logic as well as enabling them to synthesize with standard architectural devices.

CAD/CAM

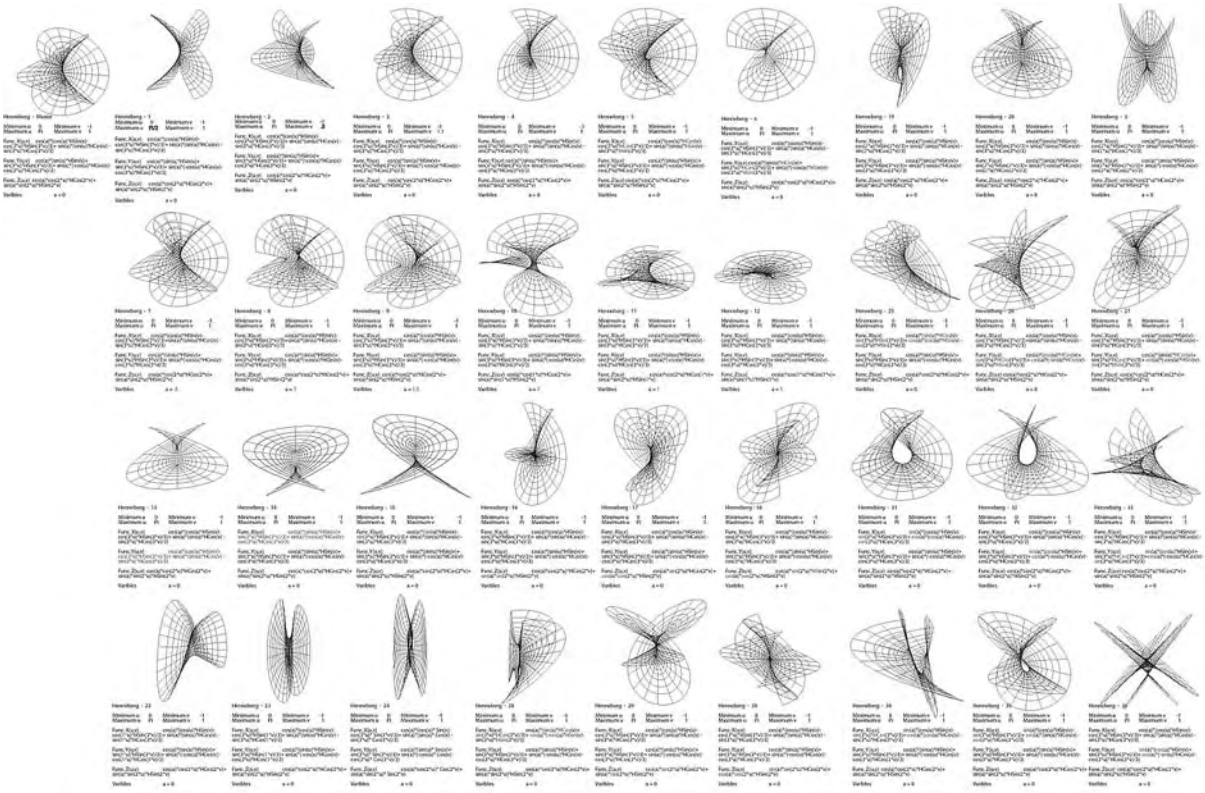
Computer Aided Drafting and Computer Aided Manufacturing have both drastically altered the industrial paradigm of mass standardization. Given these new computationally driven methods, all too often architects have quickly abandoned formal disciplines of geometry and instead turned to reductive principles for describing seemingly complex forms. In addition to totally weakening any integrity of formal logic that may have lead to the initial formation, this computationally aided process falsely assumes that as long as it is CAD/CAMed the resultant form will gain integrity. The studio will work with CAD/CAM technologies both inside the school of Architecture and the Advanced Manufacturing Lab to explore manufacturing techniques integral to the surface logics of differential geometry. **[5]**

Scripting Architecture

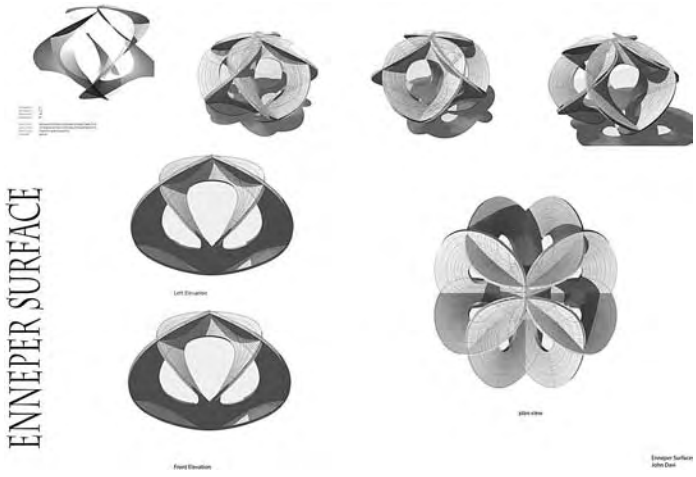
To use an interface to create parametrical surfaces is a fast and easy way to work with mathematical equations. But unique design solutions need more flexible methods. Therefore we introduced scripting to create architecture.

Scripting Architecture is an experimental learning environment of collaborative teaching between the architecture designer Andrew Saunders and the industrial designer Jess Maertterer. The work of this collaboration uses customizable scripting language coupled with computer aided modelling and manufacturing techniques to explore the new role of computation, mathematics and material fabrication. The classes operate simultaneously through an internet forum and traditional studio workshop environments. The internet forum serves as an interactive data base and communication tool between Jess Maertterer in Germany and the RPI students in New York. **[6]**

The first series of projects deploys these techniques to explore the differences between the rep-

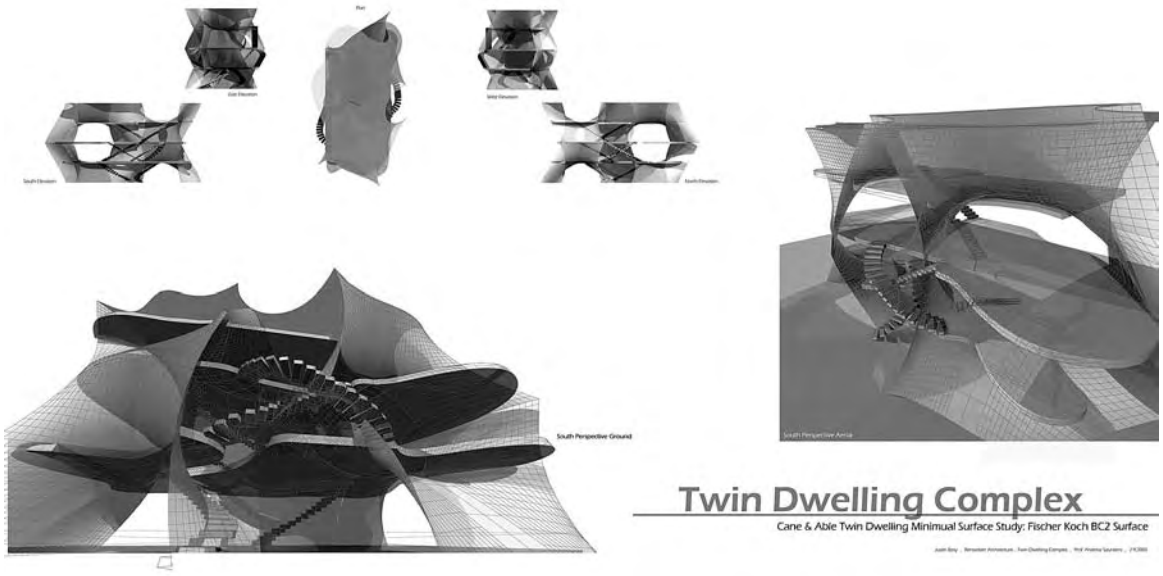


Parametric Variations of a Henneberg Surface by Lexie Sanford



Enneper Surface by John Davi

Rapid Prototype of a Henneberg Variation

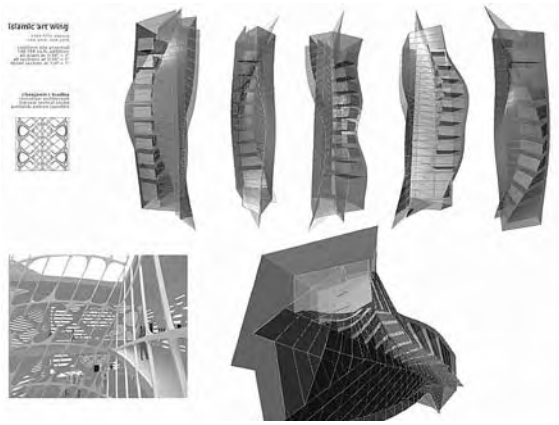


Twin Dwelling Complex by Justin Bosy

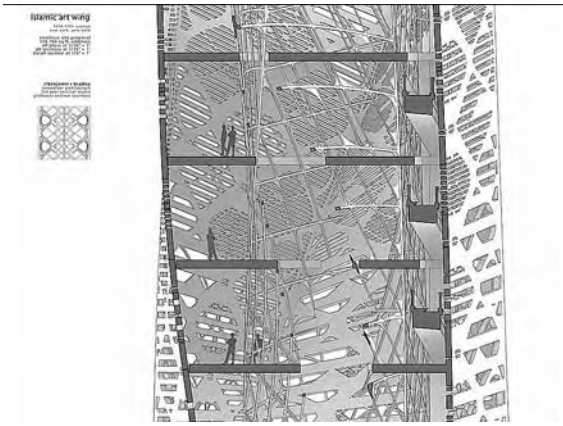
resentative tendencies of western architecture versus the algebraic field conditions of Islamic space. The students use simple programming languages to explore two-dimensional pattern recognition. Out of these initial experiments grows an exploration of three-dimensional patterning in relation to tectonics and material organization. Eventually these organizational strategies are incorporated into a building proposal for an Islamic art wing extension of the Metropolitan Museum of Art in New York City.

The second series of projects builds on the previous work but takes a broader look into scripting languages and writing algorithmic recipes for material organization. The students are encouraged to build knowledge through the internet forum and hybridize and reformulate each other's work. The final projects are architectural speculations for façade systems, pavilion structures, and interior room enclosures.

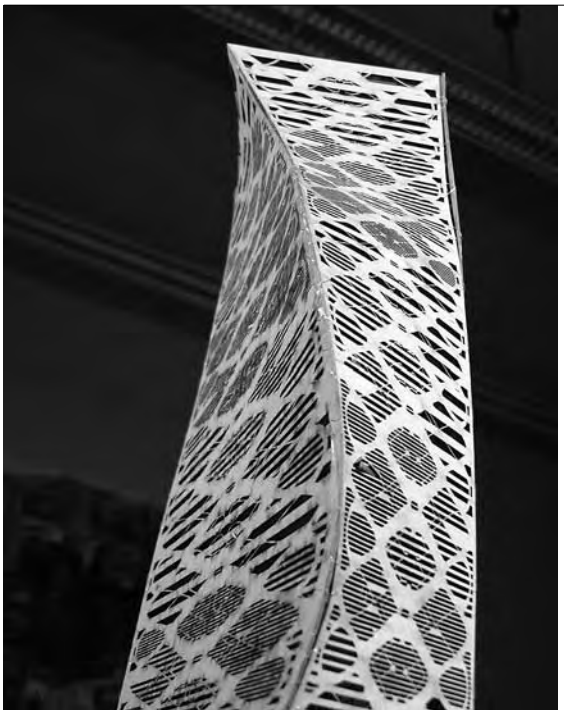
The merge of speculative academic experimentation with the real world expertise via the internet forum has led to truly unique student work that operates with a sophisticated multiplicity and finally these studios won an award from the American TeachLearn Organization.



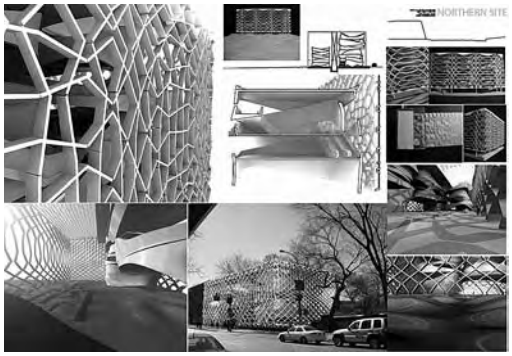
Islamic Art Wing by Ben Bradley



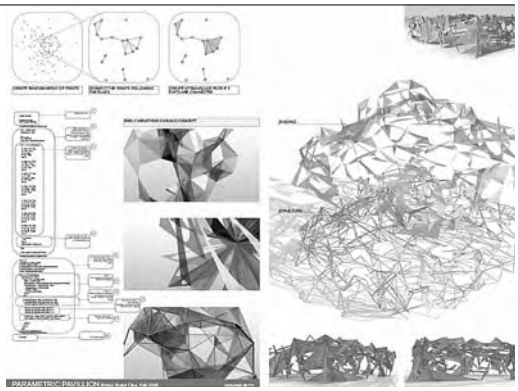
Model Section by Ben Bradley



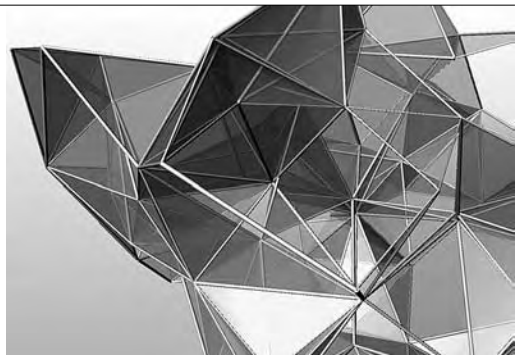
Physical Model by Ben Bradley



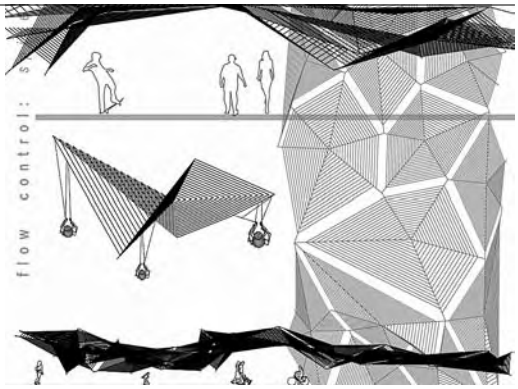
Scripted Façade Pattern



Sponge System by Giovanni Betti



Sponge Panels by Giovanni Betti



Spider Web Pavillion

Conclusion

I do not say that mathematics should be a compulsory subject in design education because this would close the design field for candidates with other talents. However, I do advocate that we should make room to enrich the education of designers with the crossover to science.

Actually there is lot of interest in mathematics at design schools and there should be the opportunity to study mathematical and physical principles which are relevant for design. In conclusion mathematics is a tremendous source of knowledge, a wonderful source of inspiration and a powerful tool for creativity.

Keywords

Mathematics, aesthetics, physics, properties of shape, intuition, parametric, equation, logic, topology, minimum, maximum, optimum

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3 Wikipedia Aesthetics: http://en.wikipedia.org/wiki/Aesthetics
4 Math-PlugIn Rhino V3: http://www.rhino3.de/_develop/__v3_plugins/math/
5 RPI Studio Results: http://www.rhino3.de/album/math/
6 3DE Online Forum: http://www.rhino3.de/educate/forum/index.php

Additional Resources

A Simon Singh, Fermat's Last Theorem (1997), ISBN 1-85702-669-1
B Daniel Kehlmann, Measuring the World (2006); ISBN-10: 0375424466
C Maths Online Source: http://mathworld.wolfram.com/

Barbara Colombo

Biomimetic design for new technological developments

Abstract

The aim of this paper is to show how Biomimetic design can create a new designer shape and develop new industrial products by the application of the designs, the principles and the processes of Nature.

Biomimetic design is indeed a recent research area and it has already been applied in several academic fields, for example: Design, Tissue Engineering, Bioengineering, Aeronautics, Space Science and Biomaterials. This study considers the Biomimetic approach because it represents an alternative model for learning the methods of product development.

The analysis described here shows that Biomimetic Design methods can be used as an instrument to create a new designer shape and can also be used as an instrument to develop new working procedures. This is because it is not only concerned with shape design, but also with the mechanical and morphological characteristics which can be found in Nature.

This study highlights how Biomimetic design represents a new method for learning the process of becoming a designer. Biomimetic Design enables one to shape new products.

Introduction

The term "Biomimetic" has different origins; the most common is the study of living form. Biomimetic design has a wide field of applictions which cross several academic subjects. Biomimetics is based on the study of the characteristics and the properties of Nature and living organisms.

Biomimetic design can be applid in product planning and development. This is possible through the analysis and use of the qualities, the principles, the processes and the transformations of Nature and living organisms for the development and realization of new products and innovative design.

The concepts of efficiency, effectiveness and sufficiency are inherent in Nature. Its methods and natural principles have been applied in the disciplines of architecture, design, engineering and elsewhere for their application in the natural manufacture of articles and in the development of new products.

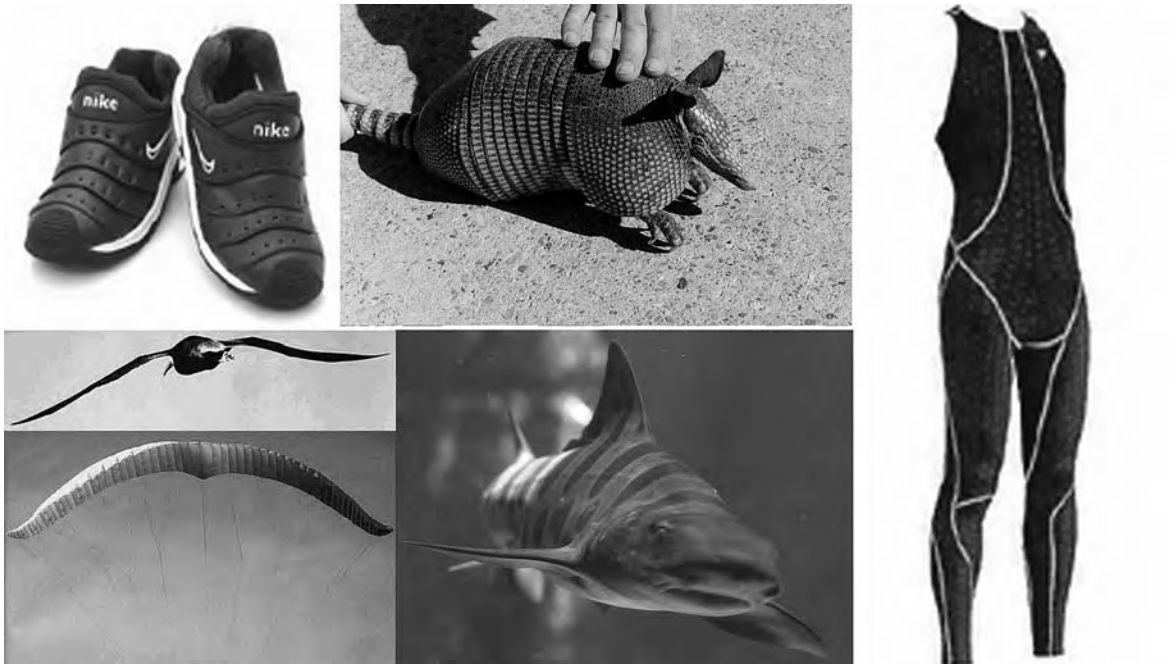
State of the art

Biomimetic design has a recent origin even if man has always observed Nature and been inspired by it in his own projects and manufacturing. Biomimetic design is a method for transforming the inherent properties of Nature into principles and techniques for new design ideas during the planning phase.

Natural materials have long been recognized by humans as sources of food, clothing, comfort, and providing much else including fur, leather, honey, wax, milk and silk. Even though some of the creatures and insects that produce materials are relatively small, they can nonetheless produce quantities of materials on a scale for mass production and human consumption.

Many man-made materials are processed by heat and pressure, which is in contrast to Nature which always uses ambient conditions. Materials, such as bone, collagen and silk are made inside the organism's body without the harsh treatment that is used for manufacturing man-made materials.

The fabrication of biologically derived materials produces minimum waste and no pollution, and the result is bio-degradable and recyclable by Nature.



Learning how to process such materials can increase our material choices and improve our ability to create recyclable materials, thereby better protect the environment. Some of the benefits for making effective artificial materials include the development of improved prosthetics, including: hips, teeth, structural support for bones and so on[1]. Because of their inherent characteristics, the use of biologically-based guide-lines for the production of devices and instruments that are user friendly once humans have understood how to design using minimal instructions.

Through this experience and working with an interdisciplinary team of an industrial designer, engineer and architect we can understand that Biomimetic design is a tool with ample possibilities of application and may be summarized in these 3 sentences:

- Bionics is a tool - not more but not less
- Bionics is not a cure and not a copy of Nature.
- Bionics is a tool which does not have to be used.
- Bionics is not a universal tool for solving problems, but may be an excellent design aid[2].

Cases Studies

I will illustrate the power of bionics with several examples, in particular with two Biomimetic design projects by Franco Lodato, the chief designer of Motorola.

PICOZZA BIONICA – WOODPACK

The first project is from CAMP, an Italian sports equipment manufacturer, which needed a design for a multi-functional ice axe to be used in variable positions. It must also be lightweight with a very high structural strength and a handle for a powerful grip. The tool would be used under difficult conditions for both the mountain climber and the axe. Consequently, it was made from materials which could tolerate the extremes of 5,000-meter altitudes and temperatures of –20C. Therefore the axe needed to be strong enough to penetrate the ice, but as light as possible to be continually carried by the mountain climber.

The natural model selected by Franco Lodato was the woodpecker: a bird that chisels into wood to get at the insect larvae on which it feeds. This bird has an extraordinary aptitude for chiseling being able to make 25 pecks a second, with a force of impact of 25 kg/mm^2. The woodpecker's body is designed specifically for this movement because it uses its tail to brace itself and it also functions as a spring. It takes advantage of its centre of gravity and the configuration of the bones in its skull absorbs the shock of striking the wood. A woodpecker utilizes its whole body to increase the efficacy of the pecking. These birds do not hammer on the wood by simply moving their necks! Even more incredibly, most woodpeckers weigh only about 500 g, or a about a pound.

The ice axe design consists of an inner core of titanium, into which is inserted an adjustable aluminium

Picozza Bionica – Woodpack

Motorola

Bionic car

point. These two components are attached by a hinge which was inspired by the two valves of a mollusk. Special attention has been paid to the shape of the handle which, rather than designing it to be straight, Lodato incorporated a slight curve into it. Once again he used the body of the woodpecker as his model and thereby improved the efficiency of the blow. The handle is lined with a knurled layer of PBT rigid polyester and is covered with an elastic layer of Rynite® to provide the grip. The designer's inspiration for this component came from the epidermis of sharks with rigid elements overlying a soft base. The overall result is a structure that withstands heat stress, water, damp, and UV radiation.

This design strategy led CAMP to change not only its image, but also its line of products and marketing strategy. Furthermore, the emphasis of the environmental aspect of the design attracted customers' interest to such an extent that it actually had an impact on the whole manufacturing sector.

MOTOROLA

The Motorola division that designs the technology and handsets for Nextel Communications introduced a new line of rugged, shock- and weather-resistant phones. Once again Lodato's model for this design is based on an organic form, namely, the tough, protective exoskeleton of lobsters and other crustaceans. The outer shells of these animals are constructed from hard and soft layers of chitin combined with calcium carbonate. The layers provide a cover that protects the internal organs extremely well. In order to achieve the same effect and to protect the phone's inner workings, our design group used hard and soft layers of polymers (chemical compounds with long repeating chains of atoms) to cover the entire exterior of the phone. The layers are made from substances such as polycarbonate and Santoprene, a rubber-like plastic material.

BIONIC CAR

The last example and novelty is from the field of automotive design from the American company DaimlerChrysler whose engineers from the Mercedes-Benz Technology Centre and the DaimlerChrysler Research department were inspired by a particular example from Nature when they produced the bionic car. The car has a fish form and was developed on Biomimetic principles from the boxfish (a member of the Ostraciontidae family).

The boxfish provides a perfect example of rigidity and low weight. In fact its skin is composed of numerous rigid hexagonal scales which can withstand the maximum resistance for the least weight and very effectively protect the animal from injury. If the whole car body is calculated according to its Biomimetic design the total weight is reduced by about a third with unchanged resistance and safety in accidents. In spite of its body, the boxfish is extremely tapered and possesses ideal aerodynamics.

Consequently, it provided automobile designers with great design potential and the DaimlerChrysler experts created a 1:4 scale model whose form was substantially based on the boxfish. Wind-tunnel tests confirmed that it had an aerodynamic coefficient of 0.095, a value unprecedented in the history of auto-engineering. The system that finally developed not only achieved good aerodynamics but also a low weight ratio. It is therefore not surprising that these results combined with the pioneering diesel technology with a diesel motor from 103 kWs – 140 hp and the innovative SCR (Selective Catalytic Reduction) technology resulted in a reduction of both petrol consumption and exhaust fumes. The car has a consumption equal to 1,3 liters for 100 km, which is 20% less than other cars in the same category.

The role of the designer

The biomimetic or bionic transfer of Nature's techniques for a design application follows a pattern which begins with identifying what is required. Then by observing the structures of Nature, a technique may be found which can be used to solve a design problem. The process may be summarized as follows: identification of a need, the observation of Nature, and the transformation of the observation from the original context to its application in the project.

The new technologies that approach Biomimetic design have enormous potential and can develop new methods by experimention with physics, chemistry, engineering, science materials and the design principles. The research into natural structures can provide a model of inspiration for improving life through design. The goal is to understand the relationship between Nature's forms and functions in order to arrive at a model, which through a process of abstraction of the principles, of the analogies of the forms, colours, structures, functionality, and of the components of the products, of the systems and of the materials used by Nature, can be applied by man.

Furthermore, a deeper geometric-mathematical model offers an even greater understanding of the relationships between form – function – structure in product design. This model is the planning methodology subject to an advanced concept and strategy path. The aims are to apply the methods of planning and analysis beginning from Nature and to use the principles and processes that can also contribute to the realization of an innovative design. The project cannot ignore an analysis of the qualities and the structural characteristics that can be deduced from the functions and the principles in the natural world[3].

Today, different and new disciplines and research fields can work together in an interdisciplinary way: design, bionics, ergonomics and topology, can thereby strengthen their aims and so modify and improve the relationships between man, design and the environment. An important consideration or parameter is the economics and costs of materials etc, and the possibility of recycling. In the evaluation of a project the more economic offer is the winner. In Nature this doesn't happen, a market law does not exist among living beings, only the hard law of survival.

Consequently, bionic design also means considering suitable safety factors, the choice of materials with characteristics such as durability, maintenance and the designs integration within a system of other structures. Therefore the designer has to analyse and evaluate the integration of the design, its planning, and realization within rational economic parameters.

Learning with Biomimetic design

Knowledge acquisition is a dynamic process, as is the scientific method, because theory and concept, practice and application are all aspects which are inseparable. Consequently, it is not possible to perform these two phases in a sequence. However, Nature's designs also offer other possible opportunites within the field of information systems. These recently developed systems introduce an educational process by the possibility of experimentation. Biomimetic design can provide an appropriate tool for learning by experimentation. An aim of Biomimetic design is to apply some basic principles which have been extrapolated from biological models. Therefore Biomimetic design is not concerned with the direct transfer of observations from Nature for the process of product development. Rather, Biomimetic design involves the creative execution of mathematics, biology, geometry, statics and technology for the design concepts of product development with a strong engineering component. Biomimetic design is able to provide the means to produce engineering models, but it is also based on collaboration between the experts of various disciplines.

In the first phase of this experimental approach Nature's optimized solutions, associated with a specific ensemble of problems, must be analyzed; secondly, the described solutions, must be transformed into abstract hypotheses which can then be subsequently transferred into technical applications.

Following this procedure it is possible to define, for the faculties of Design, a learning process through Biomimetic design, a tool for product development.

"*The aim of this process is the formulation of an aesthetic and technological innovative project. The process is carried out following these steps*

1. *Analysis of the natural object, starting with a technical function which is to be realised and a biological system with similar function is also identified.*
2. *Definition of technical characteristics*
3. *Application of the acquired knowledge to solve a problem during product development*".[4]

"*Nature has been and is an example for solving technical problems; because of the many and various biological structures represented in Nature with an inexhaustible reservoir of ideas*".[5]

Nature, through its characteristics, appears to have enormous potential to develop new methods of teaching. Biomimetic design is important for the pedagogical process, nevertheless it's a tool able to communicate notions and information of different kinds to the students of the design faculty: including geometry, mathematics, and mechanics. In fact, Nature displays its characteristics and the students recognize Nature as part of a world of experiences that can stimulate problem solving.

Case Study

The aim of employing the Biomimetic process is to decrease the gap between the natural world and the man-made world. Furthermore, it is to help to link the mathematical-engineering approach with the aesthetical-formal approach in product development.

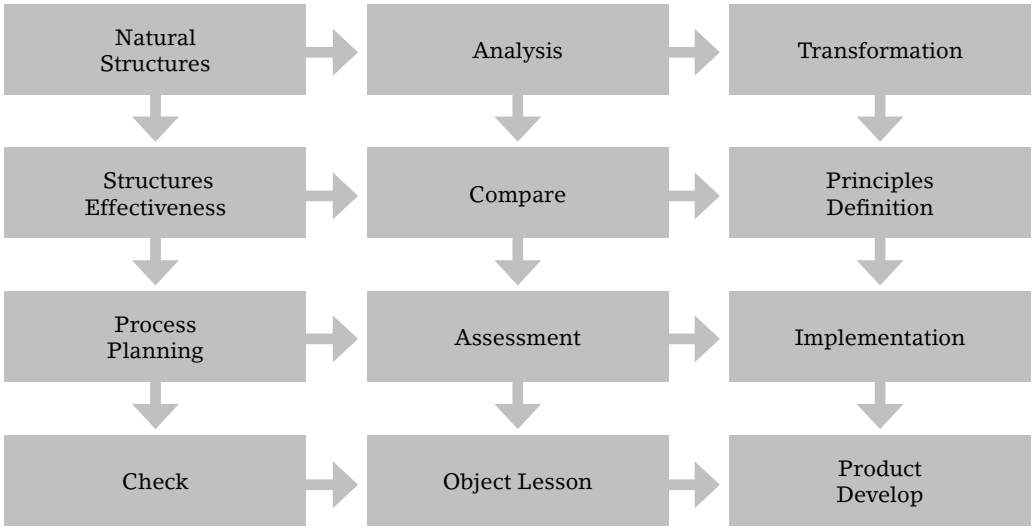
In Europe the Architecture and Design Aalborg University provides an example of the use of Biomimetics as an important educational tool in the pedagogical process, because Biomimetics stimulates interest due to the magnificent and functional structures to be found in Nature.

The didactic approach in Biomimetics has 2 objectives that the designer "always pursues" in product design:

- The technical problem solving process, because the biological structures represent an inexhaustible reserve of ideas
- aesthetical and sensual shapes inspired by nature

I have participated as a supervisor to the Bionik mini-project run by the Architecture and Design, Aalborg University during the 4° semester of studies and the method for teaching Biomimetic design on the project is described here.

Although the course has an engineering characteristic it has been oriented towards product development. Biomimetic design is a useful tool able to provide a basic knowledge to the students.



PHASE 1 – ANALYSIS

In this phase, the students choose a natural object/product and they analyze it. In the beginning this object is observed by the naked eye and it is drawn and sketches and notes are made. Then the specimen is cut, dissected and internally analyzed, after which it is examined under the microscope. Besides making sketches and notes the digital camera is also used to record and then to analyze the characteristics and the structure of the object.

From this point the object determines the analysis of the investigation:

- The object's components
- The morphological structure and the organization;
- To identify how the parts are connected, its structure and ensemble;
- To identify the mechanisms, principles and levels of organization;
- To understand how the environment has influenced these mechanisms;
- To define the geometrical and spatial organization.

The aim of this first phase is to understand the shape, structure, and functional principles of the form. During this phase the students prepare some questions: why and how Nature operates and what is the goal of its form and its structure.

PHASE 2 – TRANSFORMATION

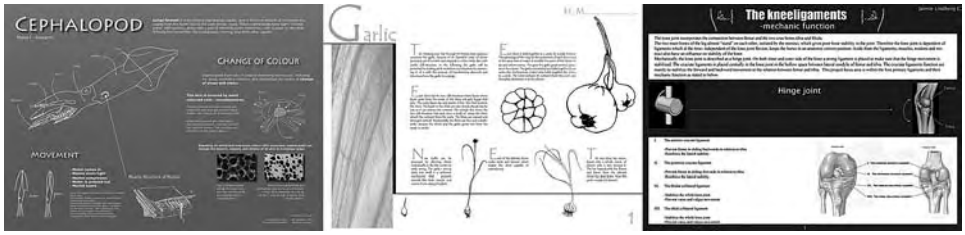
The second part of the process is to refer to the principles they have defined. Beginning from the analysis done in Phase 1, the students work with a selection of the information. At the start of the investigation they focus their attention on one element that characterizes in a unique and original way their selected object. The aim then is to extrapolate mathematical, geometrical and static principles with an abstraction and simplification process. This happens with static and mechanical resistance tests, applied on three-dimensional models that show in a practical and correct way how these principles function.

From the second phase it's possible to obtain:

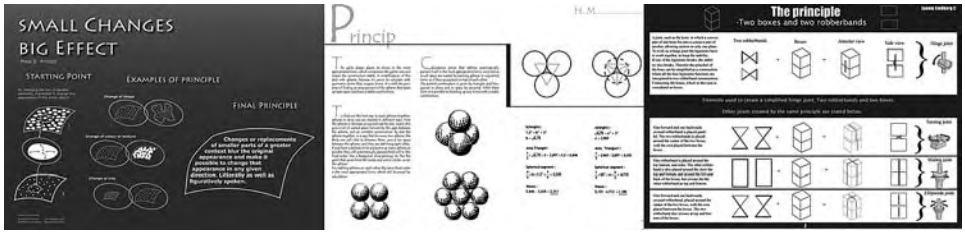
- Deduction of general and specific principles;
- Transformation of principles in a model through a process of abstraction;
- Transposition from biological behaviour to mechanic behaviour;
- Identify functions;
- To look for a possible bridge for connection between Nature/Mechanical/Biological/Mathematical/Geometrical principles;
- From general principle to a particular detail.

In this phase it is not always possible to come to a definitive conclusion, but through the practical analysis it is possible to deduce some elements that will be also useful in other areas of research. Furthermore,

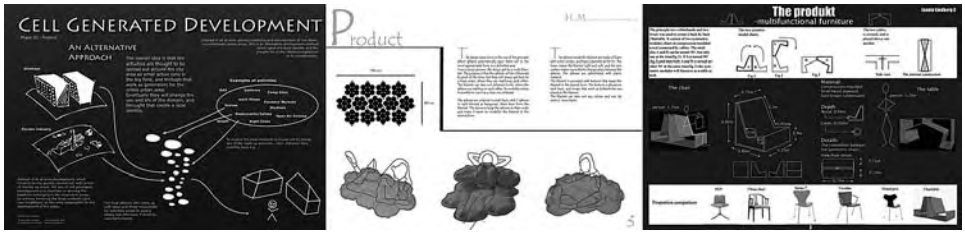
Phase 1



Phase 2



Phase 3



this phase offers the possibility to employ concretely concepts that more often than not are abstract.

In fact the students don't have engineer competences and so they are not able to give a "scientific justification". In this phase, the students transform, through the analogy, the characteristics of the biological systems into technical systems.

PHASE 3 – IMPLEMENTATION

The aim of this stage is to implement principles of the relationship between form and structure found in the analysis of natural objects/elements into the new design development. They should gain an understanding of the potential source of inspiration that a design can derive from Nature concerning construction, form and function.

This phase shows that the role of the designer, and particularly the Biomimetic designer, is important in the product development process. In fact the Biomimetic designer is able to implement innovative solutions.

The solution finding is characterised by the following steps:

1. defining the required technical function
2. finding the biological example which fulfils this function
3. transfer the knowledge gained to solving the problem

When using this approach an interest is consolidated that variety is something well worth protecting[6].

PHASE 4 – PRODUCT DEVELOP

Biomimetic design takes its models from the natural world, through the comprehension of the development process. During the elaboration and rationalization phase of the project a remarkable aspect is the costs. "*In Nature this does not happen because the law of survival decides which living beings are "economically" more able to survive and to go on. Biomimetic design has to consider suitable safety factors, to choose material with characteristics of resistance and duration, easy maintenance and integration with the other structures.*

Therefore, the designer has to examine and to appraise with attention to the environment, the characteristic of the project in consideration of a rational economy. This happens in several steps: planning/ production/distribution/use/discard."[7] Through the study of Nature it is possible to obtain models, criteria and solutions which can be proposed in product design development.

Conclusion

Biomimetic design is an appealing subject. Nature can provide us with a valid alternative methodology for applying in both the process of product development and the learning process. On the one hand Nature demonstrates lightness and elegance and on the other it has the technical ability to bear internal and external weights.

Now Biomimetic design is moving towards integrated and complete planning systems. The research is certainly becoming interdisciplinary but the realization of models and projects are still limited in number. Biomimetics is not an exact science.

The technologies and their original application through Biomimetic design, can define a new modal ity for promoting research, where the traditional distinction among inductive and deductive methods disappear.

Biomimetic design is based on the concept of "*active learning, which implies that one learns by exercises, experimenting, and studying concrete problems. In fact, the disciplinary nature of design represents a challenge towards the traditional formalities of e-learning. The didactics of the project is characterized for its participatory dimension, from the cooperation and the central role of the experience in the learning activity.*"[8]

Biomimetic design can achieve a leading role in the improvement of the new educational trials to scientific community service. The responsibility of the scholastic institutions has to be to use Biomi metic design as a tool, by which they can strengthen and improve the teaching of the design process. It needs to start with the education system for the students, the future professionals.

What it wishes for the future is to develop interdisciplinary knowledge, where Biomimetic design can represent more and more a tool for the promotion and the formation of the interdisciplinary applied research.

Keywords

Biomimetic, Nature, Design, Engineering, Products, Learning, Process, Method

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Ulrich Matern

Safety, hazards and ergonomics in the operating room

Needs and challenges for design

Introduction

The publication of the IOM Report in 1999 has led to increased discussion about failings in medicine. It is assumed that in the USA alone 40,000 to 98,000 deaths occur annually because of adverse events [3]. Von der Mosel (1971) [6] and Bleyer (1992) [2] reported that two thirds of technical errors are caused by problems in the interaction between machine and user and not by technical defects.

It is estimated that in Germany an additional 396 million Euros have to be spent annually for the treatment of complications arising at intensive care units caused by mistakes made during the manipulation of technical equipment [1].

Operating Room (OR) employees gave their workplace low ergonomic marks. Only a minority of employees are able to deal with the equipment. 70 % of the surgeons and 48.9% of nursing staff are unable to manipulate their equipment intuitively under all circumstances. This explains why 40% of surgeons and 47.8% of nursing staff have experienced situations which are dangerous for any persons within the OR [4].

This lack of integration of the equipment can be illustrated by the following example: The department of general surgery of a German hospital uses 75 electrical devices within its ORs. 55 of these devices are of various types and from different companies. Differing types of instructions provided by the various manufacturers can result in incorrect use.

Analysis of the 41 complete reports in the internet-based critical incident reporting system clarified the problems of interaction between man and machine. 44% of reports deal with medical products. 86% of the errors with electrical equipment are based on inadequate usability [5].

All these ergonomic problems are safety and design issues that might be solved by interdisciplinary research and development together with designers. In the following section some examples from former projects are given:

New instrument handles for minimally invasive surgery

23 criteria for ergonomic handle design were established as a result of several research projects in cooperation with *formforscher product design*, Gauting, Germany. These criteria were taken into consideration and ergonomic handles for open and laparoscopic surgery have been developed together with *formforscher product* design.

MULTIFUNCTIONAL HANDLE

The multifunctional handle is similar to a pistol handle and is shaped to fit only one hand. It is held in the half-closed hand between ring and small finger as well as the thenar. Adjustment of its size to fit the individual hand is possible by means of exchangeable caps located at the back of the handle. The first three fingers simultaneously carry out manipulations of the various functional elements for opening/closing and rotating the effector as well as a ratchet and the application of HF-current. Rotation movements are transmitted directly to the effector since the instrument shaft represents a direct extension of the lower arm's rotation axis. A simple model of this handle has been tested in comparison with commercially available handles for laparoscopic surgery. The results were remarkable considering that it was the only handle that can be combined with a multifunctional instrument. The multifunctional handle is built and distributed by *Karl Storz*, Tuttlingen. (Figs. 1, 2)

VARIO HANDLE

The Vario Handle represents a handle suited for general use as well as for exact and precise work. It can be used in various ways and also by short levering distances. The instrument shaft is an extension of the forearm's rotation axis. Sliding adjustment for various hand sizes is possible by moving the ball of the handle along the instrument's axis. It is shaped to fit both hands and can be held in two positions. Precise dissection is made possible by a seizing grip

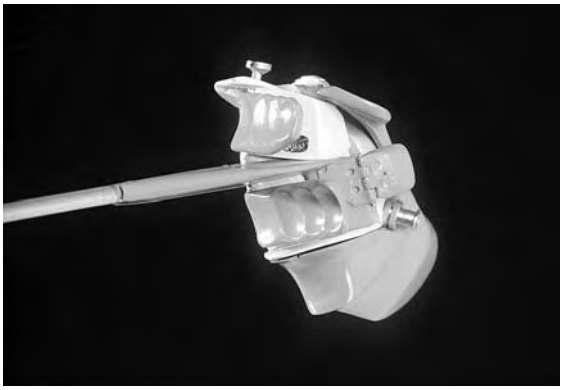

Fig. 1 Design model of the multifunctional handle by formforscher product design.

Fig. 2 The final product available from Karl Storz.

Fig. 3 Functional Model of the Vario Handle by formforscher product design using standard parts from Karl Storz

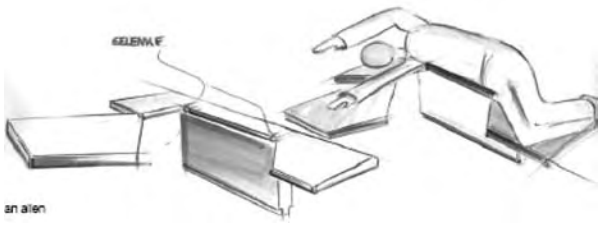

Fig. 4 The patient is lying on his side with the unused flap of the table top folded down to provide more space for the surgeon standing next to the patient.

between the tip of the thumb and the index finger which is used to manipulate the functional element that is in an upright position. The most sensitive zone of the palm is used as an abutment. An encircling grip can be used for strenuous work when the functional element is straightened down. In order to perform this manoeuvre the ring finger is positioned through the ring and can maintain this grip effortlessly for a long time. The ergonomics of this holding function are so favourable that the ratchet can be dispensed with, making rapid grip changing in the abdomen possible. This handle facilitates dissection with the right hand. When used with the left hand as tweezers the surgeon reverts to a bi-manual operation technique. (Fig. 3)

DESIGN STUDY FOR A NEW OR-TABLE FOR THORACIC SURGERY

A patient lies on their side during thoracic surgery. He is positioned on one side of the operating table that is about 60cm wide. This creates the problem for the assisting surgeon that in order gain access to the lung he has to bend over extremely both the table and the patient. However, together with two students from the 'Hochschule für Gestaltung', Schwäbisch Gmünd, Germany, the idea of an ergonomically designed new OR-table was realized in a design model. In this new concept those parts of the table top that are not necessary to position the patient are folded down and thereby enable the surgeon to stand nearer to the patient. (Fig. 4, 5)

TRAINER FOR MINIMALLY INVASIVE SURGERY (MIS)

One of the most important safety issues in surgery is the training of young surgeons. Therefore, 'trainers' have been developed by different university hospitals and companies. These are based on virtual reality, animal organs, mechanical or electrical tasks the surgeon has to fulfil during his training. Most of these surgical trainers are extremely immobile.

The Hochschule für Gestaltung, Schwäbisch Gmünd, Germany was asked to perform a design study to support the development of a new trainer. This trainer should be self-contained and easily transportable and therefore include all its technical support components such as a monitor and computer. The result of the student's design study is shown in Figs. 6 and 7.

Fig. 5 The final model of the new table by Christine Bauer & Michaela Jergentz.

Fig. 6 The working posture of the surgeon during training.

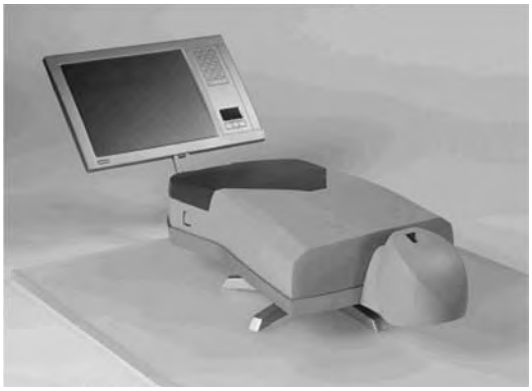

Fig. 7 Design model of the trainer by Yvonne Ackermann.

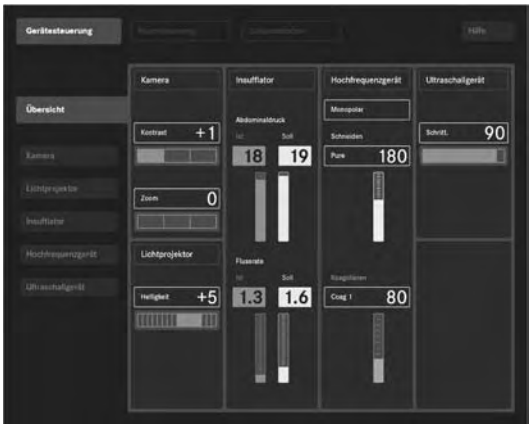

Fig. 8 New interface created by Evelin Hummel.

SYSTEM INTERFACE FOR MEDICAL DEVICES WITHIN THE OR

Most surgeons and nurses feel insecure when manipulating the electrical devices within the OR because there are so many different types manufactured by companies with various user philosophies. Yet, some companies are offering integrated systems which mean that some of the devices can be manipulated by the use of a touch screen. However, unfortunately the user interfaces of most of these products are not intuitive but confusing.

Together with the Hochschule für Gestaltung a design study was performed to create an easily and intuitively usable interface which is shown in Fig. 8. Usability studies for this new interface will follow.

Conclusion

Medical progress during the last 100 years has been without equal! However, today there are still enormous challenges for human factors, usability and design.

The operating room is one of the most expensive and most complex units within a hospital. At the moment the increasing complexity of workplaces (with their technical support equipment), the increasing number of patients and simultaneously the decreasing number of employees makes medicine and especially surgery more and more complex and dangerous. Safety issues in the OR need to be discussed not only for patients but as well for the personnel, because there are hazards which may occur for all persons within the OR.

It is absolutely essential to design much more ergonomically new surgical devices, and indeed, the entire operating context. In order to achieve this aim there has to be a fluid transfer and synthesis of knowledge from the core fields of architecture, engineering, design, human factors, hygiene and economics, etc. Only then can interdisciplinary teams with experts from these fields begin to create optimal designs which achieve new levels of safety and efficiency in medicine.

The University Hospital Tuebingen has established the worldwide unique laboratory – the Experimental-Operating Room. The new department 'Experimental-OR and Ergonomics' plans, builds and operates this laboratory and coordinates the various projects. A 400m² OR unit consisting of two ORs together with auxiliary rooms, is set up in a 1000m² factory floor. The aim is to enhance and harmonize medical and building technology. The Experimental-OR is an international open platform for interdisciplinary research and development.

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Infrared thermography in design research

The application of thermal imaging as a measurement tool in the design process

Abstract

There are many tools and methods that have been developed in an attempt to understand and define Human-Product Interaction (HPI). Recent innovations in design have been informed by knowledge from disciplines such as Psychology and Social Ethnography. However, it has been proposed that current design research relies too heavily on methods dependent on subjective interpretations. This has led to the suggestion that design research needs to shift from its traditional concerns with the interpretation of external attributes such as the qualities and processes of products and focus more on the objective study of human physiology. One of the reasons for this proposal arises from recent research in to the activity of the human brain enabled by advances in medical imaging technology. Magnetic Resonance Imaging (MRI) has been used to observe the highly complex interactions between human cognitive, motor and affective neurological systems and explore and define the complex causal relationships that exist between action, thought and feelings. Ergonomists and Psychologists already use a variety of 'contact' bio-feedback methods to measure response to external stimuli. Infrared Thermography (IRT) now offers design researchers a novel, highly accurate, non-contact method of measuring fluctuations in skin temperature arising from physical or emotional stimuli. IRT provides numerical and visual data which, we propose, offers significant benefits in measuring human response to stimuli in real time. This report highlights the knowledge base supporting this proposition and, through a preliminary study, evaluates this measurement technique and its potential application in the design process and response to the perception of form.

Introduction

Within the last decade design practitioners and researchers have recognised the importance of exploring the nature of Human-Product Interaction (HPI) from the perspective of user-experience. Previously, industrial designers and their colleagues from associated disciplines have been preoccupied with the narrow scope of user-experience that is defined by utilitarian needs (ergonomics) and commercially driven aesthetics (branding/lifestyle). It is recognised that this scope is widening to encompass emotional experience and there is a clear call for design research to develop knowledge and tools to further our understanding of responses to the manufactured world **[1]**. The driving factors encouraging design practitioners and researchers to respond to this call are three-fold: economic, environmental and social. Innovative tools that can aid designers in their efforts to understand HPI will obviously provide important commercial advantages, but more importantly they will contribute to the development of more fulfilling and sustainable product experiences.

A number of techniques have been developed recently to quantify and qualify Human-Product Interactions (HPI) within the field of Industrial Design **[2–4]**. These tools have been developed specifically to assist designers in the evaluation and development of product experience. Many utilise non-verbal methods of communication, however, their main limitation is that they do not provide objective measurements of human-product interaction and are dependent on the subject's expression of their experiences and feelings.

Love **[5]** identifies epistemological contradictions in design theory and proposes that a research programme based on a developing understanding of

physiological processes in human cognition, action and intent is required to further underpin research in this field. Furthermore, the 'State of the Art' report from ENGAGE (Engineering Emotional Design) identifies a need for more *"robust"* and *"statistical"* methods to underpin the understanding of Human-Product Interaction which *"will require theoretical deepening and instruments that enable capture of the richness and dynamics of product experiences."* **[6]**

In response, this paper outlines the transfer of knowledge, methods and technologies from the fields of Psychophysiology and Medical Thermal Imaging to the research of Human Product Interaction.

Research aim

The aim of this research project is to explore the feasibility of this question – can infrared thermography (IRT) provide a reliable and repeatable measure of a subject's affective state during interaction with a product? This research question requires the following tasks to be undertaken; firstly, the limits of IRT in the measurement of human-product interaction must be determined and, secondly, the application of this technique within the field of Industrial Design must be investigated. Preliminary work to resolve these tasks is outlined below.

Emotion, physiology and thermal imaging

The literature review has identified an extensive and expanding body of knowledge focussing on theories of *emotion* or *affect*. Early theories stemming from Darwin's 'evolutionary' approach focussed more on changes in physiology and behaviour. The more recent and favoured theories, while still acknowledging the role of the 'visceral' (physiological) and 'skeletal' (behavioural), place our 'cognitive appraisal' of the emotion eliciting situation as the key element of our affective experiences. Gross **[7]** summarises the core components of emotion as *the subjective experience* (cognitive and experiential), *the physiological changes* involving the autonomic nervous system (ANS) and *the associated behaviour* (actions and expressions). It is defining the complex relationships and mechanisms between these components and their relative importance that is problematic in emotion research. Eysenck **[8]** identifies that this complexity is further compounded by the fact that there is often a lack of '*concordance* or *agreement'* between the components.

Another difficulty arises in defining what it is that is actually being experienced. There are two dominant views on the structure of emotions: the specific affects approach and the dimensional approach. The specific affects approach focuses on core emotions such as happiness, surprise, anger, disgust, sadness, and fear. It proposes that these primary emotions can be experienced individually, in isolation, or that they can be blended to create secondary emotions providing a much wider spectrum of affective experience. The 'dimensional approach' expands on this by positing the notion of 'core affect' which consists of a blend between *valence* (the subjective perception of the experience as positive | negative) and *arousal* (the degree of physiological change from low | high). Physiological measures are commonly used in the analysis of a subject's experience of emotions and relate specifically to the activities of the autonomic nervous system (ANS). Research methods arising from this focus on the measurement of specific ANS activity and there is increasing evidence, as cited in Vianna and Tranel **[9]**, of *'emotional patterning'* in ANS activity depending on specific emotion type. Dimensional models of affective space have increasingly been used in a diverse range of psychophysiological studies, as cited in Neumann and Waldstein **[10]**. Hybrid versions combining discrete and dimensional models have been used to investigate emotion-specific ANS activity **[11]**, and have also provided researchers studying design and emotion with a useful basis to develop frameworks for the consideration of human-product interaction **[12]**.

There are a variety of methods used to measure response to emotional stimuli in psychological research studies; skin conductance (Electrodermal response, EDR or Galvanic Skin Response, GSR), cardiac function (Electrocardiogram, ECG), heart rate (HR), respiration, blood pressure (BP), facial musculature (Electromyogram, EMG) and more recently, gastric myoelectrical activity (Electrogastrogram, EGG) **[13]**. Recent studies have identified that combinations of such metrics may provide a feasible method for developing products that could measure and respond, for example, to levels of stress in the user **[14]**. Furthermore, Electroencephalogram, (EEG), and the advanced imaging technique of Functional Magnetic Resonance Imaging (fMRI) have been used by researchers in the cognitive neurosciences to observe brain activity while cognitive tasks are taking place. All of these techniques have varying levels of invasiveness that place limitations on experimental methods.

It is significant that measures relating to vascular activity, particularly HR and BP [**15**] are 'tried and tested' metrics. Further to this, although not without criticism from cognitive appraisal theorists, facial feedback theories such as the Vascular Theory of Emotional Efference (VTEE), indicate a complex relationship between brain activity, vascular blood flow and facial temperature, specifically forehead temperature. This theory, revisited by Zajonc in 1985 [**16–18**] provides a useful theoretical basis to explore the use of facial temperature as a measure of affective state. As thermography is a highly accurate method of measuring changes in temperature arising from vasodilation and constriction, it is proposed that this non-invasive method may be sensitive enough to be used as an objective measure of a subject's response to designed and aesthetic stimuli.

The review of literature has also identified that there has been limited exploration of the use of thermal imaging in the analysis of human interaction with products on a physical level, for example user comfort [**19–21**], and no evidence of its use to analyse other facets of human-product interaction, specifically affective state. As a tool for medical research, thermography is increasingly used to analyse various physical conditions but there is a dearth of information relating to it's application in Psychophysiological studies. The review to date has identified one published article [**22**] which specifically notes the use of a thermal imaging system in emotion research; however, the focus of this research work was not related to human-product interaction.

Infrared Thermography (IRT) is a technique used to visualise and measure infrared radiant energy. Infrared radiation is part of the electromagnetic spectrum, it has the same speed as visible light but occupies a space on the spectrum at a longer wavelength which makes it invisible to the naked eye. All objects with a temperature above absolute zero emit thermal energy in the form of infrared radiation, and all objects absorb infrared radiation from the surrounding environment. At any given temperature and wavelength, there is a maximum amount of radiation that an object's surface can emit – if a surface emits this maximum amount of radiation it is known as a *blackbody*. Different materials emit different amounts of thermal radiation, the efficiency with which an object emits infrared radiation is known as *emissivity*. A blackbody has an emissivity of 1.0, other materials exhibit emissivity values as fractions of this; it is known that human skin is a highly effective emitter and has an emissivity of .98 (±.01).

Technological improvements in thermal imaging systems have considerably advanced the application of thermography in the medical and engineering fields in recent years [**23**]. It is developments in medical research and diagnosis that provide some of the most important empirical knowledge for transfer to this research project. The human body is a thermo-regulatory system and human skin plays a key role in the regulation of body temperature. Regional skin temperature dynamics reflect the condition of the individual and have been used extensively in clinical work to study the effects of disease and other conditions. The repeatability and reliability of thermal imaging is an area of key concern in medicine and appropriate standards have been established to produce reliable and valid results [**24**]. Due cognisance has been given to these recommendations for good practice in the preliminary study outlined below.

Preliminary study

A preliminary study was undertaken to test the hypothesis that interaction with a product will elicit a change in facial temperature measurable using thermography. A wooden puzzle was chosen as the test stimulus. Subjects had no prior experience of the puzzle and were required to solve the problem within a predefined timeframe by manipulating the simple wooden pieces to create a capital 'T' letterform. This artefact was selected for three key reasons: to stimulate all cognitive, motor and affective systems, to provide a similar level of activation that might be expected from experience of interaction with a complex consumer product and to limit the potential for subjects to bring association of meaning or personal experience, familiarity or bias in to play during interaction. On the basis of the literature review, it was assumed that the challenge of this scenario would elicit a change in the subjects affective state, furthermore, it was expected that this change would be of negative valence.

EQUIPMENT

An internally cooled SC1000 Thermacam was used in the experiment. The camera has a 256 × 256 detector focal plane array with a thermal sensitivity of <0.1 °c (actual 0.07°c). The camera's stability and accuracy have previously been measured against a National Physical Laboratory Thermal Imaging Blackbody

(TIBB) using F250 Precision Thermometer. The camera detectors are sensitive to the shortwave infrared spectral band (3.4 – 5 µm). The camera's digitizing resolution is 12 bits, 4096 levels. The video output is PAL and the thermal images were captured from the camera using a Flashpoint 3D video capture card installed in a Dell workstation. The images were directly acquired using C-THERM V2.2, a software package developed specifically for medical thermal imaging applications. The software provides the researcher with a variety of methods, including isotherms, regional and cross-sectional tools, for the collection and analysis of temperature data. Geometric or free-form shapes can be created to sample the mean temperature of a specific region, these can be saved and loaded into subsequent images to ensure standardisation of measurement.

METHOD

To produce a manageable data set for this preliminary study, a small sample of subjects was used. All subjects were male volunteers from the student body of the School of Industrial Design, Swansea Institute. No tungsten light sources were used and a fabric covered screen was situated behind the subject to reduce reflected radiation. The ambient temperature of the test environment was 23(±1)°C for all tests. The test environment conditions were recorded for atmospheric transmission correction: values for the background temperature, ambient temperature, relative humidity, emissivity and distance from subject were programmed into the SC1000 Thermacam. A 15 minute period of acclimatisation was allowed to enable subjects to adjust to the test environment. The subjects were seated at a desk in a comfortable, upright chair facing the thermal imaging camera at a fixed distance of 1.5 metres. A further 5 minute period of acclimatisation to the experimental equipment was allowed.

Thermal images of the subjects were captured at 5 second intervals throughout the test. Images were captured for a period of 30 seconds prior to exposure to the test stimulus. The test puzzle was uncovered and the subjects were allowed to physically interact with it for a period of 2 minutes duration. The puzzle was then covered to prevent further interaction and images of the subjects continued to be captured for a period of 30 seconds, post stimulus. A total of 36 images were captured for each subject. One subject was not given the 'puzzle' task but was asked to sit for the same duration without any stimulus to provide a comparative baseline.

IMAGE ANALYSIS

The specific Region of Interest (ROI) has been identified as the forehead from the literature review **[25]**. Temperature measurements were taken from two regions directly above the pupil of each eye, midway between the hairline and the eyebrow in the anterior view of the face. A standard circle was used with an area of 353 pixels. Temperature values were recorded for both the Left and Right ROI's in each image and the data was collated for analysis. The mean temperatures between the Left and Right ROI's were calculated for all subjects. Microsoft Excel was used to graph the data. Thermograms were selected from the start, mid (peak temperature) and end of the test duration for visual analysis using the isotherm tool. The temperature range was 'squeezed' in the images to display only temperatures in the range of 26.7°C – 36.7°C. Isotherms were used to define temperature regions, 0.2°C either side of each subjects mean temperature, to indicate change in spatial distribution of forehead temperature.

RESULTS

As the temperature data recorded fluctuates, polynomial regression has been used to provide a 'best fit' curve to the temperature data change over time. The Coefficient of Determination, R^2, indicates how well the trendline fits the data.

Comparison of the trends in mean temperature changes **[FIG.1]** indicates a dynamic change in forehead temperature for stimulated subjects (01,02,03), while the unstimulated subject (00) presents a more stable forehead temperature. Subjects 01, 02, 03 all show a noticeable rise in temperature during stimulus which drops off post-stimulus. The slight oscillations in temperature of subject 00 can be attributed to the internal variation in the camera, and Ring & Ammer **[26]** note also that after stabilisation of a test subject to the test environment, oscillations in skin temperature can be detected. It was noted that in all subjects there was asymmetry in the temperature recorded for either side of the forehead. It was also noted in all subjects that changes in temperature recorded followed the same general trend for both sides of the forehead **[FIG.2]**. Subjects 00 and 01 exhibited the most noticeable asymmetry and this is significant as it is outside the potential error due to the accuracy of the camera **[FIG.3]**. Visual comparison of thermograms at key junctures pre-, mid- and post-stimulus provides a clear indication of changes in the spatial pattern of forehead temperatures of the three stimulated subjects **[FIG.4]**.

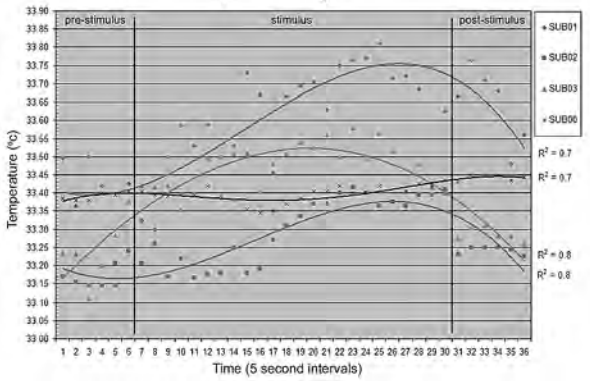

FIG.1 Temperature change trends for all subjects.

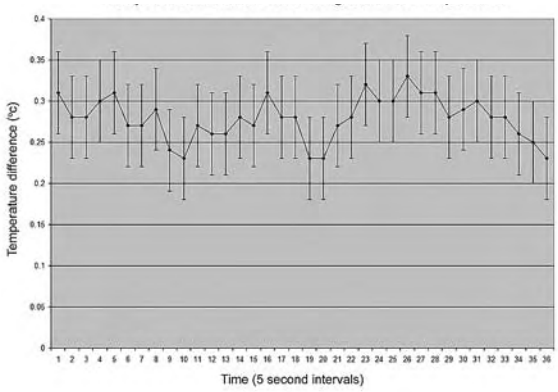

FIG.3 Significance of forehead temperature asymmetry in Subject 00.

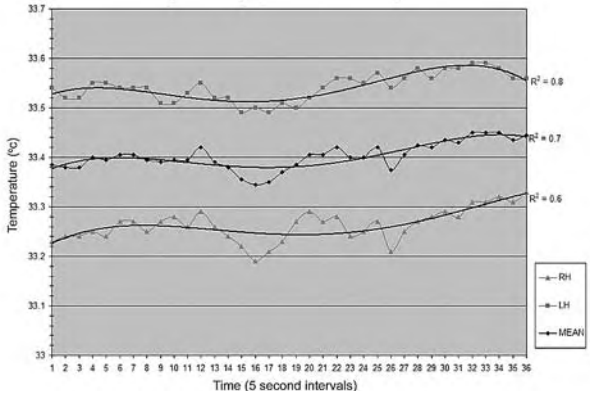

FIG.2 Example of asymmetry recorded between Left and Right forehead temperatures.

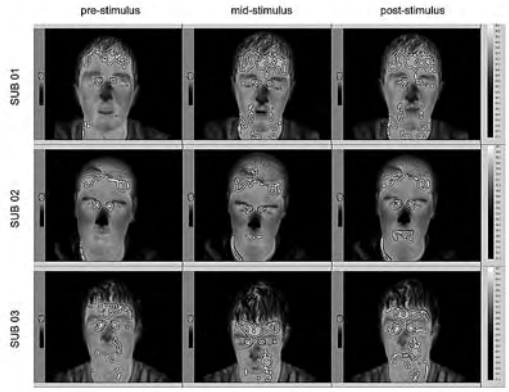

FIG.4 Examples of change in forehead temperature spatial patterning using isotherms.

Discussion

The results of this preliminary study clearly indicate two important findings: firstly, that there is a correlation between change in forehead temperature and interaction with the test stimulus; secondly, that IRT provides an accurate, non-contact method of measuring this dynamic change. It is noticeable that the stimulated subjects reacted with differing degrees and rates of change. Subjects 01 and 03 show the greatest change, >0.5°c compared to subject 02 with a change of >0.2°c. Subjects 01 and 02 show a similar trend in their reaction but with differing degrees of temperature change, while subject 03 exhibits an earlier increase and decrease in temperature. This may indicate that 'anticipation' of the event or 'disappointment' at failure may be responsible, however, the differing trends and degree of change highlight the need to further clarify how individual differences influence interactions. Initial results are encouraging although it is not clear yet whether the changes observed are transitions in affective state or simply the physiological presentation of the cognitive 'work load' involved in the task. Even if this is the case, it will still provide a useful metric by which designers can evaluate a product's usability and a user's response to the perception of its form.

There are limitations to this preliminary study, such as the size and diversity of the sample. A larger sample is required to validate the experimental procedures repeatability and confirm the significance of the results. One of the key issues for future work is the determination of protocols for measurement and the establishment of baselines. Defining 'normal' thermo-physiological references is a problem currently being addressed by specialists in Medical IRT **[27]**. Determination of absolute temperatures is not as important to this work as is the accurate recording and measurement of temperature change. It will be important to establish baselines for individuals so that changes observed can be validated. Consistency in the images captured is essential

for reducing spatial error when measuring specific ROI's. Methods of maintaining spatial positioning of the subject, tracking or image registration will be considered in the next experiment. Further consideration of subject diversity (gender, age and anthropometric factors such as Body Mass Index) is required in the development of the experimental method. No self-reporting techniques for the measurement of the subjects 'perceived' affective state were used in this preliminary study and correlation of the specificity of physiological change presented by subjects and their perception of their affective state will play a significant role in future work. Psychophysical techniques **[28,29]** will be considered, since they have already proved useful in objectifying user responses to glass product design concepts **[30]**. Furthermore, a measure of the each subjects 'emotionality', through psychometric testing, may provide valuable insight into the differences between individual affective experiences of product interaction.

Ongoing research work by the authors will determine the potential scope of IRT in the measurement of human-product interaction. First intentions are to establish any correlation between changes in affective states and changes in facial temperature, and to develop methodologies for measuring the strength of response, reaction and recovery rates during interaction with designed stimuli. Further investigation is required to identify causal variables, and exploration of the relative importance of different sensory stimuli. The opportunities for utilising artificial intelligence algorithms for visual pattern recognition are being considered, and in the longer term this may provide a basis for the development of products or systems sensitive to the emotional needs of users.

Conclusions

The authors believe this preliminary study demonstrates the potential application of Infrared Thermography in the measurement of Human-Product Interaction.

HPI is a complex and dynamic process with many factors framing our experience: physical, emotional, cognitive, social, cultural, aesthetic and symbolic. IRT can provide designers with an objective, non-contact method for analysing human response to designed experiences – responses could be categorised, their causal variables identified and their relative contextual importance defined. The implications are considerable. There are ethical issues to consider; the ability to identify and manipulate specific product attributes to engender positive and predictable consumer responses has obvious commercial advantages but suggests an Orwellian scenario. However, the environmental and social benefits would offset this; the production of poorly conceived and targeted products could be avoided, reducing development costs and wasted resources, and the life of products could be extended by ensuring greater user satisfaction through more relevant and sustainable experiences. In design practice, accurate and objective user feedback may be achievable at key points in the product development process: for example, early concepts could be evaluated for their aesthetic or tactile qualities through interaction with virtual or real 'form' prototypes; further downstream, usability studies could be undertaken to aid the refinement of product interfaces and improve user satisfaction before 'pushing the button' on production. In design research, greater progress could be made in understanding the way product experiences evolve over time: How does a product's potential for evoking particular emotional responses change during its life-cycle? What are the variables that effect this potential? What are the effects of these variables on different groups or individuals?

Initial findings indicate that forehead temperature may provide a useful metric in the study of user experience. The range of responses observed supports the author's proposal to undertake further experiments with larger sample groups to establish the statistical significance of this metric and it's effectiveness in discriminating between different responses to designed stimuli. Future research will determine whether this is a reliable measure of the user's affective state during interaction with consumer products; this will provide a valuable tool for designers in their efforts to quantify and qualify *'the richness and dynamics of product experiences'* within and between specific target user groups.

KEYWORDS
Infrared Thermography, Design, Emotion, Affective State, User Product Interaction, Measurement

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Catalina Naranjo and Carolina Gill

Towards sustainable design: lessons from developing countries

Abstract

Patterns of production and consumption within a society are determined not just by the relative economic status of that society, but also by the attitudes of its citizens. A culture like that of the United States, where many citizens feel that wealth is essentially boundless, is quite different from that of less developed countries, where possessions and wealth are held to be difficult to acquire, and thus something to be hoarded.

In most developing countries, individuals at all levels of income possess a different attitude towards products. No matter what their station in life, members of these societies tend to see products as inherently more valuable, and thus they go to greater lengths to preserve and maintain them. In effect, the concept of "*need*" is much closer to what is actually necessary for a comfortable life, leading to an attitude toward products that makes maintaining and re–using them worthwhile.

Introduction

We are living in an era where consuming in excess is an accepted practice among most people. Products that once were considered luxuries are now perceived as necessities. With the advent of mass production brought about by Ford's assembly plant in 1913, the United States solidified its position as the number one economic power in the world. Advances in technology generated unprecedented wealth; accessibility to physical goods dramatically increased. Through the years, commodities have been transformed into goods, goods into services and in our own time, services are transformed into experiences. Goods and services are no longer enough: American consumers are not satisfied with the product itself, instead they demand a more sophisticated relationship with the product and its brand. They look for a level of satisfaction that goes beyond the product meeting their functional needs **[1]**. Consumption itself has become a driving force behind modern economies. As Victor Lebow states, "*Our enormous productive economy…demands that we make consumption our way of life, that we convert the buying and use of goods into rituals, that we seek our spiritual satisfaction, our ego satisfaction, in consumption…We need things consumed, worn out, replaced and discarded at an ever–increasing rate*" **[2]**.

Nevertheless, it has become clear that a sustainable economy cannot be built on unlimited consumption of wealth because it has the potential to adversely affect the livelihood of future generations. Although we recognize that consumption contributes to human development, it also has a negative effect on the quality of life, now and for the future.

While some Americans seem to believe that citizens in other nations of the world desire nothing so much as to emulate the extravagant lifestyle of the typical 21st century American, the reality is quite different. As Luis Martinez–Fernandez says in a recent article published in the *Chronicle of Higher Education*, "*Although people around the world may wear, eat, and listen to American products, they continue to maintain their deeply ingrained values, beliefs, and underlying assumptions. They may embrace the material products of modernity, but they cling tena-*

ciously to their underlying cultural cores – which remain vibrant and resiliently distinct" [3].

In this paper, we hope to show how these cultural differences extend even to the user's experience in interacting with a product. Here we present two contrasting examples of how the life of a product can be affected by different cultural attitudes toward consumption. In this paper we will show how the same product – in this case a child's tricycle – plays two distinct roles in families in the United States and Colombia. While the product serves the same 'function' at one level, its interaction within the context of the two families is completely different.

By looking closely at this example, we hope to show how essentially identical products result in completely different experiences when situated in different cultural contexts. Furthermore, we are interested in using this example to show how the cultural expectations around a product can affect its actual life cycle and consequently, its design. The materials used, the manufacturing processes selected, the price at which it is sold, and the ability to maintain the product, are all subject to the culture in which the product appears. There are valuable lessons for designers to be learned by paying close attention to products and how they are used at this level.

Patterns of Consumption: Two Worlds

Here we present two narratives that were presented by the mothers of small children in Colombia and the United States. Both narratives concern essentially the same product, a three–wheeled vehicle designed for children too young to use a bicycle. Because the tricycle is one of the first vehicles the child owns, is quite often important in the social and intellectual development of the child. The first narrative is presented verbatim from an interview with the Colombian mother. Here she notes how the same toy was handed down to four children in succession, and how it came to play an important role in the life of each:

FIGURE 1: COLOMBIAN FAMILY

My experience with the tricycle has been wonderful. Children are always demanding attention and looking for things to do, and sometimes it is hard to keep them interested in learning. So here is where the tricycle fulfilled all my expectations. We bought it when Daniela, my first child, was two. We thought it was a good age for her to learn and to develop her gross motor skills in a fun way. She began very slowly, trying one time after the other, to coordinate both of her legs, and advance; she learned how to pay attention to the direction she was going and to control the steering.

When her brothers came along, the tricycle began to have a special significance to her because she used it as a tool to communicate with her brothers. It secured her position as the older sister. My kids began learning about directions, numbers, traffic symbols, distances, etc. When Daniela was big enough to have a bike the tricycle passed on to her younger brother, Federico. Daniela enjoyed teaching her little brother all about the tricycle, trying to figure out different strategies to help him learn. This process was repeated when Fedeico outgrew the tricycle and handed it to our third child Nicolas. Playing with this toy was an extraordinary experience for all of my children. With the tricycle they learned how to share, take care of things and be tolerant of others.

I think this tricycle has exceeded all of our expectations. It has been a very important toy in our experience as parents so we decided to keep it as a keepsake after our third child was five. And then, we were surprised with our fourth child. Now, it has been almost nine years since the first time we used it and here we are, enjoying the ritual all over again. Now we have three children interested in teaching their baby brother all about it. Having the tricycle today is a testament to their attitude towards their belongings. This not only reflects how

Figure 1:
Colombian family

the children care for their toys but it also indicates how well it was designed and built. I wouldn't consider buying my baby something different. We will keep this tricycle a few more years until my youngest child is big enough to ride the bike. We feel this toy has left a footprint in our lives.

The second narrative was by a mother living in the United States. In this case, a single child is the possessor of three different tricycles. What is interesting here is that the child has quickly developed a pride of ownership not just around the toys themselves, but around the fact that he owns three of them. It is interesting to contrast the attitude of the mother in this case to that of the Colombian mother:

FIGURE 2: AMERICAN FAMILY

My son is three years old. He loves to play outside and of course his number one favorite activity outside is to ride his tricycles. Yes I said tricycles, plural, because we have three here at our house. It may be curious how we ended up with three.

The first one we acquired came from my dad. They had an extra one laying about and gave it to Noah (my son). This one is red, blue, and yellow in color and sits about two and a half feet up off the ground. It has no piece connected to the seat to support the back and the little red pedals turn very easily. The second one we own is the one I bought Noah for his second birthday. This one has a dark blue seat, red handlebars and a yellow bucket at the back of it under the seat. This is Noah's favorite tricycle because of that bucket. He loves to ride the bike up and down the sidewalks and collect rocks. I like this bike the most as well because it is lower to the ground and a has a seat that goes up all the way to support his back so he can't fall backwards. This one is also lower to the ground so his little legs don't have to stretch so far to reach the pedals.

We attained the third tricycle through our neighbor's garage sale and it is more for my two nieces who are here quite frequently. It is a pink Barbie tricycle complete with a little Barbie backpack on the front of the handlebars and sparkling streamers coming out of the end of the handlebars as well. It is low to the ground and also has back support off the seat. Although this bike is more for girls I have to admit that Noah does ride this one too although not nearly as much as the other two.

One might say that three tricycles is a lot and they may be correct. However, I only purchased one. The others were gifts. I have to say though that I am glad he has the options. He doesn't like to ride just one. He loves to get all of them out and choose which one he feels like riding. There is never a time that we play outside that he does not get out all three. In terms of safety, I feel very uneasy about the first bike I mentioned because I worry that he will fall backwards and bust his head open. The last two are much better. The bucket of course, is priceless. Overall these tricycles are a wonderful part of outdoor activity and I love walking beside my son as he scoots along collecting rocks.

Concluding Remarks

The two narratives presented are not intended to be taken as generalizations of the two cultures they come from. Rather, we intend them purely as examples of two contrasting value systems that offer the possibility for further study. We believe that in order to build truly sustainable economies, designers and producers must begin to pay more attention to cultural, emotional, and behavioral patterns of users in different economic systems. In our view, how products are used is directly a result of how they are valued: product longevity is ultimately determined by how much value is placed on an object, whether that object is a child's tricycle or an automobile.

Figure 2:
American family

The experience of the young American boy is interesting because it shows how each toy can itself have relatively low value, because he has so many toys. One has to wonder if the child in this narrative is already being 'trained' to devalue products, because they are so easily attainable. If this attitude is instilled in the child at so young an age then will it persist throughout his life? In other words, is he being taught through this experience that having more than one needs at any given time is a desirable goal?

In the context of the Colombian children, the toy has taken on additional meaning, simply by virtue of being handed down from an older child to a younger child. The parent has an emotional attachment to the toy and therefore she will be more willing to preserve it. The toy itself is made out of local materials by local firms, and is designed to last for several years, to facilitate repair and maintenance, and finally at the end of the product's life, to be recycled.

With children's toys, product longevity is especially dependent on how strong an emotional connection exists between the product and the child or the parent. Parents tend to keep toys that are associated with a specific event in the child's life, with their own childhood, or with the parenting experience. Of course, we are not saying that similar situations do not arise in the United States, but in many cases when the parent wants to keep the toy, the products available have not been designed to withstand heavy use over several years. The American toy industry is dominated by very low–cost products, that make extensive use of thermoplastics and blow-molding, and are manufactured offshore in very low–wage countries. No provision is made for maintenance, repair, or recycling of these products, because they have no inherent value, either to the child or to the parent.

We believe that not enough attention is being paid to how product life, product use, and product design occur in less developed countries. Important lessons can be learned by looking at the ways in which less wealthy countries satisfy essentially the same needs in ways that have much less negative impact on their local environments. Can American designers learn from cultures that have retained a simpler approach to satisfying the needs of their consumers? How can designers help parents teach their children to be satisfied with fewer products? Do designers typically even consider contrasting attitudes towards consumption and products that other cultures possess? Can these lessons help designers in developed countries learn to design more responsibly?

KEYWORDS

Sustainability, Consumption Models, User Experience, Product Life Cycle

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Nathalie Ciprian and Frédéric Degouzon

Building up a sustainable design CREDO

A possible framework for an experimental "project grounded" design community

Abstract

Design practice is one of the best ways to produce tangible solutions for strategic issues.

Nevertheless, designers tend to poorly promote and evaluate these visionary AND pragmatic abilities.

A plethora of methods inside and outside the design sphere have been proposed lately but most of the efforts made in design research to arrive at a "new paradigm shift" fail to take existing works into account.

This questions the ability of the peer-reviewing process and recognition within the design community.

What may apparently be perceived as a weakness in conceptual self-definition of the field, could in fact be a specific designer's ability to manipulate heterogeneous or "translational"[1] knowledge.

Design education can be a model for a "project-grounded"[2] reflexive attitude arising from a need for the sustainable transmission of knowledge and know-how. The evolution from a *designer by trade* to a *designer by function* professional culture emphasizes the need for transparency and teamwork abilities.

The world of design education is thus a potential proactive community of practice[3].

The previous statements were the starting point for an experiment to be led from 2007 to 2009 the CREDO series of workshops organized by the Ecole de design Nantes Atlantique. CREDO stands for Cooperation in Research and Education for Design Options, and is meant to be:

- a platform for confrontation and sharing of design practices and methods within the community,
- a manifesto for a meaningful vision of our societies' future from a designer's point of view, implemented through the key notion of "scenario".
- a presentation of the design process to a broader audience.

This paper will address the issues and the notion of the "sustainable design credo" evoked here and will introduce the first results of this experiment.

INTRODUCTION

This paper is meant to be a "work in progress" report about the opportunity to build a community of practice in design through a four-year experimental program which we have been conducting for two years now. It is an introduction to the thought process and the core notions that fuel this experiment, in relation to our own global reflections about design education, design methodology and design communication.

Therefore, some sort of paradox as an introduction:

In a recent article on Innovation[1], Craig Vogel pinpointed this strange antagonism between design and designers:

First observation: Design is now considered as an effective tool to address and solve strategic issues as well as innovation processes, especially as a way to give shape and content to concepts at an early stage of the project.

Second observation: Design practitioners often have only very scant knowledge of the specificity of their field of activity despite all the methodological research material available to them. This state of affairs results in a temptation to "reinvent the wheel".

C. Vogel partly answers this situation by depicting the notion of design as "translational research" vs. "basic research" (as resorted to in physics, biology etc).

Our questions about this paradox are the following:

- Is this a conscious trend pursued on purpose?
- Can this trend hinder the designer's activity in any way?
- If so, would it then become a trademark?
- An insolvable mystery?
- Or isn't the methodological issue simply handled in the wrong way?
- Is it possible to set up some sort of sustainable management applied to creative processes and methods?
- What happens when a team of designers from different backgrounds, and with different methods and education must work together and exchange ideas with one another?

We will now try to provide a partial answer to these questions by analyzing the CREDO workshop as an experiment conducted in the framework of a design teaching activity by thoroughly reviewing the event's basic principles.

Design specificity as we see it…

Our position depends on a number of postulates that, although arguable, appear to us to be an indispensable way foreword as a means of clarifying our point.

- Design is a creative activity rooted in a widely inductive conceptual process favouring a pragmatic approach and requiring a composite knowledge.
- It feeds upon a specific culture in which the artistic education of design practitioners plays an essential part.
- It advocates a human-centered approach doted with an ethical dimension, which implies an involvement in a broader context: i.e. social, economical, technical and cultural fields.
- Design is a "praxis", a practical knowledge reaching beyond the opposition of "logos vs. technè", theory vs. practice.[2]

Historically, design has been passed on through project practice or workshop logic, in a "medieval" sense. It was translated into theory through the writing of manifestos and the school of thought logic, in a "Bauhaus" sense.

The designer's sphere of action has greatly evolved over the past two decades in the industrial context, due to the importance of the strategic dimension and elaboration of complex projects within a global system. Therefore, the designer's social position has begun to shift in companies as well as in society. His/her status has changed from that of *designer by trade* rooted in a craftsman's know-how logic to that of *designer by function*, rooted in a business-like project logic.

The designer is now involved "upstream" in the conception and definition of the project, just like employees in other fields of activity. He/she is no longer a mere performer but has become a true driving force for the project, particularly thanks to his/her ability to give flesh and life to it, and to communicate efficiently with a common language.

In this contemporary background, we think it is relevant and necessary to evaluate the designer's action and the creation processes more acutely, without adhering to a rigid hypothetico-deductive model. In a word, we must avoid providing a readymade reply to an already asked or new question but we must rather preserve and further develop the existing ability for innovation by conducting an efficient and rigorous assessment of the designer's contributions.

In this perspective, we are convinced that design education is one of the main issues to address.

Design education and communities of practice

Indeed, design education plays an essential part in the analysis of design's specific factors. On the one hand, it requires evaluation and formalization so as to transform the know-how gained from practice into knowledge – "*let know*", dear to the teacher's activities – and on the other hand, one needs to incorporate and put this knowledge into practice so as to provide the learner with useful skills.

The pedagogical activity is thus doted with an auto-reflexive dimension inherent in its very nature.

The question of "transfer", as mentioned in the subtitle of this conference, is central here: which is how to teach (and therefore how to learn) the creative process? and which is the core of design education.

If we consider (referring to Hatchuel & Weil's works[3]) that design is a way to create unknown proposals from known facts then we should focus on the best possible ways to observe and to magnify this ever-moving knowledge "corpus" that feeds design education on a daily basis. This is because the exchange between the research of new concepts and the existing knowledge is a dynamic process. This complex and specific dynamic process could be shared and documented in an efficient way if we consider the design education community (learners,

teachers and other players) as the pedestal of a community of practice according to Etienne Wenger's definition of the term:

> *"Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly."*[4]

The community of practice – a notion first coined in "Knowledge Management" – has a few features meeting the requirements of both design pedagogy experts and design practitioners (the latter can also be the former and vice versa):

- Voluntary participation
- Spontaneity
- Free initiative
- Initiation by peers.

The community of practice is a knowledge management strategy mainly based on human interactions and structures promoting these types of exchanges. In essence, a community of practice cannot be proclaimed; it can only be built through active participation. A few conditions are required for it to emerge, to continue and develop: a favourable background…

The encounter with these factors spurred us to create an experimental exchange structure in a wider institutional frame: the CREDO workshop.

An experiment: the CREDO (Cooperation in Research and Education for Design Options) workshop

Launched in 2006 as an experiment by the Ecole de Design de Nantes Atlantique in collaboration with the Royal Abbey of Fontevraud[5], the Cumulus association and with the financial support of the Pays de la Loire Region, this workshop has three main goals:

- Setting up a platform for pedagogical exchange about design practice and education.
- Providing a prospective vision of our societies' near future through the elaboration of prospective scenarios.
- Allowing a broader audience to discover the creative processes which can be implemented through design.

As part of a tri-annual program (2007–2009), this workshop is truly a long-drawn-out commitment.

The workshop revolves around the voluntary commitment of students, professors and researchers from various higher education design institutions.

Each session is constructed around a common theme which acts as a keystone and provides a prospective vision which ensures that the production remains coherent with the location:

- in 2006, "Design and Belief",
- in 2007 "Life Scenarios for an Ideal City".
  The Abbey of Fontevraud – the biggest abbey in Europe, formerly a prison – is both a fascinating, singular site for a retreat and a neutral space.

The main highlight of the event consists in a one-week group working session during which 25 to 40 participants gather together in the abbey.

Participants reflect upon the given theme beforehand so as to prepare for the discussion, conceptual production and formalization to be created during the workshop session with limited material resources.

In parallel with this group work, an observation project is conducted throughout the entire session.

A set of tools promoting long-distance collaboration are employed in order to ensure communication, information and exchange within the group and the community in a broader sense: mailing lists and the setting up of a wiki (open hypertext publishing system).

The outcome, production concepts and scenarios developed throughout the entire workshop and above all the detailed account of the various processes and approaches observed during the group work are then submitted to a broader audience.

This submission can be presented in many ways: promotional scenography, publications, multimedia documents, etc. The work produced during the workshop is then kept alive by the children-and-youth oriented activities thought out by the staff of the abbey, who is also involved in the organization of the workshop.

Assessment of the 2007 session

The 2007 CREDO session has just come to an end and we can already step back and assess what worked well and what worked less well with regards to the driving principles of the workshop.

WHAT WORKED WELL:

- The hoped-for community process settled and developed well among the participants once on location. The actual quality of the exchanges and the true empathy shared during this work session will probably live on long after the workshop is over.
- The materialization of the creation processes which were documented in an eclectic but quite complete way, particularly in a visual form.
- The opportunity to structure a certain number of exchanges within the local organization team by redefining notions, concepts, statements and methods more accurately. This was achieved by transferring the experience gained from the previous session from one team to the next. Incidentally, this paper is part of this approach.
- The integration of the workshop into the organization of the site and particularly the involvement of the staff of the abbey which confirms our idea that design could possibly become one of the abbey's activities.

WHAT WORKED LESS WELL:

- The creation of a community spirit before the actual beginning of the workshop: only when the teaching staff started a pre-workshop activity did the exchange begin, and it remained quite limited as the participants only communicated with the organizing team.
- The difficulty to work out a common prospective vision in such a short time period.
- The impossibility to document the workshop synchronously through online publishing.

WHAT REMAINS YET TO BE DONE:

- Setting up a structure to present the outcome of the workshop, to promote and to document the project.

Temporary conclusions

The need to strike up full contact in order to reach a fruitful exchange and go beyond trivial matters has been confirmed. The sharing of time and place – which could be referred to as the key notion of "being there" – is still the best way to launch such a process.[6]

Therefore the hypothesis according to which the workshop can act as the background to elaborate a community of practice in design and design education seems relevant. One issue must now be addressed: should we spread this project beyond the scope of the academic sphere, in particular to that of design practitioners?

The next step for the experiment is to give access to the results of the experiment to a broader audience: this in itself is a design project which requires an extra amount of time for reflection and action. This paper is a first attempt to answer this challenging and interesting question. To be continued…

KEYWORDS
design methodology, design research, community of practice, design education, practice-based learning, project, scenario, innovation.

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Konrad Baumann and Peter Purgathofer

How designers teach

A qualitative research on design didactics

Abstract

This paper presents the outcome of a study that tries to map design education methodology and uses qualitative interviews as the research method. This work started from the assumption that there is a need for new teaching methods in the education and didactics of human-computer interaction (HCI), user interface design (UID) and interaction design (IxD). While traditionally these methods were derived from the disciplines of engineering and science, the authors suggest that software designers, user interface designers and interaction designers should be trained like designers and not like engineers or social scientists.

The goal of this study was to create an overview on design didactics by the means of in-depth interviews, to compare it with the current status of design research, and to reflect whether it is applicable for education in interaction design. The research method was based on qualitative (in-depth) interviews. The interview guideline covered 75 questions regarding design education methods, group work, practical examples vs. theoretical foundations, interdisciplinarity, international exchange, importance of- and education for creativity, design process, preferred school type, access limits, evaluation and grading, and future trends and challenges.

An extensive content analysis of the interviews used tape recording, transcription, translation, topic-wise sorting of full text, extraction of statements, comparison with literature, clustering, graphical representation and discussion of the results. The study indicates that there are hardly any common beliefs and recognised teaching methods among design educators.

1. Introduction

The field of interaction design, user interface design or human-computer interaction is in close proximity to computer graphics and cognitive psychology. Typically, these curricula are embedded into software engineering or psychology programmes (Perlman, 2004). As a consequence the education of interaction design uses the methods of science and engineering. In everyday professional practice, however, most professionals work as designers rather than as scientists or engineers. When the work of a designer is needed then the methods acquired from science and engineering can become a stumbling block.

A similar shift from the rationalistic approach to a more suitable one for design currently takes place in design theory. Wood and Wood-Harper (1993) still argued that the design of information technologies has been dominated by a rationalistic tradition. As the two key principles in rationalistic design they cite design as functional analysis, as described by Lanzara (1983), and design as problem-solving, most prominently described by Simon (1973).

Design as functional analysis is based upon the assumption that all information about design requirements is available to the designer, and that such information can easily be assimilated. Consequently, the engineer has only to analyse a problem thoroughly in order to have the solution ready at hand. Design as functional analysis assumes that design is a deductive activity. This thinking has its roots in the scientific management tradition initiated by Frederic Taylor.

Design as problem-solving rejects the rational model of functional analysis, and introduces the concept of "bounded reality", accepting the idea that human beings have cognitive limitations constraining the amount of information that can be absorbed and processed. Since a problem cannot be understood as a whole, it is continually reduced and simplified – bounded – until it becomes sufficiently well-defined to be resolved. Next, alternative solutions are evaluated sequentially, until one such solution fits an implicit set of criteria well enough. This solution is called satisficing, in that it satisfies a minimal, rather than optimal set of solution criteria.

Both approaches, design as functional analysis as well as design as problem solving, fail to offer ways of dealing with problems that can stand the test of daily practice. Additionally, both methods cannot encompass the discovery of new knowledge, in particular the discovery of unstated goals and evaluation criteria. Moreover, these approaches fail to take into account that the point of view from which one looks at a situation determines the problems one sees, as it is for example discussed in Bryan Lawson's "How Designers Think" (1997). The rationalistic tradition of software design is based on a rather deterministic model where the individual ideas, viewpoints, interests and feelings do not change the objective problem itself. Effective, innovative user interface design must stay severely limited in this context, and consequently this must be the case as well for an equally effective education.

Engineering is a paradigm where a logical, analytical approach is used to tackle problems. Typically, larger problems are split up into smaller, interconnected sub-problems until the solution for each sub-problem nears triviality. Ideally, each solution can be proven to be correct. A rationalistic view of design is a "natural" complement to this paradigm. But, not only the rationalistic models of design fail when it comes to the discovery of new knowledge, they also fail to take into account that the point of view of the designer plays an important role in any design process (Lawson 1997). However, there is contradiction in human values. All aspects of a design problem that deal with humans involve interests, opinions, hopes, values and morals, which are normally not only subjective but also incomplete, and very often contradictory. Since these aspects cannot be dealt with in a logical, analytical way, they get pushed aside.

Rittel and Webber (1973) coined the terms of **"tame problems"** and **"wicked problems".** Their nature can be illustrated by some metaphors. Drawing an original oil painting like Vermeer did is an example of a wicked problem. The process of value judgements and decision making that leads to the result is highly linked to the act of painting itself. This is different from carrying out a pre-defined drawing by numbers exercise of the kind found in a childrens' drawing book. The act of doing this exercise is therefore not creative but consists in the application of certain rules. To create a "drawing-by-numbers" exercise needs a severe simplification of the painting done by splitting up the painting (or the problem) into small areas with simplified content.

The marginalization of human aspects in software design is necessary for engineers to apply their knowledge and methods to as many aspects of the process as possible. At the very end of a development project, when graphic designers are involved to give the software a "nice looking" user interface, they often face usability problems that are too severe to be resolved by a mere rearrangement of the graphical elements.

In his "Software Design Manifesto" (1990) Mitch Kapor stated that "*We need to create a professional discipline of software design*. [...] *Software designers should be trained more like architects than like computer scientists*." Thus, the didactics of software design or interaction design should be oriented towards the didactics of the classical design disciplines. Education consists of curricula and teaching methods. Current interaction design programs, however, often re-use methodologies from science and engineering education. The starting point of our research was the belief that in order to train software designers (in Mitch Kapor's sense) or system designers, the educators in related disciplines should learn from the teaching methods of design education.

As Lawson (1997) points out, "*design education in the form we know it today is a relatively recent phenomenon. That a designer needs formal instruction and periods of academic study and that this should be conducted in an educational institution are now commonly accepted ideas. The history of design education shows a progressive move from the workplace into the college and university studio*."

Curricula are only half of what is necessary in order to educate HCI students. The other half, teaching methodology, is barely covered in these curricula. As a result, these programs often follow other study courses in respect of their teaching methods, re-using methodologies from science and engineering education. The starting point of this thesis is the belief that in order to train »software designers« (in Mitch Kapor's sense) or »system designers« we should look at the teaching methods of design education. (Purgathofer & Baumann, 2003; Baumann & Purgathofer 2003)

2. Research method

We applied the research method of in-depth guided interviews with experienced and successful educators in design. Similar studies are described in Peters' and Waterman's (1993) "In Search of Excellence", Mihaly Czikszentmihalyi's (1994, 1997)

research on the phenomena of flow and creativity, and Bryan Lawson's (1994, 1997) "Design in Mind" and "How Designers Think". These books served as examples both in terms of the interview methodology and in the way the content has been subsequently analysed.

In this study the in-depth interviews were carried out with eleven design educators from different schools, countries, and disciplines.

The following paragraphs list the interviewees by name and give some information about their background and most important positions and activities.

1. **Günter Domenig** / studied architecture / teaching architecture at University of Technology in Graz, Austria / founder of Domenig, Eisenköck and Peyker Architects, Inc. / professor emeritus and doyen of the Graz school of architecture, built extensively in Austria and abroad / famous for his deconstructivist "Steinhaus" in Carinthia, Austria
2. **Pelle Ehn** / studied informatics / teaching arts and communication design at Malmö University in Sweden / formerly professor in informatics at Lund University in Sweden / research focus on design and digital media
3. **Andreas Gruber** / studied architecture at Cooper Union in NYC, USA / teaching architecture at University of Technology in Graz, Austria / formerly active as an architect in Vienna and Graz, Austria
4. **Joseph Gründler** / studied medicine and music / teaching electronic music at FH Joanneum University of Applied Sciences in Graz, Austria / formerly teaching at Graz University of Art (KUG) and Donau-University in Krems, Austria / well-known composer and electronic musician, co-founder of Klammer-Gründler Duet
5. **Gerhard Heufler** / studied architecture / teaching industrial design at FH Joanneum University of Applied Sciences in Graz, Austria / one of Austria's most prominent and award-winning industrial designers / first Austrian who received an Industrial Designers Society of America's Industrial Design Excellence Award (IDEA) in gold (2005)
6. **Urs Hirschberg** / studied architecture / teaching architecture at Graz University of Technology in Graz, Austria / formerly professor at ETH Zürich – Swiss Federal Institute of Technology and Harvard University, USA
7. **Orhan Kipcak** / studied architecture and film / teaching media and interaction design at FH Joanneum University of Applied Sciences in Graz, Austria / founder and CEO of ADM Atelier of Digital Media, inc., in Graz / formerly lecturer at Vienna University of Applied Art and at Graz University of Technology
8. **Rob van Kranenburg** / studied literature / teaching philosophy and history of design at Utrecht School of Art and Design (HKU) in Utrecht, The Netherlands / formerly teaching at Antwerp Theatre School and Willem de Kooning Academy in Rotterdam, The Netherlands / co-founder of Resonance Design, inc. (with M. Kirsch and A. Munro)
9. **Fiona Raby** / studied architecture / teaching interaction design at the Royal College of Art in London, UK / co-founder of Dunne and Raby, inc., an art and design practice in London, UK
10. **Michael Szyszkowitz** / studied architecture / teaching architecture at Braunschweig University in Braunschweig, Germany / co-founder of Szyszkowitz and Kowalski Architects, inc. (with Karla Kowalski)
11. **John Zimmerman** / studied drama and film / teaching interaction design at Carnegie-Mellon University at Pittsburgh, PA, USA / formerly interaction designer with Philips Design, Inc., in Briarcliff, NY, USA

The guideline document used for the interviews consists of fifteen topics or seventy-five questions that are divided again into several sub-questions each. The fifteen topics were: *(1) general information on the interviewee, (2) preferred education methods, (3) practical-oriented teaching versus theoretical foundations, (4) interdisciplinarity, (5) teaching creative design skills, (6) teaching the design process, (7) design schools, (8) the ideal form of design education, (9) grading and evaluation, (10) access limits to schools, (11) internationalisation and student exchange, (12) future trends and challenges, (13) reception in public, (14) conflicts of interest between aesthetic, usability and economic factors, (15) gender specific aspects of education.*

The number of questions in the guideline is very high and has a considerable amount of overlap. This was done on purpose because we expected every interviewee to give emphasis to a different subset of the questions.

After carrying out the interviews, an extensive content analysis was performed using audio tape recordings of the interviews followed by a full-text transcription and translation. The full text was then

sorted according to the topics and important statements were compared with literature, clustered and this finally led to a graphical representation and discussion of the results.

Results

The results of this study are summarised in a graphic representation shown in the table below. The goal of representing the results of a qualitative study in this visual way was to search for patterns, schools, trends, or similarities between the positions of the interviewees. As the reader can easily verify, we could not identify any patterns in the results of this study. We therefore concluded that there are no commonly held beliefs concerning recognised teaching methods among design educators.

However, we can identify a few statements that are expressed by all participants of the study. These seem to be the unquestionable elements of good design education:

A wide variety of different design education methods are used in parallel. The following paragraph lists the design education methods gathered in the interviews. The number in brackets represents the number of interviewees that mentioned the method. The list items are sorted starting with a high tutor-to-student ratio (one-to-one) and ending with a low one (one-tutor-many-students):

> one-to-one tutoring (3), "scholae", walk and talk (1), individual e-mail threads (1), teacher personality (2), group teaching (1), coaching of teams (1), problem-based learning (1), studio-based teaching (3), workshops, group work (3), practical exercises with feedback (4), project work (2), interdisciplinary projects (2), bidirectional exchange (2), exchange between students (2), "final crits", critique sessions (4), hearings (1), competition or pitch (1), readings and discussion (1), action-production-reflection (1), project hand-over (3), presentation hand-over (1), excursions (1), guest speakers (2), lectures (only as part) (5)

These methods have a certain overlap, e.g. workshops and problem-based learning, hearings and crits. Some methods are elements of others. There is apparently no big influence of "trends" or "schools" in design education. Instead, every design teacher picks his or her favourite methods, modifies some or invents new ones, creating an individual portfolio of methods, modified constantly.

The interviewees typically don't easily decide on a clear statement or disagree on issues that require a decision. As an example, some interviewees state that there are positive aspects of group work, but at the same time see some problems with it as well. The positive aspects of group work include that tasks can be distributed according to skills and interests; group work increases social competence and empathy; it prepares for practical work, builds trust, and reduces the ego of the students. The problems with group work include that a part of the group can hide certain weaknesses or do less work than the others; also evaluation and grading of group work is difficult. Grading of group work is done in various ways: Some educators give the same grade to all students, others give individual grades, and some combine both ways.

When asked about the **theory-practice dichotomy** in education, six interviewees did not see any problem, while three of them see a strong conflict in this issue. Five responded that the emphasis in their teaching is on practical exercises, while five emphasised the theory, but nearly all of the design teachers also gave examples for a balanced way of providing theoretical and practical issues.

In this study three educators perceived **creativity** as very important in design education, three others considered creativity as helpful for a successful student, while another three state that creativity in design is definitely over-rated. The controversial issue of creativity, therefore, shows in a typical way that there is hardly any common understanding among design educators on the central issues of their profession. However, we do not necessarily need to locate a problem here, but we can see this as the main strength of design education, and more than this, as the core competence of design itself: its individualistic nature.

However, there are a few areas where all interviewees gave the same answer: interdisciplinarity, one-to-one tutoring, studio-based teaching, practical exercises with feedback, lectures, and international student exchange.

Interdisciplinarity is seen as an important and central issue in design education, and this was recognised unanimously by all eleven educators in this study. In this context, it has to be noted that only four interviewees are working and teaching in the discipline they originally were trained themselves, seven of them were not. Therefore, it is obviously easy for them to establish links to other disciplines in their lectures or seminars. However, it seems to be a com-

mon belief that to bridge disciplines is a core competence of a designer.

One-to-one tutoring is unanimously considered as an important element of a well-blended method portfolio of design education, as well as **studio-based education, practical exercises with feedback and lectures.**

The last unanimous statement refers to the positive evaluation of **international aspects** in education, i.e. the importance of student and teaching staff exchange and international co-operation. While studying abroad is certainly fruitful for a student of any discipline, it is certainly of the highest importance for a young designer to be able to include a wider perspective in his or her work, especially in the context of today's globalised world.

Conclusion

Certainly, these results do not mark a natural end of our research project, but they do form a collection of statements on which further research activities can be based. Therefore, the results of this interview-based research have been used as an input for two workshops with interaction design educators (Baumann 2004, Purgathofer & Baumann 2003, Baumann et al. 2003, 2007). Further follow-up activities are planned to discuss and compare the results and generate additional insight.

In most of the important issues of design education, there is no consensus among design educators who participated in this study. It appears that design can be taught successfully in a variety of ways and based on a wide variety of methods and beliefs. It looks like individualism or the prominence of the educator's personal style and personality is the single most important common denominator in design education. This is probably the most interesting finding of this study as we have it so far.

As a reviewer of this paper put it, this study is an example of how research into design education can acquire – respectively transfer – knowledge about itself, since this study indicates a lack of recognized teaching methodologies. It can be concluded that this possibly helps to make design education more responsive to market forces than the education in other disciplines, and thereby benefits student career trajectories.

Bryan Lawson states that design problems cannot be comprehensively stated. They are often full of uncertainties both about the objectives and their relative priorities. In fact both objectives and priorities are quite likely to change during the design process as the implications of the solution begin to emerge. Furthermore, design problems require subjective interpretation. (Lawson 1997)

As our study shows design education is very different from education in most other disciplines. Lawson's statements help us to understand that these differences reflect the nature of design as a whole. In this light it is obvious that there is hardly any common understanding among design educators on design didactics and on the central issues of their profession. Hence, we can interpret this as the main strength of design education. In other words, the individualistic nature of design education reflects one of the core competences of a designer and one of the inseparable properties of design.

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Tables and pictures

	1	2	3	4	5	6	7	8	9	10	11
interviewee	DOM	EHN	GRU	GRÜ	HEU	HIR	KIP	KRA	RABY	SZY	ZIM
teaching small groups (seminars)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
teaching large groups (lectures)	(Y)	Y	Y	Y				Y			
activity as thesis supervisor	(Y)	Y	N	N	Y	Y	Y		N	Y	Y
preferred teaching methods											
preferred group size											
1 (individual)	1				1				1		
2 to 3					1	1	1				1
3 to 4			1								
4 to 5								1			
4 to 8		1									
20 to 50		1				1				1	
other				1						1	
group work											
positive aspects of group work		Y	Y		Y	Y	Y			Y	Y
problems with group work		Y	Y	Y	Y	Y	Y			Y	Y
preconditions for successful group work	Y	Y						Y			
grading of group work											
individual grading		Y				Y		Y			Y
mixture of individual and group grading		Y	Y					Y			
all group members get the same grade	Y		Y	Y	Y		Y				
teaching by "gurus"											
individual examples for own work	2	1	6	1	1	3		2	1		2
institutions, countries						1	1			2	
use of gurus' work in teaching	Y		N	N	P	P	P	P	Y	Y	N
conflict between theory and practice											
there is no conflict	Y		Y	Y	Y		Y		Y		
there is a strong conflict		Y				Y		Y			
theory and practice in education											
emphasis on practical exercise			Y		Y		Y		Y	Y	
balanced	Y	Y		Y	Y	Y	Y	Y			Y
emphasis on theory				Y		Y		Y		Y	Y
relationship teaching and own practice											
has private practice	Y	N	N	N	Y	N	Y	Y	Y	Y	N
combine teaching and own practice	Y	N	N	N	Y	N	Y	Y	(Y)	Y	N
present examples of own work in seminar			N	P	P	P	N	Y		Y	P
combined relationship teaching-practice	Y	N	N	PN	PY	PN	PY	Y	PY	Y	PN
interdisciplinarity											
works in original discipline	Y	N	Y	N	N	Y	N	N	N	Y	N
interdisciplinarity in design education	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
creativity											
creativity is very important			Y		Y					Y	
creativity is helpful						Y	Y				Y
creativity is over-rated				Y					Y		

	1	2	3	4	5	6	7	8	9	10	11
interviewee	DOM	EHN	GRU	GRÜ	HEU	HIR	KIP	KRA	RABY	SZY	ZIM
where is it better to learn design											
at a school			Y				Y				
both in part				Y	Y						
at practical work											
design process											
do you have a specific process model	Y	P	Y	N	Y	N	Y		Y	Y	N
teaching evaluation or test methods	N		N	P	Y	P	N		Y	P	
design movements, influences											
individual examples for own work		5	Y	3	1	5	3	1			
institutions, countries, groups		1			1	1	1	1		1	
design movement reflected in teaching	P		N	N	N	N	N			Y	Y
ideal kind of design school											
scholae								Y			
post-grad., atelier, studio, academy, master class	Y	Y			Y		Y		Y		Y
university			Y	Y		Y				Y	
comparison with own education											
is design education better now than before	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
students are more critical now, can express th.			Y	Y							
students are more instrumental, pragmatic now							Y	Y			
small groups better than mass university		Y			Y						
grading											
steps on grading scale			6				5	9	3	13	5
final crit (critique session) with external experts	Y	Y	Y		Y	Y	Y		Y	Y	
does it make sense to grade design skills		Y	Y	N	Y	Y	Y	Y	Y	Y	Y
thesis evaluation			P		P	P	P				P
grading as a jury member					P	P	P				P
criteria for grading		P	P		P	P	P			P	
participation, motivation, form, presentation			N	Y	Y	Y	Y			P	Y
is objective evaluation of design possible			P	P	P	N	N				
is obj. eval. of earlier works of art possible			N	P	Y	N	Y				
mutual evaluation by students		Y	Y	P	Y	Y	Y			Y	N
access limits to seminars or school											
are there access limits to your seminars or school	P	Y	N	Y	Y	P	Y	P	Y	Y	Y
what are the effects of access limits	P	Y	N	P	Y	P	P			P	P
student exchange											
how valuable is student exchange	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
optimum one semester or more in middle of study			Y	Y	Y	Y	Y			Y	Y
future trends and challenges											
traditional job disappears, technology dominates	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y
adaptive, flexible, dissociate design and tech skills			Y		Y	Y	Y		Y	Y	Y
aspects of public, economy and gender											
influence of public reception of design in teaching	N		Y	Y	Y	Y	Y			Y	P
conflict aesthetics – usability of a product	P		P	P	P	P	P			P	P
conflict aesthetics – economic aspects			P		P		P			P	P
relevance of regional aspects for design			N	Y	P		N			Y	Y

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Ian Damerell

New divisions (mind your language)

Multimodality in visual education

Abstract

In a society of multiplicity, the act of representing and communicating meaning will evolve to include new modes of signification. Meaning production, situated within a textual/semiotic framework, will address and cross traditional course boundaries of monomodality. This form of communication, multimodality, is, as yet, partially undefined. Multimodality requires a semiotic approach as it overrides traditional media territories.

The digital revolution brought about multiple-digital imagery that, coupled to music, speech and written texts and with the speed of its interaction, saturates communicative strata with a new complexity. These paradigmatic changes (already in progress) will probably bring about the dominance of image over writing and the screen over the book. "*The world told is a different world from the world shown*[1]." The narration of the world is replaced by its display.

Writing subjugates us to 'reading paths' where the sequence of information (in time) orients us towards causality. Imagery acts differently, rarely compelling us to follow distinct paths. We 'perceive' a visual composition, rhythm or path where meanings traverse a screen, presented for our semiotic involvement.

Developments within transduction[2] destabilise modes of understanding that have been traditionally dominant. It is no longer possible to envisage art and design education without the concept of multimodality.

Introduction

The complexity of contemporary urban culture and the development of digitalisation necessitate multimodality as boundaries are continually negotiated and transgressed.

While traditional monomodal course divisions are generally defined by materials or techniques; conceptual approaches that transcend material limitations define multimodal divisions. They incorporate meaning embedded in strata of communicative forms rather than in specific materials or skills.

Art and design education, that embraces a wider field of disciplines, recognises the society of the multiple and requires multimodal articulation. It requires re-evaluation and 'de-structuring' of course set-ups anticipating interaction between disciplines.

New course divisions need 'shadowy contours' or unclear limits that emphasise open systems that are under continual reappraisal, as preferences, questions and revisions from students and staff, take effect. The availability of tutors and a favourable administration are crucial to such an education.

Multimodal divisions

The possibilities and processes available to students addressing multimodal projects will bring about negotiations with not just materials and techniques but with new concepts and disciplinary limitations. Problem solving will anticipate new constellations of materials or social functions.

Examples from history include dance, industry, design, art and politics that interacted during the Russian Avant-Garde period, the Futurists' multimodal situations involving performances and combined architecture, and art and architecture in De Stijl. Present-day multiplicity requires limitless interventions with other discourses that could involve medical-personnel, the unemployed, environmentalists, engineers and undersea divers.

Multiplicity and the concept of non-hierarchical difference, is pivotal to this education. It does not presuppose, but allows us to confront new constellations with less prejudice.

Stratification

Technological transformations, such as the miniaturization and commercialisation of machines, have considerable impact on knowledge. They are changing the way in which learning is acquired, classified, made available and exploited. When students work multimodally across discourses, they contend with numerous materials and techniques. General semiotic readings are necessary when evaluating. It demands constant reviewing of approach-relevancy to the issues raised, and an overview of possible alternative media which could be used.

Multimodal communication divides into 'stratifications'[3] of communication. Stratification was, initially, the distinction between content and expression, while signification focused on signifier and signified. The invention of writing extended stratification into discourse and design. For instance, there is a difference between writing a novel and the minutes from a court case. Modern communication technologies further stratified the expression stratum into production and distribution.

There appears to be a linear development from discourse, through design and on to production and distribution. That is how we have been taught to think. Design ideas can, for instance, be produced using principles of semiosis typical for production. One of these is provenance[4] where signs are imported from another context, in order to signify the values associated with it in its new context. Provenance works through insinuation of the imported values, for instance, in naming a lecture theatre *Apollo* there is an attempt to imbue a sense of abstract thinking – an intellectual climate (ignoring the Dionysian). Material signifiers have an experiential meaning potential[5] that derives from our actions when we articulate them. Doctors often speak with quiet certainty in order to make us believe that they are in control of the situation.

Negotiating boundaries

Digitalisation indicates a profound change, not only to writing but to thinking. We may be witnessing a rupture in our reasoning with consequences for how we look upon life. Gunther Kress maintains that written language will become sidelined by digital technology's far-reaching use of imagery. Communication once written, will, in future, be on screens. This is debateable. The book in your hand, as a seductive and physical experience is still rewarding.

Specialised tasks have ceased to be under the sole ownership of separate individuals; one person can, through digital technology, complete a series of tasks that would previously have required a number of people. For instance, novelists thought little of fonts or visual imagery yet now they are involved in widening the field of their discipline. There will be a need to be trans-boundary orientated; a language that speaks for a multitude of tasks.

Multimodality is situated in the transgressions of boundaries and in the combination of semiotic modes. Kress and Leeuwen advocate a move away from what they term "*strictly bounded and framed specialist tasks*." This move away from the industrial age's division of labour is heralded because computers have revolutionised specialisation by allowing a handful or even one actor to perform whole operations. Digitalisation gives individuals the capability of functioning within a series of skills once seen as separate. Earlier this would have required a number of experts to complete. Other authors, once solely responsible for results, are now only partially responsible. Munch's woodprints may be seen as his production alone, yet the printer may have made vital decisions that affected the result.

Challenging traditional limits, the movement of boundaries re-groups activities by 'de-skilling' and 'multi-skilling'. As demarcation lines are crossed, skills are either bundled together (multi-skilling) so that the same person has a multitude of skills or dispersed among 'actors' (an actor looses skills or privileges). Once photography was the domain of the photographer, film the domain of the film-maker and painting the domain of the painter.

School teachers were once seen, in conjunction with nurses, priests and artists, as being 'born to the profession' or having a vocation. This is a response to a discipline or script that is predefined and in little need of the changes that design brings. Monomodality gave rise to hierarchies. The design of a printed image required numerous experts to complete the task. In the hierarchical division between tutors and technicians in British art colleges, technicians dealt with production and tutors design.

The 'design' of a lecture usually constitutes choosing images and writing short texts. The choice of introductory sentences and the tone and volume of the voice are design elements that may not have been anticipated. Consequently, they are not seen as lecture design.

Discourse

There is little difference between the terms 'genre' and discourse'. Genre usually refers to a set of criteria, such as sport that can be subdivided into subgenres such as football and soccer. Discourses are semiotic terms for linguistic units of some content (i.e. composed of a number of sentences), for instance; debates, formal speeches or friendly conversations.

Discourse is socially constructed knowledge[6] i.e. developed in specific social contexts. The concept of a discourse makes statements or truths valid *within* a discourse that may not be so outside it or in another discourse. For instance, the discourse of the nude will vary according to the actors involved. The term 'the nude' is itself already within the discourse of traditional art education. Artists refer to naked bodies as 'nude' because it gives the situation a neutrality which is necessary for serious study.

Design

Design is an organisation of content that is to be communicated; an articulation of concepts created within a discourse. It prepares for production. Kress and Van Leeuwen place design midway between content and expression because they claim it to be the conceptual side of expression and the expressive side of conception. That locates design in their strata of communication and signification.

Designs are the materialisation of ideas; transferring concepts from the mind onto say, paper or to a screen. They appear as a form for ideas and, in this way, they change ideas. There will always be a gap between the idea imagined and the idea designed or given physical shape. Once the idea materialises in its physicality, it feeds back information and guides further ideas. Already in this initial state of communication where only two strata are used we experience interaction. Designing is an opening of possibilities by feeding back information to the discourse. It is not surprising that many can remain at this process stage, oscillating between design and idea. By giving the discourse itself location, or more loosely, form, design becomes the pivotal axis upon which the process itself balances.

Design is the expression of ideas. Since ideas are characterised by discourse conventions then designs can embody the 'spirit' of the discourse. That is why I stress the need for an open-ended art education (discourse) rather than a 'total' system. The more open to possibilities the discourse is, then the more surprising design can be.

A reader of a book can be unaware of the effect of the text design upon the production of meaning. The design of text and image manipulates our approach to information. Documentary television, informing us of the miner's strike in Britain, manipulated us by interviewing the strike leader Arthur Scargill in a street crowd, and the director of the mine seated in his office. This decisive difference did not interfere with the actual spoken words recorded.

Production

Multimedia production is a direct response to the multiplicity of society. It favours the multi-skilling that digitalisation makes possible and spawns highly complex practices where processes are constantly re-evaluated and reassessed. This is a sophisticated approach to communication, seeing the process as integrated practice rather than an aggregation of independent semiotic modes and involving decisions that consider contextualisation. Organisation is important. Compact disc production is divided into the production of the disc and of the music when played or produced (or is that distribution?).

Design, (expression of concepts) is prominent in art production. When the conceptual artist Lawrence Weiner designs the artwork (a text) and then sells it to an art museum, the museum is responsible for producing his art. Having given instructions on text spacing, colours, fonts etc. Weiner accepts artistic responsibility only when he has approved the museum's production; it is the role of architect/designer.

Distribution

Distribution conjures up images of transport, such as vans or trailers, distributing goods to stores and appears, erroneously, to have no semiotic value.

A music composer, for instance, will hope that the distributors will capture the original mood and aim of the work. Yet, the performer (a conductor) may interpret it in a ground-breaking form that pleases the composer. Jimi Hendrix's version of Bob Dylan's *All Along the Watchtower* was so successful that Dylan remade it in Hendrix's style. When faithful rendition is termed distribution (neutral interpretation), expressive creative readings approach production. Printers make sure that the prints of a designer's colours are as chromatically correct to the original as possible. Sound engineers may advise musicians that certain adjustments are necessary for the ultimate musical appreciation

in a specialised setting. Gradually distributors will become producers.

Multiplicity

Contemporary culture's complexity and multiplicity requires college curricula to emphasise multiplicity and difference and to aspire towards it. There is a need to step *outside* of the discipline's immediate arena, its traditional methodologies and strategies, by contesting (deconstructing) central areas such as validity, contextual compatibility and ethical confrontations. When students look at their role in a process they attempt to see it critically, not within the confines of a narrow discipline but outside of it. The discipline itself may be changing and its location or its boundaries may be moving.

Examples of multimodality

Paul Jeff's Performative Photography

In 'performative photography'[7] the photograph does not simulate the 'perfect' painting but is a recording of memory (a deconstruction). By setting up events through a mutually agreed basic framework it is possible to open oneself to the fluctuations of the event (variables). I include the artist Paul Jeff here because he represents an alternative art discipline. What is problematic is that the idea of art as a corrective and as a voice of dissent has diminished considerably. Here too lies the problem of postmodern distance and the consumerist quest of ambition that forces compromise. In his performative photography, through moves based on theoretical interventions and Deluzian concepts of fold and duration, Paul Jeff[8] has created an art/photography form that documents the performative moment. In my mind it is an extension of a more serious and committed art that postmodern irony dismissed. There are photographic links with Nan Goldin and Allan Sekula, who both document 'real' people. He states:

> *"Made as a response to the continuing abduction and murder of young women in N.Mexico 'I watched Her Until She Disappeared' is a work of political art/theatre, which draws a moving performance of resistance by one Mexican woman from the durational act of having an identical portrait taken every hour; day and night for a week - whilst incarcerated in a prison cell with a white male photographer. Doubly trapped, first in the pose and then in the cell, the woman is the object of 168 (24/7) ostensibly identical portraits."*

A suggested project design for a multi-model and e-learning oriented approach to reflective practice in the "training post" at the Faculty of Nursing, Oslo University College

In conjunction with the concept of multimodality and of art and design in a wider context my students and I will contribute to a project designed to illuminate and aid nursing student training. This will be in association with the Norwegian publishing house Akribe (http://www.akribe.no/) as a core component to improve learning at the Faculty of Nursing, Oslo University College. The following is a brief sketch:

We suggest a project with the aim of improving student work by multi-modal means on several levels with a new constellation of agents, technologies and didactic approaches. In particular, we want to explore the teaching and learning benefits of an explicit process of intertextuality between textbook material and photographic images of student contributions in order to strengthen students' reflexivity-in-context. The recruiting and inclusion of students of photography will create an interaction that combines assignments. Elements that will be addressed are knowledge construction, impartment, digital photography (as technique) and aesthetics.

Conclusion

Multimodal education addresses a world that appears disconnected and even dysfunctional, since multiplicity still appears unfamiliar. Restructuring colleges to admit multimodal processes is not amalgamating specialised media but acting *outside* specific media and having a range of media available. Previously specialists interacted with others but remained within the confines of one material or skill. Multimodality requires a far-reaching skill combination. The difference is in the distribution of tasks; one person's speciality will be shared by others, and one person can deal with multiple tasks, once divided between numerous workers.

Yve-Alain Bois defines what made me write this when he states: *"…we've been united in our desire to reshuffle the cards, not only to revisit canonical moments of modernism and "postmodernism", but also to retrieve from oblivion many aspects of the cultural production… that had been ignored or deliberately repressed."*[9] Theory, correctly approached as possibilities not unquestionable facts, prevents repetition and presents opportunities to judge. Rather than a replacement of one system by another, as 'reshuffling' seems to indicate, it is an 'unfolding' of possibilities. Systems easily fall back into convention.

KEYWORDS
multimodality, multiplicity, communication, open Curriculum, stratification, signification, difference, unfolding, transgression, design

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6. From Kress & Van Leeuwen
7. This term was coined by Paul Jeff, head of Masters at The Swansea Institute, South Wales.
8. http://www.morebeautifulthangod.com
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Martti Raevaara
and Jan Kenneth Weckman

Interlinking studio and VLE

New ways for international collaboration in art and design education

Abstract

The School of Art Education at the University of Art and Design in Helsinki has carried out over several years a master degree e-learning programme Virt@ for art teachers. The Virt@, based on the use of the net, has been a great opportunity to explore and to develop innovative design for e-learning and e-pedagogy in art and design higher education (HE). In addition the Virt@ has also generated a number of interesting e-learning projects, which are based on blended learning, interlinking studio and the net, and an international co-operation of teachers, experts and students between different programmes and institutions. One of the most challenging is the EU funded Interface project (2005-2007), focusing on the development of international e-learning modules and courses of fine art and visual communication design. Courses and modules are organized simultaneously for the students in three of the partner sites.

This paper shares viewpoints and results of the Virt@ programme and the Interface project. As a case study we introduce the course Stories and Places from this project. It shows an alternative view to collaborative education and blended learning distributed between European schools demanding a tight adherence to the transferability of knowledge and learning outcomes in identical or near-identical degree programmes. The issue of transfer can be articulated on three levels, e.g.: physical transferability/non-transferability, secondly as a question of transferring educational knowledge and skills of different art and design programs, and thirdly as a challenge to transfer and share an inspiring and effective learning process and space in collaboration at distance. A shared thematic base enables the participants to collaborate on specific professional areas in new ways. This paper discusses aspects of using a thematic collaboration as starting point for remediation and the building of art and design knowledge, with the help of the net as a tool for international co-operation in art and design HE.

In this paper we use "the net" concept to illustrate the elements, which are the basis of e-learning and e-pedagogy. The net can encompass the use of the Internet, virtual learning environments (VLE), information and communication technology (ICT) tools and any matrix or platform to integrate different kind of contents and activities. The last one implements the idea of ubicomp, which turns our whole world into a computer interface (1). It is also important to notice that the net interlinks both technology and social aspects and emphasizes the interaction of these viewpoints.

Introduction

The Virt@ is an e-learning based master degree programme for art teachers. The first programme was implemented during the period 2001–2004 and we are now already starting the third one, which will be carried out during the years 2007–2010. The programme is funded by the Ministry of Education.

Most of the students are working in the fine arts, but there are also designers, art and craft artists, media artists and so on, as well as teachers and museum lecturers. The students are able to simultaneously study on the M.A. programme because the programme is mostly organized in the form of web-based studies. The students live dispersed throughout Finland and will complete the degree of Master of Arts in 3 years. Already over hundred students have participated in the programme.

The aims of the Virt@ are to explore, develop and promote innovative practices and methods for e-learning and e-pedagogy in art and design education. These aims focus on interlinking studio and contact teaching with the working process on the net,

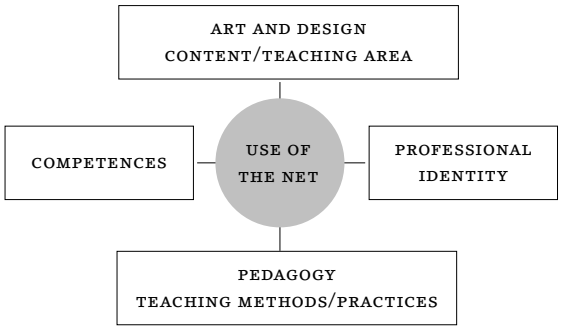
and the process of building a professional identity when using the net in art and design HE.

The use of e-learning has also opened up new and interesting options for international co-operation between teachers, experts and students. The Interface project (2005–2007) focuses on the development of international modules and courses of fine art and visual communication design, which are organized simultaneously in three of the partner sites. The partners are Dublin Institute of Technology, University of Art and Design in Helsinki, Art Academy of Latvia Riga and Middlesex University, which will evaluate the process and outcomes. The project is funded by the EU Socrates programme.

Significance of the net in professional education

An art and design higher education programme can be divided into four elements: content (teaching area), pedagogy (teaching methods/practices), competences and professional identity process. These construct a matrix of two crossing lines of content – pedagogy and identity – competences.

One of the key objectives of professional degree programmes is to build and strengthen the professional identity of students so that they can become members of the professional community. The teaching contents and methods of art and design degree programmes are based on the tradition, the know-how, the research knowledge and the future visions of the profession. An educational programme provides the assistance the student needs to learn and acquire the (presumed) competences needed in the future.



In order to contextualise the topic, we will now discuss the challenges posed by the use of the net because of the problem of the relationships shown in the diagram between content, pedagogy, professional identity and competence. The use of the net has an increasing significance for people's everyday life and society and the outlook for art and design education is strongly linked to this fact. Its importance is difficult to ignore or overestimate. The use and critical study of the net are important elements of the professional competence and the identity process and play a central role in the content and pedagogy of art and design disciplines.

Ideas and results of the Virt@

The first step towards e-pedagogy is very demanding for many teachers, because it challenges the teacher to rethink and revaluate his teaching practices, course contents and working methods. He will have to endure the lack of self-confidence and the possibility of failure. On the other hand this instability may open new ways of thinking and lead to alternative and unexpected solutions. (To get know about student's aspects, see reference (3))

The production of the net course demands teamwork with other professionals – producer, technical supporter, tutor etc. It takes time to learn the same language and to discuss and negotiate the working methods and timetables. Teamwork and use of the net make the planning and teaching process more open and public. The planning process is a significant part of the teacher's work and the concept of teaching has to be redefined.

The net can be used in several excellent ways in art and design education. The production of a course should be a project of experiments and it is important to provide the foundation for encouraging, supporting open-minded teamwork. Inspiring examples are valuable and even small steps can lead up to an innovative solution of great value.

Teachers are not made to use any particular method of e-pedagogy. The new learning environment is made by interlinking digital tools and real spaces, studios, workshops and classrooms as well as students' working spaces at home. In practice, this means a variety of teaching methods. Frequently the course is built by combining different kinds of elements: web sites, VLE, blog, email, skype, video meeting, database, link lists etc. The aim of this "lego tool method" is to keep the teacher and his course content as a starting point and to find, combine and apply any ICT tool which fits the purpose as well as possible. We don't believe in "the mega VLE" which fits everyone and is all-embracing for all purposes and needs, and where all the elements are synchronized.

The aim of producing a course is not merely to produce learning objects but to make a creative process out of teaching and learning what can then happen. The basis is the teacher's possession of teaching and pedagogical expertise. We do not buy teaching materials or learning objects but good learning processes. In general, the aim is to keep the teaching/learning process and course materials as open as possible and test the boundaries of the teaching/learning community. In practice, open access to Virt@ courses is very limited. It is not so easy to open the door of your classroom and let your methods of teaching and studying be available for public dialog, use and assessment.

The concept of a learning object is also used in the context of pedagogical delivery. E-learning is seen as a delivery of digital course contents and the digital control of studying outcomes. That's why the administration, and particularly budget managers are so fond of e-things. In "delivery pedagogy" teachers and teaching can be replaced with course sites and material folders. These inspire students to study and generate an effective learning process and results in outcomes that are easily controlled and assessed by a "teacher computer". This is a very curious and limited idea of learning and education; besides which the book and the library already exist.

A case: *Stories and places*, a course module autumn 2006

The Dublin Institute of Technology, Art Academy of Latvia, Riga, and the University of Art and Design, Helsinki have launched a course module in which studio practice and net sessions alternate. Around 30 students from different programs: art education, design and communication and fine art collaborate with each other regardless of their specific learning outcomes in relation to their* own BA or MA level study program. Each participating school has allocated a number of tutors to work with their students, regardless of group affiliation in relation to VLE work. The tutoring focuses on both the specific learning outcomes for each study program, especially when Stories and Places were included within the obligatory course modules as an alternative way of working. UIAH students were enrolled through voluntary application.

Students were tutored to work on- and with the following:

1. A self-presentation to introduce oneself to other students
2. A visual essay in relation to a journey in the city
3. The result of the initial tasks, self-presentation and visual essay were published on a blog-site reserved for a group of students
4. Six web-blogs were established for a crossover group with members from all three schools, each group consisting of 6-8 students.
5. A main web-blog was established for tutoring information, see: http://interface2.uiah.fi/2006/
6. The visual essays were commented on by students and tutors in the blogs
7. The visual essays formed a basis for the next task, in which students of other groups designed fictional "souvenirs" based on the visual essays given to them. The students could self-organize their task within the group or divide the workload.
8. Finally, visual essays and souvenirs were requested to form the basis for three alternative remediations: an art/design concept, a graphic presentation, an installation. Each of these alternatives was processed for a virtual presentation but could also result in a studio outcome not open to be experienced by all participants, but only partially documented.

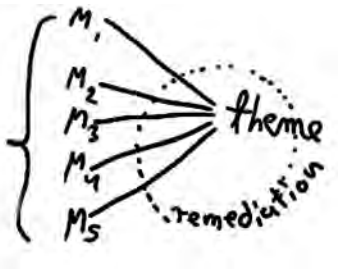
All three main phases, including, in principle, one studio session of variable length and a VLE collaboration were linked to each other not through common, identical or near-identical learning outcomes, but by thematic, conceptual (and graphic) collaboration. Students freely used the material created and given by other students, paraphrasing a given starting point by thematic, formal or media- oriented remediation. The impossibility of physical collaboration over distance revealed the conceptual and narrative options at hand. This distinction in transferable and nontransferable objects could be said to indicate to various degrees those key skills common to a number of different but still connected areas, e.g. visual culture.

Conclusions

As digital technology is a growing part of any art/design milieu, *Stories and Places* positions this contemporary development in its core, termed, and correctly we believe, as a field of remediation. Subsequently, remediation was subjected to different degrees of complexity and challenge depending on the study program and the studio sessions. The

object of art and design education becomes a nexus of things. Some parts of this nexus are less visible to other participants than the VLE material. The task of transfer of knowledge is solved by a diversity of solutions. In one of the participating schools the same thematic starting point was simultaneously given as a studio task to another group of students without the VLE platform in order to make a comparison with those students using the blog. This fact was not interpreted as a loss, but a result of the evident diversity of learning outcomes reflecting different study programs. Different materials and results in the VLE were produced: text, image, video, sound as well as different studio outcomes, which were based on the assignment criteria of each school in relation to their respective student groups and study programs.

The following diagram displays the learning outcomes in relation to three immanent aspects of any art/design work or process: media, form, themes. (The topics (phenomenal and aesthetics) of *form*, or visual quality, are not, however, discussed in this paper)



Learning outcomes differentiation according to specific media

Thematic collaboration is proposed as an effective starting point and focus for collaboration between students, but not between programs, which preserve their local and specific context legitimately assessed within each institution. It may also become an institutional step towards future collaborations between programs where learning outcomes can be identified in their details for shared and international HE program development.

One further conclusion from the Virt@ and *Stories and Places* course experiences is that contact teaching or face to face meetings are very important when working on the net in order to support students and to empower and deepen learning. The use of the net allows an expansion of tools and methods to reshape educational settings. However the pedagogical questions concerning learning, such as how to support creativity, artistic process or visual knowledge building, still exist.

Furthermore, it is evident that the use of the net, even when integrated into studio and contact teaching; emphasizes new, alternative methods of learning and teaching. This is because the net becomes a tool which can link both the educational environment to the matrix, and the technology with social aspects. The status of e-learning and e-pedagogy in art and design HE should be discussed from the viewpoint of professional competences and the identity process. This will then enable us to identify further important themes for discussion, such as a sense of community and social interaction. Thematic collaboration makes student involvement visible. It facilitates both tuition and and observation of the student's learning process so that they can be helped in sustaining their commitment whilst also supporting collaborative learning and visual knowledge building. Furthermore, by exploring the use of visual communication and artistic work in more detail, previously closed objectives and learning outcomes of art and design education can be analyzed through their different possible remediations by thematic collaboration. Consequently, interdisciplinary communication will enable us to find new ways of making our university or educational institution, our professional community visible, vivid and attractive. In relation to the question of knowledge transfer, thematic collaboration both stresses and enlightens the global character of communication and its virtual and narrative nature.

At its best, the shared planning and production of e-learning modules or courses may be an effective tool to reform the working culture and leadership of an educational institution; from individual work to collaboration and to inspiring knowledge sharing and building. It will also open new creative ways for cooperation and collaborative modes of action in teaching and research, notably in the international context. This concept of a working community resembles the flexible network of professionals in their teamwork.

Communication and working across borders between schools, countries and languages, however, is as demanding as before. The ideology of digital technology celebrates immateriality, immediacy and immersive images but these aims must be encountered through media, old and new, over both geographical and cultural distances. What may well be an alternative way of bridging and bringing distant programs together is, to overcome the restrictions of identical learning outcomes. Another option is to open cross-

disciplinary collaboration initially via thematic and conceptual collaboration, which is capable of being transferred in graphic interfaces at the current level of digital technology and over different programs/ learning outcomes.

It is obvious that the implementation of the net in education is more complex and slower than expected. This point is not concerned with a vast amount of equipment or high capacity computers or proper software. The biggest challenge is to change teaching routines and to rethink pedagogical courses of action. It is also obvious that the pedagogical use of the net does not fit well into the existing teaching culture and education system. Teachers' work is still often seen as contact lectures and summative assessment of learning outcomes.

The use of the net in art and design education also emphasizes changes to curricula and pedagogy. Students need to develop new competencies, which are not implemented within the traditional curricula and educational strategies. An interesting question is how social interaction functions in an information society. If it is still based on story telling and stories, as we believe, we need media, design and communication to create models of drama, elements which also focus on developing and renewing art and design education. At the same time the role of technology has changed the way art and design is created and distributed. It has also blurred the line between art, social studies and science and enhanced the value of culture and creativity. At this stage art and design can provide new insights and new tools for creativity into e-learning.

You may ask, if there is something teachers could learn from their students. In general this question is connected to the idea of social media (social web, web 2.0). Students, if they have been motivated to do it, are often more experienced in their use of many of the communication tools and knowledge sharing methods, for example: text message, chat, blog, skype, wiki or mobile camera etc.

The transfer of knowledge and learning processes and outcomes challenge us to rely on a hybrid learning environment enhanced by a variety of media linked together with the most fundamental traits of communication: a concept and the story. The different elements create a meeting place, an agora for discussion and inspiration rather than a linear chain of data. The use of the net enables us to understand knowledge building and transfer as a process of dialog, reflection, interpretation and questioning, and not as a system of pipelines for the automated transport of goods or learning objects from one place to another.

KEYWORDS

art and design education, blended learning, remediation and transfer of art and design knowledge, international co-operation, learning outcomes (2).

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Robert Barelkowski

Unique spaces: interdisciplinary contributions in architectural design process

Involving the fields of art and design, social sciences and economy in mixed-use developments

Abstract:
One of the key motives of architecture is to deliver liveable space: multi-valued spaces for mixed-use, which can either, improve the built environment, make it more attractive, inspire proper social activities, and last but not least, stand the test of time. This complex task may be performed successfully only when an interdisciplinary team is involved which includes specialists from various disciplines – mainly art and design, architecture, social sciences, and economics. This paper focuses not on the already known and established problem of space-making and shaping the marketing principles of mixed-use developments. The aim here is to propose a structural scheme for a multidisciplinary design process which will provide a timely and economically legitimate solution for an environment that may become a habitat which can support social ties and a local identity while remaining adaptable for implementing necessary changes due to technological or social transformations. This structural scheme requires a meta-design model as a vehicle.

The four disciplines already mentioned interweave in the proposed methodology. The paper provides theoretical assumptions for the thesis as well as an explanation for the interrelations between the participants. It discusses the platform for the exchange of information and the transfer of knowledge between the parties. The concept of the "identity" which is created by the artists, graphic designers and assisted by the architects is evaluated by the experts in economics and social sciences who provide consultation as an integrated team. Then the structure of the work itself extends to new activities including working with targeted clients, composed of the social (mixed) structure (to avoid over representation of specific social groups), and economic analysts among others. The result is planned to establish a space that is rich not only in terms of the program or quality of architecture, but also by allowing people to understand their own environment, bringing them together, and providing multi-valued space based on principles of architecture with an underlying methodology. The article introduces the level of integration, the indivisibility which is expected to solve properly and profoundly complex design tasks.

1. Introduction

One of the important problems of contemporary architecture is the ambivalence of current tendencies concerning the issue of how our built environment is created, interpreted and evaluated. On the one hand we face the problem of globalization, the unification of various processes which occur despite attempts to implement the concept of mass customization, homogenization of previously distinct spaces of cities or landscape. On the other hand there is the proliferation of diverse technologies and the efforts to make them available worldwide which have led to the emergence of analogous urban structures that often disregard the cultural context which is so important in creating architectural identity. Meanwhile, the process of rejection of the cultural and contextual aspects of design, so common in contemporary design methodologies, results in losing the concept of time and its influence on how space should be appropriately created. Furthermore, this process of rejection also ignores the link between time and identity as well as people's expectation to be able to identify themselves in space as

one of the most important concepts in architectural creations.

The uniqueness of an architectural object is defined by multiple relations and conditions. These include the architectural object's external reference which is its contribution to the relationships between itself and its surroundings; an internal reference which is the coherence and the variability of its internal spaces; and then there is the dialogue between the interior and the exterior of an architectural object. Then there are the varied levels of interaction between people and the object and the relevance to the cultural context. The architectural object's uniqueness is the total sum of all these interwoven relationships. Simultaneously, there is also the problem of how the object responds to its environment, what kind of social reactions, validation and behaviour does it generate. Consequently, projects of this complexity require a mixture of research methods[1].

In order to design a unique space or unique architectural object, it is necessary to control this complex process in which multiple factors play important roles and significantly influence the outcome. It is worth explaining, that the problem we are examining now is different from the typical developer-customer-investment relationship, which is well known and whereby the design process is determined by the economics and production and is completely subordinate to the developer's requirements[2]. Our current interest lies in the "production" of uniqueness by generating timeless architectural values and the attributes of architectural space which will maintain attractiveness, and support the cultural activity, vitality and appreciation of its users.

The examination of such places indicates that growth, of an almost evolutionary character is the most common way to acquire the expected features. Peters quotes Brock stating that "*urbanity is not the quality of cities, but rather of their inhabitants*", then she cites five qualities that urban space requires to become unique and habitable – one of these qualities is time[3]. This growth in time allows for an harmonious creation of a culturally rich, multi-layered and multi-valued environment that people tend to identify and judge as unique. But we experience many examples of short-term, large-scale developments which contribute to urbanized spaces for a period of a few years. I would argue that to achieve a similar or close "richness" of space that a more complex and interdisciplinary approach to design should be established – herein Meta-Design is the proposed methodology to support the process of the creation for unique urban spaces.

The research was focused on a model that could reflect the complexity of the architectural environment which involved the issues of culture, art, social perception and the evaluation of space, and also acknowledges the behavioral constraints of design and – to be appropriately rooted in reality – verify these issues through the filter of economic analyses. It demands results from mixing the world of imagination and sources of inspiration with the world of a rational, systematic problem-solving attitude. Robinson, the protagonist of interdisciplinary applications in many fields, rightly says that, although seemingly contradictory, these worlds of myth and of science can coexist and support each other[4].

The methodological structure of Meta-Design was used to help in creating the uniqueness of the space through efficiency, liability and applicability – all important research issues[5]. The case studies are diagnosed to determine how the design process contributed to the emergence of the uniqueness of architectural space and of the values embodied in the urban space. Then, the architectural design process is observed and described with its most significant contents. It has a non-linear structure and reflecting this character the new methodology of Meta-Design extends the presumptions and the references to architectural values, like those pointed out by Crowhurst Lennard and Lennard[6] or Bohl[7]. The meta-structure allows for planning of design activities and gives control over the whole process from the first idea to the period of occupancy[8]. The model of meta-design has still to prove its usefullness following its implementation in reality, because only in this way can the method be exposed to the process of falsification.

2. Case studies

Four cases have been selected to be briefly presented below from numerous analyzed examples – Xin Tian Di Area in Shanghai was the subject for a revitalization process including commercialization; Stary Browar in Poznan, required a new cultural and commercial center with an old refurbished brewery complex; Bayt El Suhaymi in Cairo was to be renovated and extended by significantly adding to the area of historical housing; and finally Paternoster Square for mixed-use in London. All four projects required different programs and distinct approaches to the commercial aspects for their development, and all pos-

sessed diverse cultural backgrounds, yet they were designed to shape significant and vivid public spaces.

It can be determined whether the architectural goals were acquired from many sources of information: public reception and acclaim, interviews and/or inquiries, opinions by professional critics and the evaluation of researchers. When we analyse the comparative analytical results, mostly to define the prognosis for the tenants' acquisition and determine the budget, we may find some common symptoms which limit the ability to create unique spaces, for example: when the interdisciplinary character of the design process has been strictly limited. All four areas in the case studies are successful, but the way their images were produced resulted in a partially random emergence of values and public opinions about the areas. However, all cases indicate a great role of cooperation between the professions in achieving goals properly and the best results are visible where various specialists played an active role in the process of development.

Where is there a real potential and real value for architectural space? Is it in the creation of unique spaces? This discourse on values is necessary to determine those attributes of architectural space which allow us to identify the goal of uniqueness and thereby arrive at an identity. There is the popular word, it is– "context," that describes this complex relationship and identifies the source of interest or rejection, architectural attractiveness or an abandoned, omitted space. A set of four principal properties of context which displays independence from time-related factors, and which includes: uniqueness, quality, multivalue and the induction of emotion in people who use space[9]; may often affect, change, or pervert our contemporary concepts of what is valuable and what is not. But even if we assume that these features of context are accomplished in every case we studied; we are clearly observing a vast area of randomization in the process of establishing spatial, architectural or even iconic form of space. The flaws of this low-level organized process are well seen in the examples of Paternoster Square and Bayt El Suhaymi Area, even in Xin Tian Di Area and Stary Browar[10].

Simultaneously, the higher the degree of implementation of an interdisciplinary design process does not guarantee meeting the goals successfully [cf. fig. no 1], because the real problem is how purposefully and profoundly interdisciplinarity is achieved. This is clearly visible when comparing Bayt El Suhaymi and Xin Tian Di Areas. An image of uniqueness was built only in the case of Stary Browar where the architectural creation was planned alongside the artistic vision. From a very early stage artists, graphic designers and conceptual specialists were involved and formed part of decisive group to shape the physical space. This was done based on a corporate identity creation process and previously formulated principles, including: to expose the authentic structure, revive the traditional language of space and combine it with modern applications. This was accompanied by economical analyses, but these analyses were not to be decisive and so both, architects, artists and other specialists retained a certain flexibility and freedom in their pursuits.

The team produced a coherent image of place where culture is mixed with commerce, where people meet, where the majority of details, furniture and fittings contribute to the maintenance of a profound vision for this exceptional area which is one of the icons of contemporary Polish architecture. The real success was confirmed by the fact that publications and websites operating from the opening of Stary Browar resulted from peoples' need, and were not the result of the developer's marketing division. There is still much to be improved due to the fact that in each case the negative tendencies may occur as at Stary Browar where some values were awkwardly altered during the second extension phase.

3. Methodology

There are two main directions to follow in this research. The first one is *extended (or true) interdisciplinarity*– a term related not only to the involvement of representatives from various sciences, but to the type of cooperation and knowledge exchange which occurs between the participants. True interdisciplinarity imposes the establishment of a rich team of, often syncretist, specialties. Furthermore, the team is supposed to control the whole process, from at least the definition of the task to the beginning of occupancy. Partial implementations of this kind of approach may be frequently observed.
The second direction is the elaboration of a set of guidelines which improves the control but does not hamper the creativity of the team.

When discussing the Meta-Design concept, we have to point out that the design process can occur in an unlimited number of configurations. Complex tasks add many factors that make the control of design very difficult, if indeed it is possible while searching for an acceptable solution on every incor-

Fig. 1. Comparative analysis of case studies, aut.: RB, 2006

		Stary Browar Poznan						**Xin Tian Di Area Shanghai**						**Bayt El Suhaymi Area Cairo**						**Paternoster Square London**					
		1						**2**						**3**						**4**					
INVESTMENT DESCRIPTIVE DATA	program	commercial / cultural center						commercial/ office complex						housing/small commerce/offices						offices/ appartments					
	space type	urban						urban						urban						urban					
	intervention type	refurbishment extension/additon						renovation extension/ addition						revitalization extension/addition						conversion new development					
	% of historic structure	20%–25%						10%–20%						40%–50∞						0%–5%					
	development type	private investor						state investment						state investment						private investment					
	architect	one						multiple						one (joint groups)						multiple					
	architectural practice	Studio ADS						Nikken Sekkei Zapata + Woods Arch. Design+ Research Institute						N.A.D.I.M. + SCA						MacCormac Jamieson Prichard Eric Parry Allies & Morrison Whitfield and Partners Sheppard Robson					
	target user	known partially						known partially						mostly known						unknown					
INTERDISCIPLINARITY	**interdisciplinary approach**	**yes** spontaneous/ programmatic						**yes partial** economy driven						**yes partial** socially/culturally driven						**yes partial/limited** economy driven					
		TD	**PL**	**PG**	**D**	**SP**	**B**	**TD**	**PL**	**PG**	**D**	**SP**	**B**	**TD**	**PL**	**PG**	**D**	**SP**	**B**	**TD**	**PL**	**PG**	**D**	**SP**	**B**
	architects involved	N	N	Y	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	N	N	Y	Y	N	N
	artists involved	N	N	Y	Y	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	Y	N	N
	historians involved	N	N	N	Y	N	N	N	Y	N	Y	N	N	N	Y	N	Y	N	N	N	N	N	Y	N	N
	sociologists involved	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	N	N	N	N	N	N
	economist involved	N	N	Y	N	N	Y	N	N	Y	N	N	Y	N	N	N	N	N	Y	N	Y	N	N	N	Y
	scale of interdisciplinarity	**35%**						**30%**						**40%**						**15%**					
VALUES ACQUIRED (0–10)	livable/vivid	7						6						7						4					
	attractive	8						6						4						5					
	culturally active	4						5						6						3					
	commercially active	9						8						2						4					
	identifiable/unique	10						9						7						7					
	indentity building	10						8						4						5					
	authentic/harmonious/coherent	8						7						10						5					
	evaluation of contribution to urban space	**8**						**7**						**7**						**5**					

TD Task definition PL Planning phase PG Programming phase,
D Design phase SP Social participation activities B Budget adjustment

Fig. 2. Typical design process scheme, aut.: RB, 2005

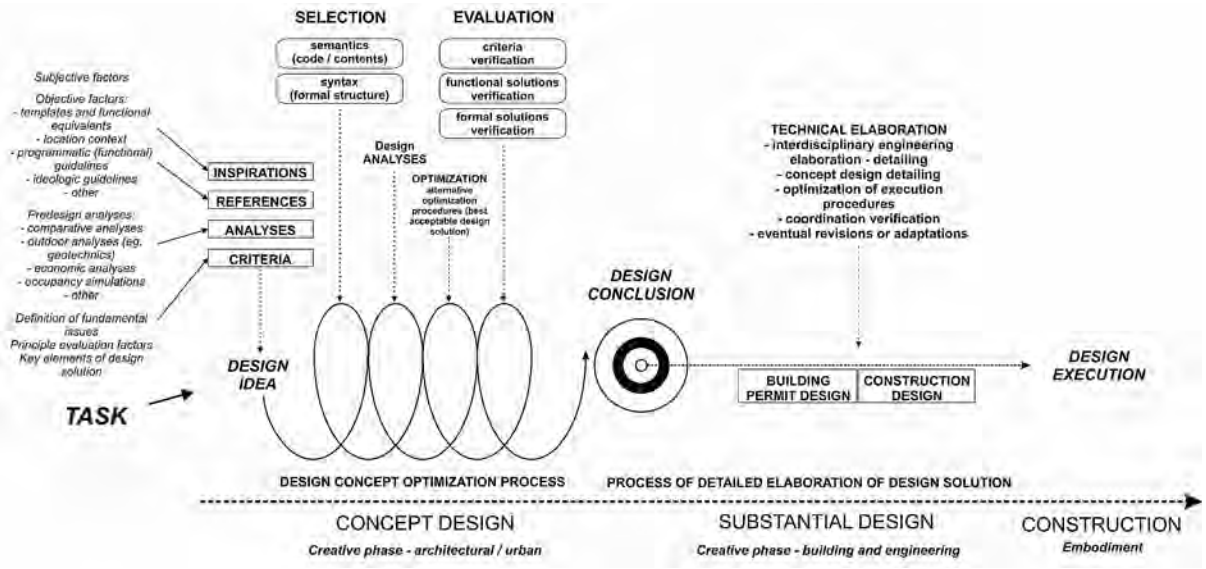
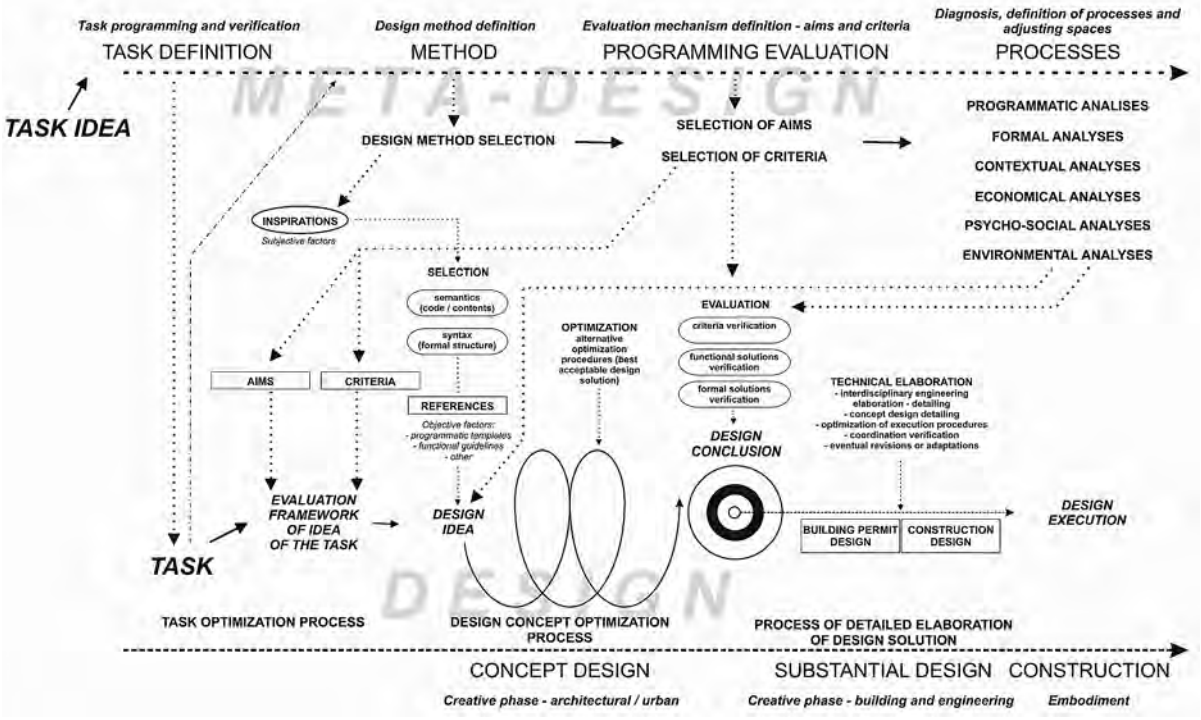


Fig. 3. (Meta+)Design process scheme, aut.: RB, 2006



porated sub-field. This is especially the case when multiple triggers affect the course of the design process at different moments. Once the design process is proceeding then it can be much more troublesome to make steps back or to check completely the consequences of some major general decisions [cf. fig. no 2]. An architect is encouraged to define the spatial properties of an area, and the program with detailed functions, items and spatial information differentiation, aesthetic variability and coherence as well. An attempt to attribute the urban space with selected and preferred values may become too complicated if it is not supported by meta-activities[11], a self-organizing mechanism, especially when combining the efforts of many contributors in the team. Simultaneously, in order to (re)create architecturalvalues which will produce uniqueness, the model has also to allow for openness and flexibility when approaching target problems, thereby avoiding algorithmization, routine and repetitiveness [fig. no 3].

Meta-Design grows from the observation of complex design processes and applies a superstructure and superprocedures that form a common communication platform. Its inherent interdisciplinary character may be well seen in the scheme, exposing the fields of analyses, criteria, and interrelations. However, this methodological structure may be taken only as a assumption until implemented, verified and evaluated.

4. Implementation

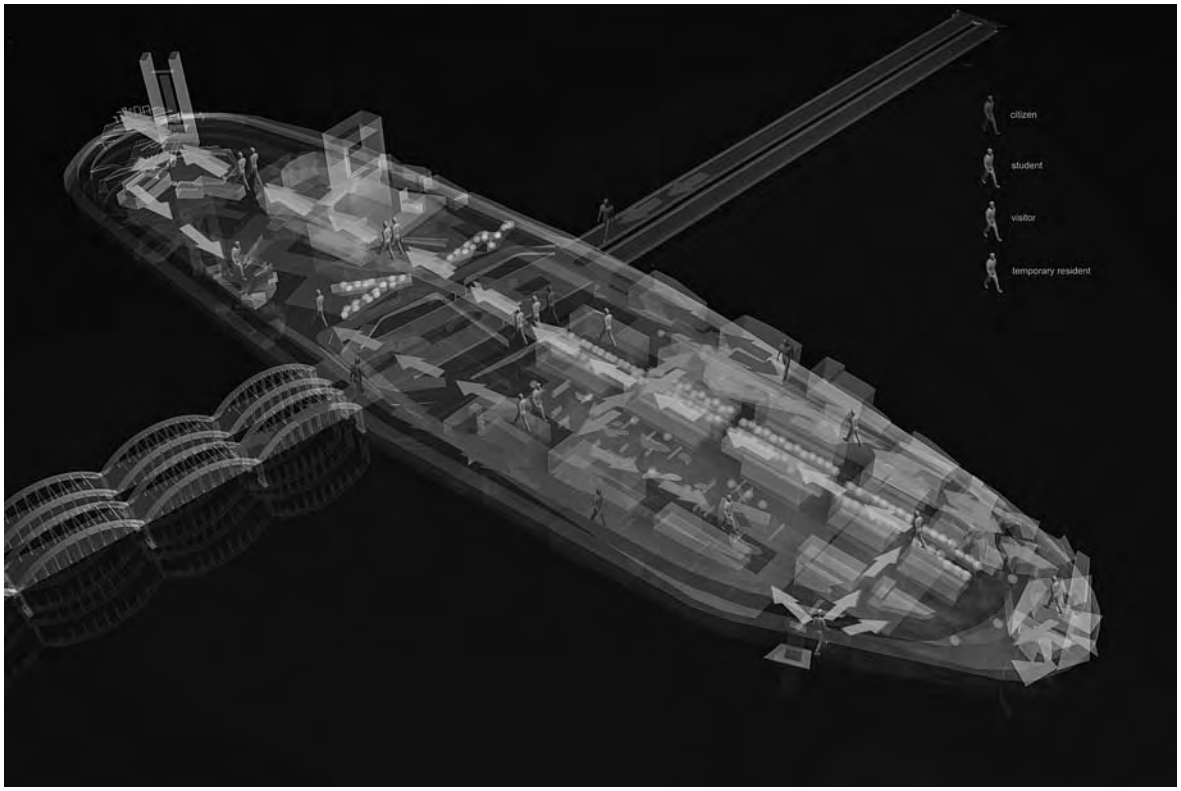
The application of the Meta-Design model has become necessary in at least two diverse complex projects which focus on the creation of unique urban spaces. The first preliminary test for some of the Meta-Design procedures and multi-discipline cooperation was for a design competition for the Seoul Performing Arts Center on Nodeul Island. The second test was for a commercial implementation involving not only the research team, but other professional parties or companies.

The first project was approached as a competition design, and therefore the application of the Meta-Design methodology and interdisciplinary cooperation was limited and restricted to architects, artists and sociologists who worked on the programming phases, planning the design structure and designing the mixed-use area on Nodeul Island. This short term and intense cooperation was based on achieving the principles of the values of urban space by a dedicated team.

Nodeul is an isolated place and the exchange of information between the participants at an early stage led to establishing the idea of an island as an autonomous urban structure – uniqueness based on self-maintenance. It was to be filled with a mixed program so as to avoid the situation of allowing Nodeul to become a temporary and quasi-transit area – a place of cultural events, but nothing more. The definition of the idea for the task involved sociologists, who defined a possible functional structure and then proceeded with a preliminary evaluation of the concept. They determined the minimal population required to assure the liveability of the area and the behaviourally rooted volume distribution related to the most significant programmatic elements on the island. The graphics and conceptual / image artists focused on reinterpretations of the social issues and they prepared two diverse proposals for public spaces in the cultural and habitable halves of Nodeul. The architects defined parameters for the volumes and surfaces, the programmatic interrelations and the relevant constraints. The identity for Nodeul required iconic shapes for the main buildings – the opera and the concert halls. However, the most important synergic effect was inscribed in the idea of lifecycles [fig. no 4] – in which human behaviour simulations are attributed to various users: inhabitants, students of performing arts, artists, visitors etc.

The full scale experiment is now being carried out, together with its implementation in the planning / programming phases. The project focuses on 7,8 ha located in an old industrial area providing over 160,000m² of net area for diverse use. Although unlikely in most other cases, the investor agreed to reject the typical market-driven process for establishing this mixed-use estate. This time the interdisciplinary team has been appointed to embrace the entire process of attempting to give the answer to the fundamental question of configuration and production of the timeless feeling of uniqueness in the area. The research team sought the basis for their decisions by determining the values, criteria and strategy.

The team members defined the general structure of the process together with the detailed design activities. During each step, all the participating parties collaborated, resolved their opinions, exchanged knowledge, concepts or information, and provided the necessary details for the content of the selected tasks. The Meta-Design process introduces and ensures that the collaborating parties support each



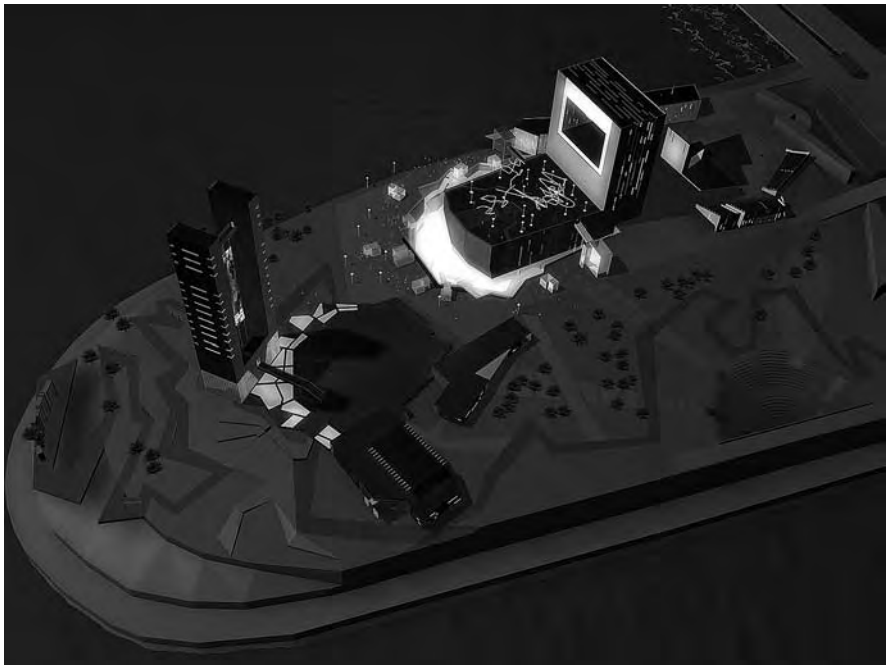


Fig. 4. (above) A reflection of pre-design meta-assumptions established among various specialists superimposed on finished project in order to display the concept of "lyfecycles", SPAC, Seul, design.: Armageddon Biuro Projektowe, 2006

Fig. 5. (right) SPAC, Seul, design.: Armageddon Biuro Projektowe, 2006

other in fulfilling their mutliple and diverse subtasks.

The team followed the strategy for the project, according to their responsibilities, once the structure had been finally decided upon, The investor was accompanied and advised by designers ("Armageddon" for architecture, "Diagram" for PR strategies, image and identity creation) and consultants ("Armageddon" and CBRE) who from the very beginning played an active role and collaborated on the final idea and the program for the project. Research work on the preliminary program was previously tested at SPAC, so in this project sociologists contributed greatly with their recommendations to optimize the configuration of the program structure for the development of this project.

"Diagram" has been delegated with the responsibility for the visual strategy. However, until the task is finally defined the idea for the project identity evolves with the architectural proposals. The image of the "Dawn" mixed-use development is co-created and driven by both architects and artists. The strategic decision has been made to ensure uniqueness and heterogeneity of the area – for which other architectural practices have been invitated to contribute to the final shape of the estate is planned in a few selected areas. The estate will be executed as an open yet guarded area, according to the analysis and the negotiated solutions – thereby avoiding disconnection between the new development and the remaining elements of urban tissue.

Fig. 6. Comparative analysis of Meta-Design implementations, aut.: RB, 2006–2007

		Performing Arts Center Seoul						**"Dawn" Mixed-use Dev. Poznan**					
		1						**2**					
INVESTMENT DESCRIPTIVE DATA	program	mixed-use / cultural center						mixed-use/appartment/offices					
	space type	urban						urban					
	intervention type	new development						new development revitalization (post-industrial)					
	% of historic structure	0%–5%						5%–10%					
	development type	state investment						private investor					
	architect	one						one*					
	architectural practice	Armageddon						Armageddon					
	target user	known partially / programmed						known partially / programmed					
INTERDISCIPLINARITY	**interdisciplinary approach**	**yes partial** organized/ programmatic						**yes** organized/ programmatic					
		TD	**PL**	**PG**	**D**	**SP**	**B**	**TD**	**PL**	**PG**	**D**	**SP**	**B**
	architects involved	N	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y
	artists involved	N	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y
	historians involved	N	N	N	Y	N	N	N	Y	N	Y	N	N
	sociologists involved	N	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y
	economist involved	N	N	N	N	N	N	Y	N	Y	N	N	Y
	scale of interdisciplinarity	**45%**						**95%**					
VALUES ACQUIRED (0–10)	livable/vivid	9						9					
	attractive	8						9					
	culturally active	8						6					
	commercially active	6						7					
	identifiable/unique	9						9					
	indentity building	9						8					
	authentic/harmonious/coherent	8						9					
	evaluation of contribution to urban space	**9**						**9**					

* - it is possible that other architects will be invited to the team later on

TD Task definition PL Planning phase PG Programming phase,
D Design phase SP Social participation activities B Budget adjustment

Economic analyses proceed simultaneously on a wide scope into various areas, including financing, development staging, targeting clients, and more. These analyses indicate how the development shall be structured when launching the construction and how the design shall respond to the necessity of making this mixed-use area a unique place not only at the moment of completion, but also at every intermediate stage and in the future.

The scheme for the implementation of Meta-Design presents a wider scope for the applicable interrelations involving various parties at distinct stages of the project [fig. no 6]. Despite the fact that only limited conclusions may be drawn now because the project is incomplete, we may nonetheless observe the differences between case-observed design processes and the research related process enable us to favour the latter one.

5. Conclusions

We may consider the works here to be similar to one of Kulikauskas et al[12]. because of the exemplary implementations of interdisciplinary design procedures which enriched the architectural design work. But we have to clearly understand that in order to guarantee proper representation of complex issues in the process of the creation of unique urban spaces it is necessary to go far beyond the basic problems of architectural or urban design. An architect is no longer able to control all the environmentally defined factors. Moreover, when controlling them, he is unable to balance properly the content of the solved problems and issues.

What are the implications of interdisciplinarity for the design process? How different will the outcome be when previous forms of the design process are abandoned? The ability to develop the idea of unique spaces depends on facilitating the completely integrated collaboration of the work of the diverse specialities. Normally architectural conceptualization focuses on the programmatic and volumetric aspects of design involving some contextual analyses. However, when more sophisticated models of design are applied as in the proposed structure, then the conceptualization is preceded by a preliminary evaluation, a consideration of the principles, architectural, aesthetical, social values, and the multiple effects that diverse strategies may produce. Information is exchanged constantly between the participants and feedback boosts the abilities of the team and amplifies the support provided by all the members. The systematic transfer and exchange leads to a more efficient use of other types of knowledge which, in this case, may also be implemented in professional applications[13]. This approach provides the specific background to allow for the multi-valued growth of ideas which correspond to the development, and hopefully produce a richer environment.

KEYWORDS
interdisciplinary research, interdisciplinary design process, design methodology, meta-design, design model

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1 The synergic combination of research methods – case studies, modelling and simulation, and experimental research. Groat and Wang (2002), Architectural Research Methods, p. 255–264, 282–283, 346–355, 368–369. It is worth pointing out that the classification of research types is approximate. Complex architectural tasks have a very individual character and the opportunity to examine these cases are to few to consider e.g. purely experimental approach – we should rather assume a quasi-experimental nature for this research. Similarly, modelling and simulation are rather focused on establishing the methodological framework related to actual phenomena observed in case studies (verified through various modelling procedures) rather than simulating complete causal cycles.

2 An example of professional developer's approach for important mixed-use urban spaces is explained by Schwanke, Phillips and Spink (2003), Mixed-Use Development Handbook. However, economical constraints form the starting point for programming mixed-use developments and are of primary importance here. Definitely the first step is analyzing the "market", not the cultural and social background – which seems to be the major difference and distinguishes our field of interest.

3 Peters (1997), Can Urbanity be Planned?", p. 95–97.

4 Robinson (1990), Architectural Research: Incorporating Myth and Science, p. 20.

5 This research is part of Meta-Design methodology research analyses and approaches conducted by the team led by Barelkowski.

6 Crowhurst, Lennard and Lennard (1995), Liveable Cities Observed, p. 225-229.

7 Bohl (2002), Place Making. Developing Town Centers, Main Streets, and Urban Villages, p. 277–280.

8 C.f. Barelkowski (2007b), Meta-design. Technicalization and humanization of design process, p. 3.

9 Barelkowski (2006), On the nature of spatial context, p. 86–87. In the source article it is said, that there are three properties, but finally the author adds another one, which corresponds with and indicates an unceasing emotional reaction of people, who use a particular architectural object or who simply observe it and evaluate it.

10 That is particularly seen in the extension of Stary Browar, where the primacy of economic constraints led to diminishing the power of the internal court as an exceptional urban square – now minimized and partially converted into a passageway between one commercial center and the other.
11 Barelkowski (2007a), Designing Time – Architecture of Becoming. The Strategy of Genuine Development of Architectural Design, p. 274–275.
12 Kulikauskas et al. (2001), Transdisciplinarity in Planning of Sustainable Urban Revitalization, p. 195–196. This example does not go far beyond the integration of social participation – as an example of transdisciplinary application. Cf. the terms of interdisciplinarity and transdisciplinarity.
13 E.g. tacit knowledge confronted with other team members.

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Mirja Leinss

The role of designers in multi-disciplinary teams

Experiences from design research

Abstract

Today's complex design problems are mostly approached by groups of people having expertise and skills in various disciplines. Skills initially different from stereotyped "design skills". Engineers, social scientists, anthropologists, medical experts, computer scientists, neuroscientists and linguists, marketing people and project managers. What about designers? How can we define the skills a designer should be equipped with, what are the values a designer can bring to a multi-disciplinary team, and how can these values be taught within the framework of 21st century design education?

In this paper, I would like to illustrate the values, challenges and power of multicultural, multidisciplinary design teams and the role of "design thinkers" within these teams, using example projects, mostly from my own experience as a research fellow at the MIT Mobile Experience Laboratory. At the MIT Mobile Experience Laboratory we generate ideas and prototypes – sometimes based on real world demand, sometimes envisioning potential needs for the future – in collaboration with industry, cultural and political institutions, start-ups and established full profit firms.

Introduction

Design adds value by making products or services more than merely functional and the term design is not limited to only "giving a form". Design is human focused and strategic, and aesthetics plays a role as well as usability. Design always depends on its context and whereas a designer can provide scenarios or 'worlds,' the experience is always subjective and user specific.

One of a designer's major tasks is to create experiences that combine technological, informational and contextual factors and make them valuable to the user. It appears that, observing and experiencing the role of a designer, that she is evolving more and more towards a holistically thinking "communicator". The designer is positioned at the intersection of disciplines and becomes essential to understand and bridge technology, sciences, humanities and people. Traditionally, the origins of design are rooted in craftsmanship, but today, design is considered as a way of thinking and taking action.

Design driven problem solving is integrated into the project development from the beginning and is believed to be a key factor for innovating and creating change. "Design driven" means to believe in the value that design brings to a project and to practice this in both analytical, strategical and creative work and decision making.

The terminological aspect with design

Design is still not clearly positioned as a discipline and also has multiple, subjective definitions. Our collaborative partners at MIT Mobile Experience Laboratory often seem to look for, what I would like to describe as, "creative ideas". 'Creative' and 'innovative,' are words that are used a lot these days, almost as much as the word 'design.' What is 'creative' and 'innovative'? And what is 'Design'?

Personally, I do like the two definitions for Creativity and Innovation that Prof. Teresa Amabile, Harvard Business School, uses in her Seminar "Management for Creativity" [**1**]. She defines Creativity as: "*The production of novel and appropriate ideas by individuals or small groups*", and Innovation

as: *"The successful implementation of creative ideas within an organization."*

The term "design" is becoming more and more difficult do define, although originally it had two meanings: "doing something by purpose" – which is very generally used – but also, "giving a form to something".

In the "design process" designers must accommodate: economic, aesthetic, technological and commercial constraints, etc in order to arrive at a synthesis. There are many parallels between this kind of "design thinking" and management because both disciplines follow a systematic and logical process.

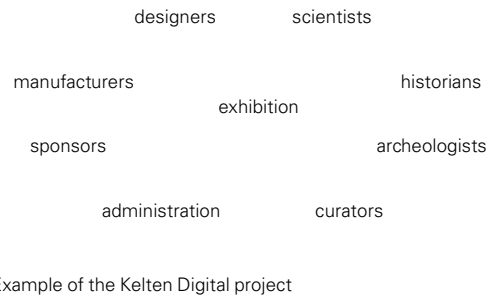
The "form-giving process" is still the predominant notion in most people's minds when thinking of design. Equally, it is the one where the design profession becomes evident, visible, tangible and where it obviously distinguishes itself from a business management strategy.

Multiple disciplines and forms of collaboration

CASE STUDY A: KELTEN DIGITAL – ARCHAEOLOGY AND HIGH-TECHNOLOGY

The first project with which I was involved in where I was confronted with inter-disciplinarity was a project at the Hochschule für Gestaltung Schwäbisch Gmünd. "Kelten Digital" was a concept for an exhibition to be presented by the Württemberg State Museum in Stuttgart. It was to present innovative methods being used in archaeological research. A group of 17 students had the opportunity to work on a challenging real-world project sidestepping the academic framework of the separation between different semesters and specializations. Undergraduate and Masters students collaborated together who embraced all the skills and expertise we needed to eventually realize a successful exhibition project.

Multidisciplinary
Disciplinary comptence and communication between disciplines



Example of the Kelten Digital project

Retrospectively, and as I describe below, I would not call our team inter-disciplinary, but rather multi-disciplinary.

Why this differentiation? This distinction makes a fundamental difference in the organization of the team and the methods for communication and knowledge transfer that will work. The Kelten Team was merely a design team, with design-experts in specific areas but all having experienced the same basic education and all having more or less a similar cultural background and mostly agreeing on a common viewpoint. In contrast, at the MIT Mobile Experience Laboratory's inter- and trans-disciplinary teams we face the potential and difficulty of working with experts from clearly different disciplines. In daily practice, these differences become evident as a simple communication problem. If one goes even deeper into the essence and outcome of a project, it evolves into a real challenge to develop a vision and methodology that will allow the team to achieve efficient and successful collaboration. It needs "something" that holds the team together. Can this "something" be design?

DISCIPLINARY

Talking about multi- or inter-disciplinary teams points necessarily to the essential "single-discipline". A multi-disciplinary team requires members that are specifically skilled in at least one discipline. In the traditional education methods of many design schools, these specific competences are taught during undergraduate studies – for example courses on three-dimensional structures, materials, typography etc. On a graduate education level, these skills are applied in design studio projects, where people from the same discipline work with the same methodologies. There is an exchange of knowledge on a highly elaborate level, whereas a common basic understanding of the matter is a precondition.

MULTI-DISCIPLINARY

On the next level, multi-disciplinary projects bring together a group that demonstrates disciplinary competence, and communicates with other disciplines – which happens in most applied design projects. This was also the case in the "*Kelten Digital*" project mentioned above, in which the design team was cooperating with scientists, curators and manufacturers and relating their work to the design and vice versa. This can often have a positive impact on the team from an organizational perspective because

it is kept together by the common "contender". The transfer of knowledge within the team happens on an expert level but interaction with new fields outside the team demands an empathy for other disciplines and a willingness to relate the external input to the team's own work.

CROSS-DISCIPLINARY

In cross-disciplinary teams, the primary discipline actively collaborates and intersects with other disciplines in order to resolve problems. For example, the design team might work closely with an engineer, to bring his or her expertise in mechanics to the project. However, cross-disciplinary means that there is still a dominant discipline that collaborates with other fields in a problem-focused manner. This problem oriented approach facilitates communication between the disciplines and knowledge transfer to the extent of understanding the "joints" between the disciplines in order to complete the project.

INTER-DISCIPLINARY

Inter-disciplinary teams include sub-groups from different disciplines. Each sub-group brings expertise that cannot be addressed by the others. Still, one discipline is pre-dominant over the others and they operate mostly in a problem-focused manner. Inter-disciplinary groups clearly contain at least two different disciplines, whereas cross-disciplinary groups show strong disciplinary competence in one field, collaborating with others. On an individual level, it is also very likely that in inter-disciplinary teams the individual already subsumes several disciplinary competences.

TRANS-DISCIPLINARY

The most complex stage of collaboration is trans-disciplinary groups, in which multiple disciplines are represented by individuals and sub-groups and a total merger of these different disciplines generates unique findings. It is even likely that this melting of fields and skills creates entirely new disciplines. The levels of co-operation are based on Jantsh's model of cognitive development [2].

The designer as communicator

CASE STUDY B: METRO 2.0 –
SMART CROWDS IN THE METRO

Recently, we have been running an inter-disciplinary workshop in collaboration with RATP, the company operating public transportation in Paris. "Metro 2.0 – Smart crowds in the Metro" is an idea-generation workshop with the goal to develop scenarios for new forms of communication, exchange and space based on the idea that a crowd of 10 Million passengers every day could be a potential resource. The workshop was announced at the beginning of the semester throughout different departments at MIT and Harvard and we finally recruited 12 students to work together for one semester. We deliberately chose specialists with strong personal interests in the larger topic. Among them, for example a japanese PhD candidate with his research into crowd patterns in public spaces, an American undergraduate in city planning who had already travelled more than 40.000 miles by train, some MBA students that had experience in online and viral marketing. In addition some austrian, turkish and american students from the media lab's sociable media group, an indian masters student working on tangible maps and a visiting researcher from Canon, Japan.

One might say diversity not only in terms of discipline but also in terms of culture which could allow different viewpoints, approaches and frames of mind to emerge. [3] The workshop is run in a manner whereby the group gets a very open brief at the beginning of the semester and the next steps get defined based on the topics which emerging. Each student started by approaching the topic from his or her individual perspective. One can imagine the first presentations – with the individual ways of thinking, choosing words, phrasing and visualizing information causing an insurmountable obstacle in terms of communication. No one understand each other nor were they able to ask questions or give advise. Expertise and a very strong personal focus had created boundaries within the group. As Tom Kelley writes: *"Experts can inadvertently block an innovation by saying, "It's never been done that way.""* [4] The

Interdisciplinary
Sub-groups of different disciplines

Metro 2.0

group 1 cultural space	**group 2 sociable space**	**group 3 commercial space**	**group 4 learning space**
media arts	media arts	business	architecture
media arts	media arts	business	urban planning
business	media arts	media arts	transportation
city planning	city planning		

Example of the Metro 2.0 project group and sub-groups

next step was to work in groups which were made up of 3-4 people from different backgrounds and for them to apply different design methods in the development process. In peer-to-peer learning, the students contribute fundamentally to the general education of each other, and through introducing tools like ethnographies and storyboards they were able to develop common concepts despite having different perspectives. The teams could "design" a concrete proposal with scenarios showing interventions and interaction principles.

CASE STUDY C: CASTEL PULCI

We are currently working on a second project which is: "Castel Pulci - Center for business, fashion, innovation and education." The goal of this workshop is to develop a strategy and concept for the re-use of a 13th century Castle outside of Florence, Italy. In this project, one focus is on the conceptional, organizational and operational strategy for the Center, a second is to develop an architectural concept for the space based on the program and the vision for the institution. Four business students, two urban planners and two architects are working on this inter-disciplinary project. The business students cannot solve the architectural issue and the architects do not have the experience to develop a business plan for Castel Pulci. Consequently, the common design vision holds the sub-groups together. On an individual level all the students bring at least 2 fields of expertise with them – one of the architects has a Bachelor's degree in civil engineering and a personal interest in the preservation of buildings. One of the MBAs has a Bachelor in Arts, Anthropology and Sociology and has been a consultant for several italian fashion companies before coming to MIT; the other one, was working as an IT consultant and in Investment Banking prior to coming to MIT; one of the urban planners is consulting for non-profit organizations during her studies and so the list goes on. The collective knowledge of this group is impressive and we could generate a wide-ranging analysis on relevant topics even before developing the actual strategy for Castel Pulci. Once again, design tools like brain-storming with post-its, network- and process visualizations and spatial diagrams facilitate the development of a vision for the project. Therefore "[Design] *is not a substitute for other activities. Rather it supports other activities and partners creatively* […]" **[5]**.

The capability of transferring or translating into design is where the creative potential becomes evident. And it is at this point that the role of a designer to act as a communicator who can subsume the knowledge of different disciplines, trans-forming it so that it eventually leads to the creation of a meaningful product or service.

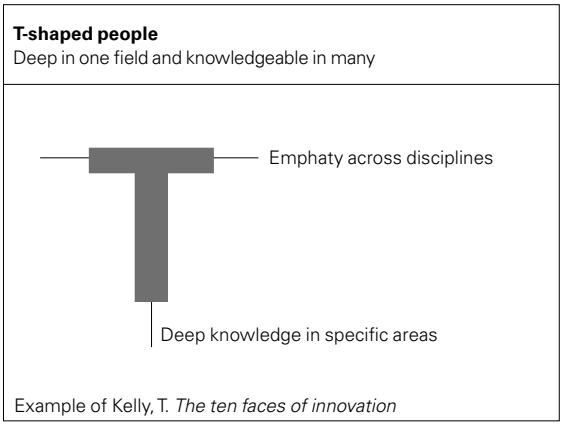
Design skills and education

Design reflects human needs and wants, as well as dominant ideas and artistic perceptions of the time.

Design is a service, which means that another important asset is the imagination to put oneself into the position of the user and show a strong sensibility for the context – only this can give the design its unique value. Another necessity is the appropriate knowledge of technology in order to understand the restrictions of production and implementation. It is crucial for a designer to have a sharp mind so as to be able to quickly understand processes outside the design area and the capability to transfer those into the design language.

Enjoying a breadth of knowledge in many fields and having depth in at least one area is what Tom Kelley, IDEO, describes as valuable assets to nourish cross-pollination within a team. T-shaped people with an open mind and at the same time strong skills in at least one discipline are the ones that can hold a team together **[6]**.

However, traditional design education institutions are mostly focussing on a specific discipline. Nonetheless, there is a growing number of recent ventures that seek to teach design in a broader sense by bringing different disciplines together. Mostly this happens at a graduate level or in the form of laboratories where students and researchers from all kinds of different fields solve problems together, often in a pro-active and future oriented way. MIT Mobile Experience Laboratory, Stanford's D-School or The Art Center College of Design in Pasadena to mention



Example of Kelly, T. *The ten faces of innovation*

just a few operate in this manner and attract all kinds of experts from science, business and the humanities [7]. These teams need cross-pollinating design thinkers. And they are great places for teaching a designer to learn thinking and acting in the novel communication role.

Conclusion

Today, it seems that the traditional definitions of design are incapable of capturing the potential of the design discipline. Design is a strategic problem-solving activity, operating at the intersection of different fields and developing concepts in a collaborative, creative manner. Great teams need a visionary leader that fosters transfer and the members of the team need to be able to work together, which implies having personal visions that are compatible with those of the group. [8]

The outcome of this process is a human focused product or service that makes some cultural contribution. Media technology, computation in the design process and manufacturing, complex social environments and global markets demand highly skilled people that have an open-mind and a willingness to collaborate in multi-disciplinary teams. A key role for a Designer within these teams is to bridge between the disciplines and to demonstrate the ability of developing a "vision" that leads the team beyond a strategy to a compelling, tangible or visible project. Design tools such as as: sketching, brainstorming, mood boards or prototyping help to overcome language barriers and bring members of the team towards a common perspective.

Temporarily becoming exposed to other domains, new places, other cultures and cutting-edge technologies can help to teach communication skills and leadership thinking to designers. In turn, including designers to multi-disciplinary teams helps facilitating collaboration between different disciplines and creating powerful human focused products and services.

KEYWORDS

Design, multi-disciplinary teams, communication, collaboration, design thinking, design research, design skills, MIT, MIT Mobile Experience Laboratory

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Carolina Gill and Blaine Lilly

Communicating across disciplines through systems thinking

Abstract

In spite of the dominance of the concurrent engineering paradigm in many businesses, firms often find that creating truly integrated design teams is made difficult by lack of cohesion among practitioners of the design disciplines. Here we suggest methods for using some of the conceptual tools prevalent in systems engineering to assist in creating more integrated design teams.

Introduction

Although the concept of "concurrent engineering" has been widely accepted in industry for the past two decades [**1**], the process by which firms bring new products to market continues to be impeded by artificial barriers and problems of integration among the principal design–related disciplines. To this day, there still exists a widespread lack of understanding between industrial designers and design engineers over the exact nature of the other discipline. When one adds to the mix disciplines that have traditionally not been thought to be part of the design process, such as anthropology, psychology, and manufacturing, the problems inherent in bringing new products to market quickly and effectively become even more daunting.

As educators in industrial design and engineering, we are acutely aware of the difficulty of explaining each other's contributions to colleagues in our own disciplines. Engineers persist in conflating design with 'style', and quite often think that industrial design is merely about 'making the design look pretty'. Engineers as a rule are trained to think quantitatively, and tend to be suspicious of knowledge that does not come with numbers attached. Designers, while they tend to be more open to the contributions of engineers, also often seem to believe that engineers 'just don't get it' when it comes to design. Quite often, the comment is made that emphasizing design functionality at the expense of focusing on aesthetics results in designs that are 'too engineered'.

In our work together over the past several years, we've come to expect a certain level of skepticism and misunderstanding from our more traditional colleagues. We have attempted to build bridges between industrial designers and engineers in a variety of educational contexts, from conducting design workshops in secondary schools to teaching in each other's courses in a large university, to bringing design methods to engineers and technical managers at NASA [**2**].

The demands of the global marketplace have driven many designers to recognize that sustainable product design is about much more than merely 'designing the artifact'. The complexities involved

cannot be dealt with by a narrow focus on the object itself, or even the relationship between the user and the object. Rather, effective design truly requires a system–wide approach. We have come to believe that an effective method for bridging some of the conceptual gaps between the design disciplines might lie in combining the designer's abstract approach, the design engineer's concrete focus, and the systems engineer's understanding of the interactions among people, components and processes into a comprehensive method that includes the expertise of every relevant discipline.

Where does design begin?

We begin by asking a simple question: where does the act of design begin? We have found that the answer, like so many other answers related to design, depends very much on the context in which the question is asked, and on the discipline to which the inquiry is addressed. An anthropologist who specializes in field studies might well say that design begins with the dissonance between the designer's intent, the user's expectations, and the user's actual experience. For this reason, the anthropologist will look closely at human behavior in a range of contexts, always looking for those moments that may signal a new design opportunity.

A design engineer might well turn the design problem around by starting with a solution, in the form of a new technology, and embedding it into an already existing framework. The market for consumer electronics, for example, is saturated with 'breakthrough' products that have followed this path to new product design. The industrial designer, on the other hand, may '…satisfy themselves with the cosmetic task of branding the experience for the next generation of users' [3]. They tend to see design beginning with the opportunity of enhancing the experience of the user through form and features, with the assumption that the actual functioning of the device can be taken for granted.

To get some idea of how the relevant disciplines see the design process, we looked at a wide array of design textbooks, and selected two representative approaches embodied in popular and influential texts. Figure 1 below shows the design process as presented in the most widely used engineering product design textbook in the United States, and in a widely quoted industrial design text. The upper section of the figure, which is taken from *Product Design and Development* by Ulrich and Eppinger, essentially presents every function other than 'Planning' as an engineering function [4]. It also depicts the design process as essentially flowing in one direction, from initial concept to finished process. The necessity of constantly going back and revising and re–conceptualizing is missing from this diagram, though in fairness it must be noted that the text itself does deal with the need to iterate. The lower half of the figure is taken from the text, *Return on Innovation* by Dresselhaus [5]. While this diagram does make explicit the fact that the design process can move in both directions, it also seems to separate the tasks by discipline, showing 'design' in the early stages, followed by 'engineering', 'manufacturing', and finally 'business'. The juxtaposition of the two shows that in neither discipline is much attention given to the formulation of the design problem or opportunity itself.

While one cannot draw too much from these diagrams, we believe that they represent at least the underlying assumptions made by two important disciplines when they look at the process of design. Each discipline tends to emphasize its own role in the process, which is to be expected. In both of these diagrams, the question, '*where does design begin?*' is left unanswered. While Ulrich and Eppinger include a 'planning' phase that precedes the 'concept development' stage, it is not clear what 'planning' entails.

In our view, the formulation phase is where real innovation is generated. Design teams must take into account all aspects of the system in which the product will live: they must acquire a thorough understanding of the context, the constraints, and the interactions that affect the product during its lifetime. Deep understanding would include comprehending the nature of global markets, the specific technical and environmental constraints limiting the product, and potential uses and misuses of the product over its entire lifetime. For these reasons, it is imperative that the multiple disciplines involved interact at the earliest possible stage of the process, so that no disciplinary perspectives are overlooked. By placing greater emphasis on the formulation phase, the products that are the outcome of this total process are more likely to harmonize with the greater needs of the system. Greater communication among the disciplines leads to a greater likelihood that the product will be responsive to a wider range of needs.

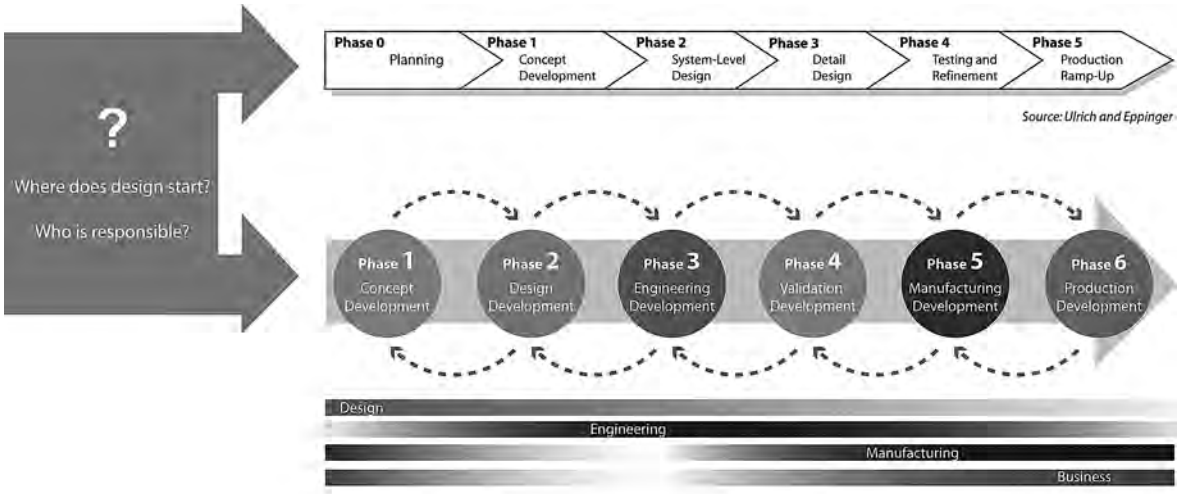


Figure 1: Two contemporary views of the design process

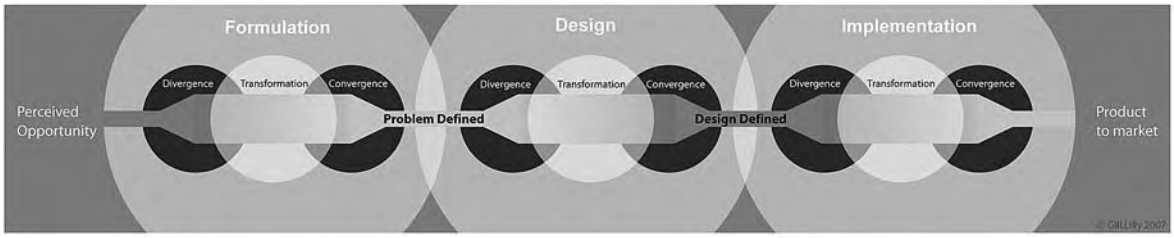


Figure 2: A more inclusive design process

A more inclusive design process

Our approach to teaching design has been influenced to a large extent by two sources. The first is John Chris Jones's seminal work, *Design Methods*, in which the idea that designers continually cycle though the three stages of *divergence*, *transformation*, and *convergence* was first presented [6]. Our second source of inspiration comes from the work we have done for the NASA Engineering Training Program from 2003 to 2006, during which time we taught a course in design ideation to engineers, technical staff, and managers, and also worked on a revision of the *NASA Systems Engineering Handbook* [7]. Through this work we came to appreciate the work of the NASA systems engineers in integrating extremely large and complex design problems, beginning with the Apollo Program and continuing through the present day.

At NASA the systems engineering function is given the task of integrating all aspects of a new project, from what are called the 'pre–proposal' stages through to the end of the project's operational life. NASA divides the process into two major stages: formulation and implementation. We have used both NASA's systems thinking and Jones's concept of the three–stage design process to create what we believe is a more inclusive map of the actual design process, shown in Figure 2. Our design process map has three equally important stages: formulation, design, and implementation. Each one of these involves the three iterative and overlapping phases outlined by Jones, divergence, transformation, and convergence. Further, we believe that no stage belongs exclusively to any single discipline. An emphasis on systems thinking requires that every discipline be involved to some extent at every stage, so that the needs of every part of the system are taken into account, and transitions among system elements occur seamlessly. Clearly, it will never be the case that all disciplines will be engaged at the same level throughout the process; it is equally the case that when any discipline is excluded, the final result will suffer.

Applying systems engineering tools throughout the process

Referring again to the diagram from Ulrich and Eppinger, we see that 'systems level design' is confined to a single stage of the process. We believe that in fact 'systems level design' surrounds the entire process. However, it is also the case that the conceptual tools created by systems engineers to capture

and define the system architecture of a product can also be applied to the larger system concerns. One tool in particular that is often used when breaking complex systems down into their component parts is the system decomposition chart. While the method is most often used to define the architecture of a single product [4], we believe that by bringing this method into the formulation phase, its full potential can be realized.

In Figure 3 below, we show a typical upper–level functional decomposition of a popular consumer product, the vacuum cleaner. Note that the system boundary in this case coincides with the actual 'boundary' of the artifact itself: the user, the source of power, and the larger activity are all outside the system, in this view. The scope of the analysis in this case is reduced to the machine. This is clearly an engineer's view of solving the problem of removing dirt and debris from a surface, and it unintentionally relegates the larger context to a less important level. Without any conscious action on the part of the engineer, this diagram narrows the possible paths that innovation can follow.

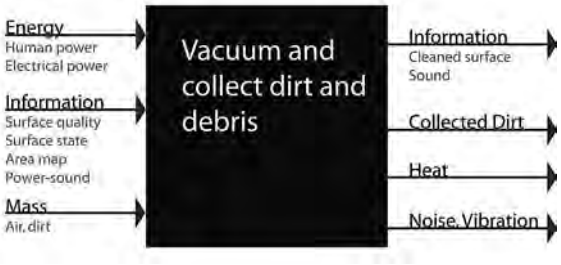
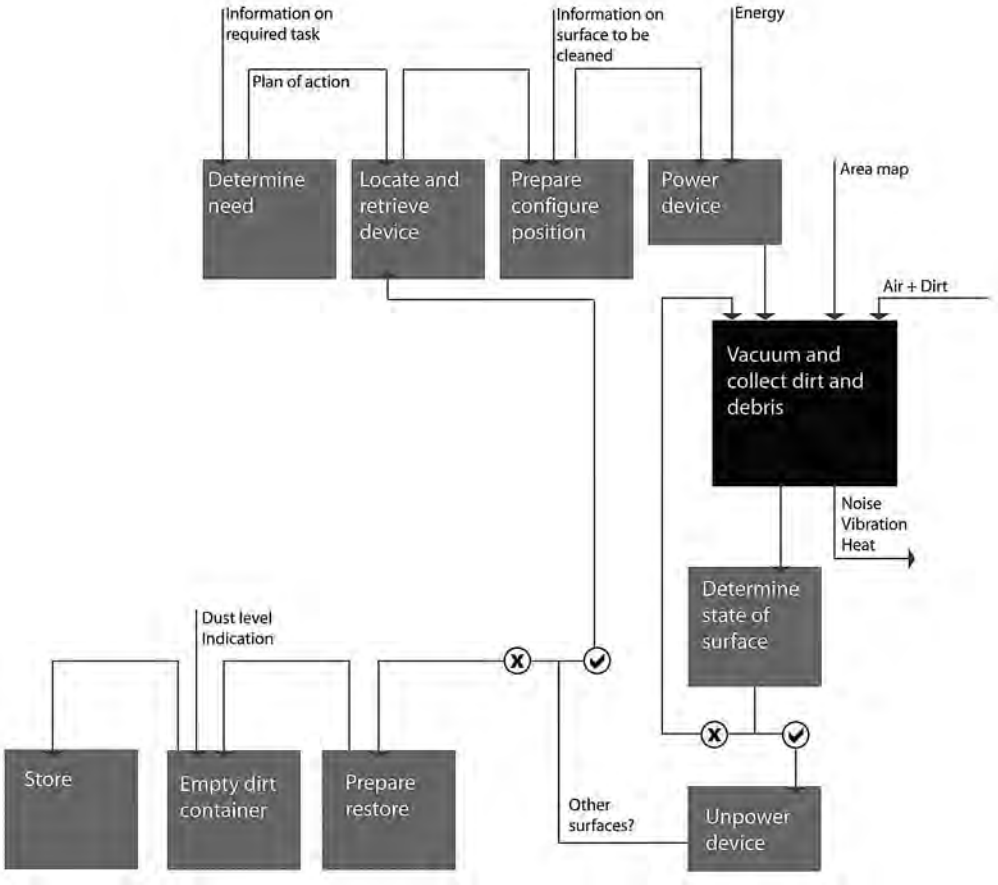


Figure 3: Top–level functional description of the artifact

In Figure 4, we show how the scope of the problem can be expanded by including an analysis of the entire activity of vacuuming. In this case, the system portrayed by the diagram includes not only the smaller 'artifact diagram' of Figure 3, but also the flow of actions that can impact the outcome and open up new paths to innovative solutions. In essence, in Figure 4 the system decomposition tool of Figure 3 is transferred to the formulation phase of the process. By including the user, the use environment, and the interactions among them, more questions regarding the performance of the product arise earlier in the process. The issue becomes not how

Figure 4: Top–level functional description of the user's activity



well the machine removes dirt from a surface, but rather how well it performs in its true context. A whole new range of needs become evident, for example, how difficult it is to adapt and reconfigure the machine while transitioning through different surfaces, applications, orientations, and locations.

However, this diagram is also not the final step. The next level of abstraction during the formulation phase would call into question the actual need for vacuuming itself. Might it be better to think of other ways to clean surfaces? Does a single machine or product need to be able to adapt to so many different surfaces? Does the imperative to create a machine that meets too many users' needs result in sub-optimal performance for all uses? Is there room to think about surfaces and materials that clean themselves? Finally, how are the issues around sustainability taken into account?

Conclusions

The ongoing design of products that fail in the marketplace due to the failure of the designers to consider the wider context in which the products operate shows that there is a clear need for greater emphasis on systems thinking in design. The crucial issues of global climate change, impending energy shortages, and sustainable design demand that we begin to take a larger view of our actions. As citizens, educators, and designers, we need to gain a greater appreciation for the unintended consequences of our designs, and learn from these failures.

We believe that the most critical phase in the design of any product, in terms of collaboration and in terms of innovation, is during concept formulation. Intentionally or not, the decisions made at this stage affect every subsequent decision. In order to ensure that a range of possibilities is considered, the key players must be present, and equally importantly, they must be able to communicate clearly and understand the needs and constraints of the other members of the team.

KEYWORDS

Interdisciplinary Design, Systems Thinking, Design Process

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Loredana Di Lucchio

Design tactics

The transition in the design focus from the object to the subject

Abstract

In the contemporary social-productive context the importance of an object's technical and functional performance has now been lost because it has now become a message, a concept, and a meaning. Therefore, the relationship between design, production, and consumption is no longer a simple problem-solving activity but a comparison between specific cultural models. This has modified design activity, which now requires a different generative and creative action that passes from a known present to a possible future. The creative action has now become diffuse, and we can call it "design tactic". Its aim is not an objective but a subjective quality perceived not only by the present society but, above all, by a future one. This signifies a passage from the creation of an object to the creation of a subject able to construct the meaning of human behaviour.

According to this perspective; this paper proposes an interpretative model of the design / production / consumption relationship for an exchange of knowledge from companies to society by products. This paper is illustrated with an example of a project: the "On Air" project, conducted in collaboration with *Elica*, a leading company in the production of cooker-hoods.

Introduction

In the contemporary social-productive context, the relationship between design, production and consumption is no longer a simple problem-solving activity, but a comparison between specific cultural models. Between the rational culture of production and the emotional culture of society, the design shapes itself as a culture of devising. The designer expresses himself through a generative and creative action, passing from a known present to a possible future. In Latin etymology, the translation of the word "design" (designare) means to establish and it is directly linked to the word "project" (projectus) which means to throw ahead.

Therefore, everywhere we recognize a "projection" from an idea to the concrete action that defined it. That is the design activity. This implies that design is not a codified activity anymore, but a complex activity. Design is an amalgam of knowledge and skills, whose real essence exists not only in the material sphere but also in the immaterial one.

In contemporary societies, the importance of an object's technical and functional performances has been lost because they have now become messages, concepts and meanings. This modifies the design action and requires that companies move from productive leadership to cultural leadership and consequently the need is for products and brands which are able to acquire a social meaning. Furthermore, in the production and delivery of products, new methods of design must be developed which will lead towards an innovation in the aesthetics, the semantic languages and the contents.

The creative action becomes diffuse, and we can call it "design tactics". Its aim is not objective quality but a subjective quality perceived not only by the present society but, above all, by the future one. It is a transformation from object creation to subject creation that is able to construct meaning for human behaviour.

The concept of tactics, according to its etymology, means "*matters pertaining to arrangement*", and if we consider the context in which design takes place then it is influenced by fuzzy logic. Fuzzy logic refutes the classical idea of logic according to which

every concept can only be in two conditions, true or false.

When we consider a thing, for example an apple, we can recognise all its characteristics; but after we interact with it, when we eat a part of an apple, can we still consider it in the same way or is it changed? And when we have eaten the whole apple, is it still an apple?

During their interaction with us all things change their identity. We can identify everything with an exact label – a chair, a phone, a pencil, a car, a shirt; an exact label in relation to the function of things – a chair to sit on, a phone to call with, a pencil to draw with, a car to travel in, a shirt to wear – but these labels do not express the emotional meaning that we assign to these things.

Indeed, the most important transformation in design theory after the post-modern period was to assign new natures to things. The relationship between people and things, between action subjects and action objects, was no longer a question of use or of possession, a question of context or of nature. Design was able to divide the (artificial) world into a world of ordinary things and a world of extraordinary things. Of course the ordinary things are useful, equal to themselves, neutral and without "opinion", whilst the extraordinary things are interesting, "beautiful", able to change the context and even the people that interact with them. This cognitive perspective of the social and contemporary cultural context imposes a re-definition of the design approach.

Theoretical research in the design discipline, during the last 50 years, has tried to understand its specific field of action. In 1958 G. Dorfles said that "*Industrial Design is a particular category of development focused on mass production with industrialized methods and systems that link the technical aspect to the aesthetic aspect*". According to T. Maldonado (1961) the design activity is "*the coordination, integration and articulation of all factors about the consumption and the production*". E. Frateili (1969) organizes these factors into three different and overlapping spheres. The morphological sphere, with perceptive phenomena; the technical-scientific sphere, with the connections between the mind's capabilities and the technical tools; the social sphere, with economic, psychological, and ergonomic factors. The evolution of the technical-scientific sphere has brought us closer to a sort of paradox where the creative capability (morphological sphere) can reach higher levels whereas an incomplete control of the technical system has broken down the deterministic design methods.

This change of perspective is well defined by E. Manzini's words: "*the system of objects became a second nature that is complex like the first one […] the designer lives, now, in a condition of feeble demiurge, able to create at the local scale but not able to control the global scale*" (1990). The practical and theoretical activities of design must be focused on its hard-core: the development of material objects, but simultaneously they must live on a flexible and changeable "protective belt" composed of social, economic and technical matters. To manage both the hard-core and the protective belt in a synergetic way it is necessary to build up a research method that starts with the interaction between objects and subjects, identifying wherever possible the new latent conditions to recognise spaces for designing.

Research Method

This research method has been developed using two complementary fields of study: strategic design and user-centred design.

The main aim of this research method is the construction of new ideas based on the recognition of products as a meeting-place between technological skills of the companies and the expressed and unexpressed needs of society. Indeed, the designer's work is as translators between the company culture, as a rational subject, and the society culture, as a hybrid subject. The designer's mission is the construction of a dialogue between these two cultures. On the one hand the company culture is expressed by three different rationalities: the economic rationality, the technological rationality, and the management rationality. On the other hand the social culture is expressed by three different rules: rules based on traditions, rules based on behaviours, and rules based on human relationships. The relationship is based on communicative tools, one to translate the company culture and one to translate the social culture.

The communication tool of the company is the brief, which means "information".

The brief is a schematic, analytical, and closed structure. it is composed of three key factors: the price – which is fixed and divided into the input price, the process price, and the output price; the target, which is about the contexts of consumption and use, is recognisable only if the company is aware of its market; the strategy – which is divisible into commu-

nication strategies, product strategies, and strategies of market positioning, and is the most indefinite and variable factor.

The communication tool of society, managed by design, is the concept, which means the "intention". The concept is a plural, sensorial, and "absorbing" action; it is composed of three aspects: the material aspect, which is directly linked to the design action, the social aspect, which becomes a cognitive mesh for design action; the language, which is the most personal and changeable aspect and is built on the other two. In particular we can recognize in the material aspect three different features: technology, meaning, and use. At the same time the social aspect will be expressed by present aspects, hidden aspects, and aspects in the perspective of time. Finally, the language can be both a communicative language, an explanatory language, or an inductive language.

A resourceful cross-fertilisation arises between brief and concept: M. De Lucchi has called this the "counter-brief". Its role is to define the creative boundaries of the design action. It is a vision about shapes, functions, and meanings, represented respectively as signs, uses, and behaviours. The counter-brief connects the aspects of the brief with the aspects of concept and assigns different conditions. It assigns to the price a numerical condition against the morphological condition of the material aspect; it assigns to the target a theoretical condition against the perspective condition of social aspect; it assigns to the strategy a short-term vision against the long-term vision of language.

This is a specific creative approach that I call consumption-centred design.

Consumption-centred design starts from the analysis of the evolution of behaviour and consumption. Its aims are, on the one hand, to discover latent needs and problems, and on the other, to define trends and "spaces" for expressing concepts for new products.

Starting from the analysis of the brief context, the first working step of consumption-centred design is the construction of the research context. It is not defined exactly but it can be explained as a particular behaviour (doing) or a perception (feeling) or a feature (being). Indeed the aim is to build up a map with specific coordinates: the consumer, production, and the market. This specific operative action is called behaviour mapping and its aim is to build a representation of behaviours and contexts of use relative to the interaction between the specific objects category and subjects.

Data for this step comes from interviews with the consumers, photo-reports about the contexts of consumption, and research on texts and images from indirect media, such as the Internet, books, and magazines.

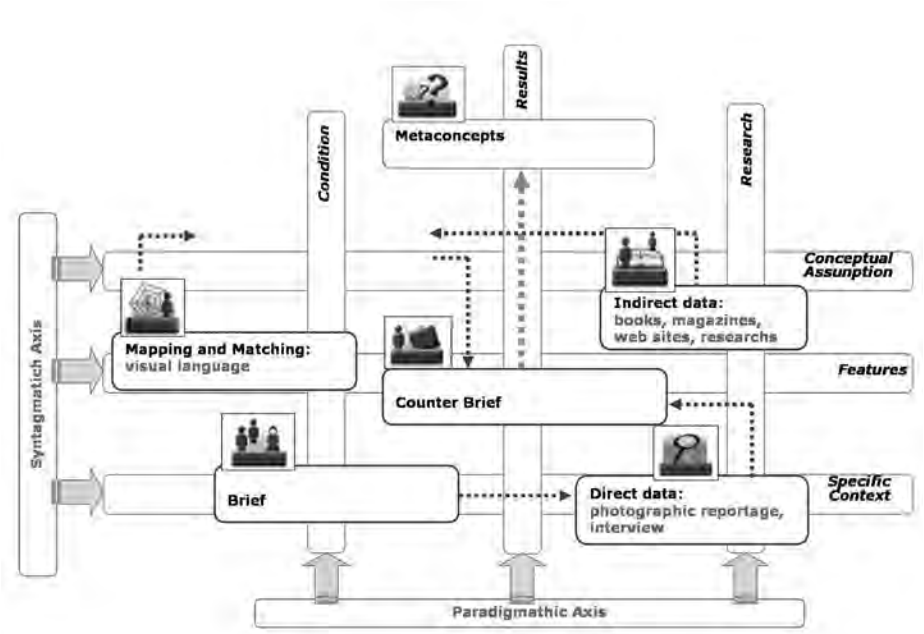
The second working step is the identification of a focus index, a possible sequence of problematic knots organized according to the highlights of the previous mapping phase.

The aim here is to identify an hierarchy of key words to express: fullness (as a prevailing condition of the consumption), emptiness (as missing conditions of the consumption) and contrasts (expression of the consumption idiosyncrasies). This specific operative action is the iconographic matching: the aim is a comparison of "symbolic" information to obtain a synthesis.

The final working step is the design of a meta-concept: a creative tool for the de-construction and the re-defining of the design approach. De-construction of the interaction between objects and subjects enables us to understand the consumption semantic value and, subsequently, the re-defining of a new and more socially and culturally sustainable interaction. In fact, nowadays, it is possible to assert that creativity lies not just in the results but in the tactics necessary to reach the results. If the result is a defined solution of design activities the tactics used by design can change according to changes in the social, economic, and technical contexts. Consumption-centred design can be defined as a tactic for the contemporary challenge posed by the production of a new aesthetic (A. Branzi).

The specific aim of this tactic is to build a synthesis according to different variables of the interaction between objects and subjects: behaviours (expressed as new product typologies), objects (expressed as new product performances) and market (expressed as new product values). This specific operative method is the creation of a hypothesis: the aim is a cluster of new product concepts. By building a synoptic panel of consumption-centred design we can organize the working steps, according to different values, on the crossings between the syntagmatic axis (conceptual assumption, features and specific context) and the paradigmatic axis (conditions, research and results).

At first, between the specific context and the conditions, there is the analysis of the brief's context by



Synoptic panel of consumption-centred design.

direct data. Then, between conditions and conceptual assumption, there is the construction of the research context with the mapping and the matching phases; afterwards, between features and results, there is the definition of the counter-brief as an overlap of the two previous steps; finally, on the results axis, there is the creation of the meta-concept.

Research Action

To sum up, consumption-centred design can be considered as an interpretative model of the design/production/consumption relationship for an exchange of knowledge between companies and society through products. Accordingly, this paper reports the results of its application for the "On Air" project, developed in collaboration with Elica, a leading company in the production of cooker-hoods. Elica is an industrial group that also produces motors, electronics, and components. There are a total of eight producers of cooker hoods active in several markets around the world, from the USA to Russia, from China to Japan. The brand Elica is the European leader in producing cooker-hoods for the most important brands of household appliances.

The collaboration between Elica and the Design Research Laboratory of Sapienza University of Rome – Factory LSD – was initiated with the aim of recognizing new competitive opportunities for Elica's products. Applying consumption-centred design, the first step was to define the brief. The analysis scenario was widened because the focus was not to be on the production of cooker-hoods but more general on the production of air-regenerators.

The research context took into consideration the urban environment, where the public and private places of human exchange are characterized by the "artificial modification" of air: by conditioning, by pollution, by mixing functions, and by smells. Under these conditions the need emerged to identify a new relationship with the air as a healthy element and also as the driver of all sensations, including emotional sensations.

In this way, the counter-brief was described with the claim "air as environment – air as vector".

This assertion converts the blocked brief about new products for Elica into an open vision that stimulates new concepts about new possible uses of air-regenerators.

As a result five specific analyses, contexts were recognised according to these descriptions: smoking areas, public food areas, coffee areas, domestic areas (excluding kitchens), and areas for well-being. Each one of these contexts, according to the behaviour matching phase, was described with images and texts as a result of the analysis of the direct and indirect data (interviews, reportage, research on the Internet and in books).

The condition of the air stimulus in all five contexts is described by different and complementary key words to describe the "symbolic" information of the iconographic matching. This iconographic matching, organized as a visual analysis, was tested

by several groups of people (with free interviews) to define a hierarchy of values.

This hierarchy of values was able to identify the specific focus index with fullness as a prevailing condition, emptiness as a missing condition, and contrasts as the most problematic characteristic.

Finally, for each research context some meta-concepts were defined as guides to the design development for new product concepts. In fact, at the end of this research process, and as an experiment, the final year students of Industrial Design of Sapienza University of Rome were able to develop new product concepts for Elica according to several meta-concepts of the "On Air" Project.

As an example, here are the steps for two of the analysed contexts: "smoking areas" and "food areas" in order to understand the possibilities which developed as a result of consumption-centred design. The behaviour mapping and iconographic matching for the "smoking areas", defined for the specific research context two different conditions of consumption: a slow use – more intimate, ritualized and relaxed, a pause in the frenetic daily life. Secondly, a fast use – adapted to socializing, more as a sharing experience of our status-symbols.

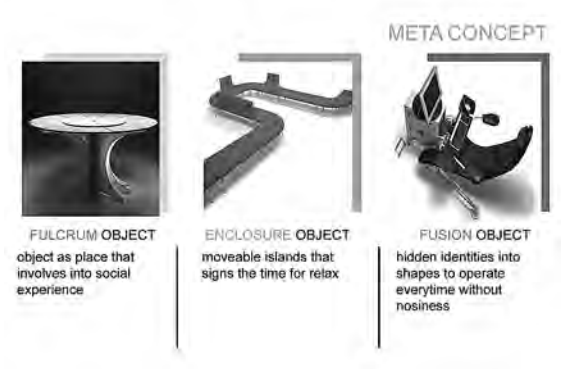
The relative focus index described the spatial surroundings for these two uses. The key words were: inner space vs micro-habitat, isolation vs accessibility, visibility vs multi-functionality.

According to the "space vision" for these experiences, three meta-concepts were defined: the fulcrum object, an object as a place that involves the consumer in a social experience; the enclosure object, an object as a movable island that indicates a space and a time for relaxation; and finally, the fusion object, an object where the function is hidden in a shape which operates only with discretion.

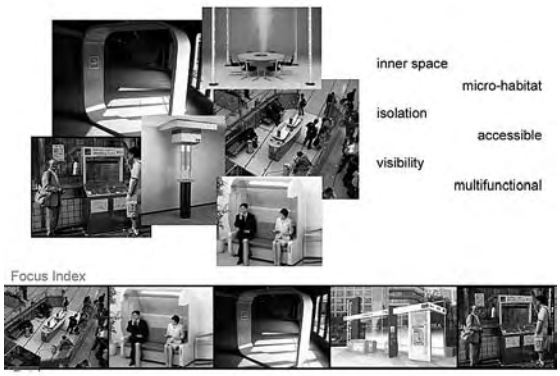
One of the product concepts developed by students according to these meta-concepts is the "pipe system": a simple linear module for the ventilation system and a junction to build unlimited configurations of space.

The behaviour mapping and the iconographic matching defined the specific research context for the "food areas" with three different conditions

Behaviour mapping for the "smoking areas".



Meta-concepts of the "smoking areas".



Focus index for the "smoking areas".

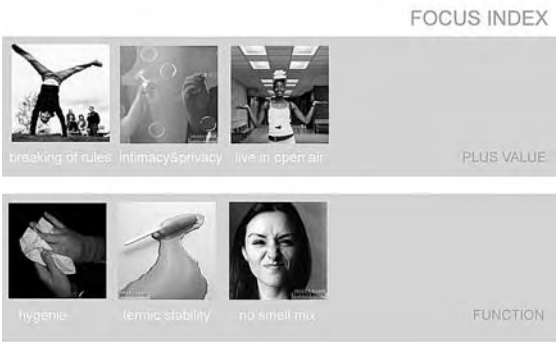
Behaviour Mapping for the "food areas".

of consumption: slow food – where the experience is oriented towards a discovery of sensations; fast food – where the experience is linked to functional needs; and ethnic food – where the experience is addressed to the experience of new stimuli.

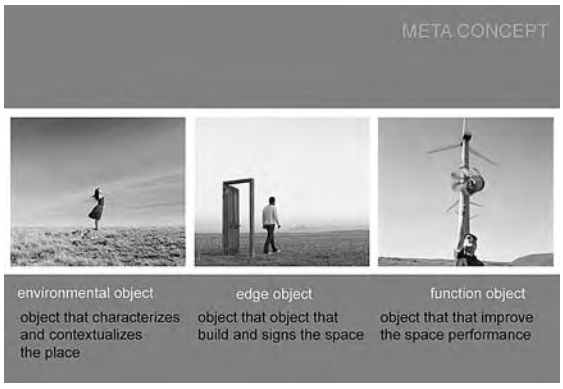
The relative focus index described the experience surroundings for these three uses. The key words were: added value as such as the breaking of rules, intimacy & privacy, open-air life; hygienic function, no smell mixtures, thermal stability.

According to the "experience vision" of these consumption modalities, three meta-concepts were defined: environmental object, an object that characterizes and contextualizes the place; edge object, an object that builds and describes the space; and a function object, an object that improves the space's performance.

One of the product concepts developed by the students according to these meta-concepts is "Soffione", a lamp with a technical core that breathes to purify the air and a soft cover that slowly deflates and inflates to visibly demonstrate its performance.

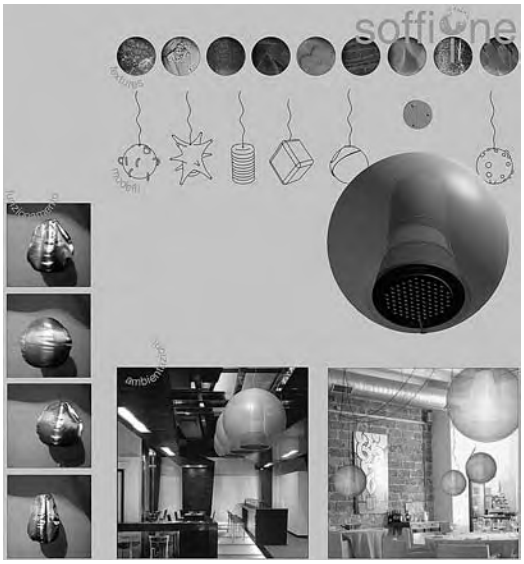


Focus Index for the "food areas".



Meta-concepts of the "food areas".

"Pipe System", students Elisa D'Ortenzio and Tommaso Venettoni.



"Soffione", students Elisa Padroni and Sara Palumbo.

Conclusions

The aim of this research process is to identify a real strategic role for design. Indeed, design is able to define the social, productive and cultural characteristics of products in order to develop a system of consumption and experience that improves the quality of life.

This specific research method, consumption-centred design, is closely linked to an individual perception of satisfaction.

According to the reknown hierarchy of needs described by Abraham Maslow (1970), where human needs are classified as "conative needs", "cognitive needs" and "aesthetic needs", consumption-centred design works by overlapping these three levels of needs. In particular, it focusses on the "cognitive needs", considering fuzzy logic as the basis for human choice in contemporary post-modern societies. Indeed, consumption-centred design responds to the most intimate experiences that define needs and instincts in order to gain a semantic localization and personalization of objects. In addition, it provides a sustainable answer to today's inexorable globalization of the aesthetic languages.

KEYWORDS

Production/consumption Relationship, Semantic value of Design, Knowledge Transfer from Companies to Society by Design, Strategic Design, Consumption-Centred Design, Design Tactics.

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Götz Wintergerst and Ron Jagodzinski

haptICS : a collaborative research project led by the HfG Schwäbisch Gmünd

Abstract

Specialists are working worldwide on the development of technologies for future interactive systems which will offer new possibilities for solving both usability problems and the management of large quantities of information. It is particularly in the field of vehicle development and cockpit design that increasing attention is being paid for driving safety and comfort when managing complex traffic situations.

In the "haptICS" (which stands for "haptic Interface Communication System") research project described here, basic principles and technologies are being developed for a novel cockpit system using haptical (touch) interaction- and communication controls. In this paper about haptICS we will report on some of the progress and developments we have made so far and in addition how we are using information transferred from several other scientific disciplines.

Introduction

The strain for today's driver continues to increase due to the steady growth of the volume of traffic and the increase of additional tasks. Therefore, in order to ensure his safety and roadworthiness a means of reducing the workload on the driver's visual perception is urgently required. Consequently, an ideal interaction tool is required that could support the driver during periods of heavy workload whilst dealing with large quantities of incoming information. This interaction tool should distribute and coordinate the information to several appropriate perceptual channels. In this way it is possible to deal with a large quantity of amazingly complex information. The aim of the development of man-machine-interfaces (MMI) is to develop devices and interfaces which enable mutual communication between the interaction technologies. Furthermore, the interplay of the individual perception channels holds a great potential for the fast and effective processing of complex information.

As the largest human sense organ, the haptical system is, by comparison to our visual data processing capability, predestined to become the interaction organ. In contrast to our acoustical ability, haptical perception permits a substantially larger volume of information to be simultaneously perceived and processed. Above all, the almost simultaneous perception of action and reaction offers the potential for quick and precise interactions. Furthermore, combined with the adoption of already existing abilities it enables the cognitive workload during the interaction with the car to be reduced. Thus, although the range of communication between man and vehicle increases, it occurs naturally since it uses a new modality without visually distracting the the driver's attention from the traffic conditions.

This is where haptICS starts. haptICS is a Bundes Ministerium für Bildung und Forschung -aided (BMBF) research collaborative project under the management of the HfG Schwäbisch Gmünd. The association partners are the Hochschule Karlsruhe für Technik und Wirtschaft, the DaimlerChrysler AG and the Faurecia Interior Systems GmbH. The project began in October 2005 and will continue until August 2008.

Theoretical Basis

The simulation of haptic signals has been analysed and used in VR systems and by tele-operations for some time now. So far it has been mostly concerned with hardware developments for very specific purposes, such as keyhole surgery. In order to guarantee maximum precision and sleight of hand, a complete and, so far as is possible, a true feedback of the original record is provided to the user.

Nevertheless, haptical communication differs from the haptical elements of Virtual Reality (VR). In VR systems real characteristics are simulated as realistically to the original as possible in order to increase the degree of immersion. However, for the communication process this is neither necessary nor makes much sense. A reduction of the quantity of data can lead to a quicker and more unequivocal mediation of information by the abstraction of the perceptions of a few, consistent key stimuli. Nevertheless, the development of haptic communication must also involve haptical perception.

On this basis the following aims can be formulated for the haptICS research project:

- a basic part of our work on human haptical perception consists of a comprehensive literature search,
- combined with our own investigations, which will enable us to systematize the relevant characteristics of haptic communication.
- this information will be made accessible in the form of guidelines for other designers and developers in the field.

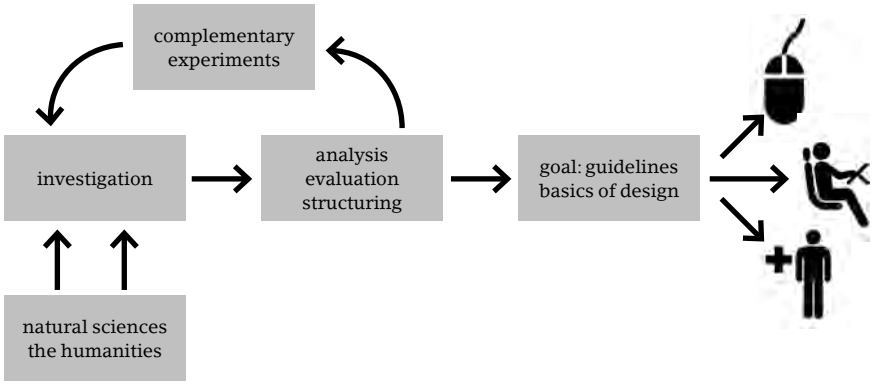
The second part of our work will involve the conversion of the software, the sensor technology and the actuating elements and also include the development of a technical description language for haptical perception as a toolkit for haptical interface designers.

Method

The guidelines will provide designers and developers with an established procedure for designing haptic interfaces for haptical perception tools together with other relevant information for the functionality of the haptic channel. The sources for this information, which must be both analyzed and evaluated, are partly from science, and partly from the humanities. Missing information will need to be provided by own experiments while other information for this new context will have to be discovered and evaluated for its validity. The resulting information will be organized and compiled into a user-friendly, introductory compendium which can be understood by the layman. In this way we hope to provide a new impulse for both the development and integration of haptic design by both developers and designers.

Performance / Discussion

The principal purpose of this research project is to identify, establish and elaborate the basis of haptic perception for the design and development of haptic interactions. The work contains an introduction to perception theory with the main focus on psychophysical methods, a description of our haptic sensors, deliberate and subconscious processing, the motor activity and an explanation of haptic figure laws. An essential source of knowledge is neurophysiological research [**1,2,5,6**] as well as the latest research developments from associated fields of science. The Guidelines should provide developers and designers with the necessary grounding for a feeling and perception of the haptic sense together with an understanding of the the supporting haptical interactions. Clearly, because of the interdisciplinary character of haptics it is essential that the text will be easily understandable because one cannot assume that the reader will have the specialist knowledge



of either neuro-linguistic or psychophysical vocabularies. Consequently, these Guidelines will only be successful if they translate complicated neuro-scientific knowledge into an easily applicable language without being superficial or becoming academically incorrect. This is not easy because the representation of human perception does not take place in precisely formulated parameters or tables of values. Perception involves a complicated system which must be holistically understood. In order for the Guidelines to be fully comprehensive it is also necessary to consider what peripheral knowledge is relevant and should be included without the text becoming bewildering. Furthermore, different fields including: sensory physiology, perceptual psychology, mechatronics and design must all be clearly related to each other. The purpose of the section on sensory physiology is to provide a broad account of the human sensory system where the basic phenomena of the senses are described.

The section on perceptual psychology examines the more complicated, information-processing but without becoming statistical in order to show simply the basics of sensory physiology which are much closer to the application of the haptic context when considering the needs of design and development.

Neverthless, the sensory physiology must be integrated with all the other components to find the appropriate balance so as to achieve intelligibility and completeness. It will be evident which data are measurable facts and which possess a more systematic character. An aim is a summary of the most important knowledge from all the disciplines involved in order to identify a set of haptical figure laws. These will serve as guidelines for the design of haptical supported interfaces and be similar to the figure laws of the visual perception theory [**4**]. Under the circumstances how these can be achieved and verified within the remaining time of this research project is as yet uncertain.

The second principle aim of the research is the technical conversion of haptical supported hardware prototypes and haptical interaction models. This takes place in a close collaboration with the involved industrial partners working on the direct interaction models and on the development of a toolkit. The Toolkit contains technical solutions, with the accompanying interfaces and supporting software without a specific connection interface requirement. It is intended to be a development tool for creators of haptical interfaces and therefore it must be designed to be much more adaptable than would be necessary for specific interface developments.

The development of this toolkit revealed the basic absence of a language by which the form, surface and materiality of objects could be precisely described. However, such a language is essential for the creation of sensitive haptical feedback and this task was therefore added to our catalogue of jobs. In order to develop such a language it is helpful to examine the basic structures of all forms of perception.

According to Birbaumer & Schmidt [**1**], the characteristics of the human senses can be divided into the modality, quality and quantities and in addition every material phenomenon has a spatial and a temporal dimension which are also perceived**.**

1. modality: Birbaumer & Schmidt call the perception channels. One speaks of five classical senses, the visual, the acoustic, the haptic, the olfactory and the gustatory. Less widely known classifications with another number of modalities also exist.
2. quality dimension: Each of these modalities consists again of different qualities. In the visual system these qualities correspond to the brightness and the colour. The qualities are therefore distinguishable qualities which contribute to the character of the perception.

Again every quality has a certain

1. intensity dimension
2. spatial dimension
3. temporal dimension

It is with the help of the visual modality that this subdivision and their characteristics can best be explained. The human eye can detect light and consequently requires different sensory cells to detect brightness, red, green and blue. If one wants to develop a device which can very precisely simulate real visual impressions, then it must generate these same qualities. The remaining qualities are concerned with the eye's ability to see sharply: the property of resolution, both spatially and temporally. Then there is the perception of different intensities. This limited range of values clearly defines the requirements for a simulation device. The better these requirements are fulfilled, then the higher the reality quality of the simulation.

Haptic perception has a similar subdivision but here the detection of surfaces is distinct from the visual perception of form. Therefore the two systems can be considered separately. This differentiation is

necessary because form recognition is a complicated, cognitive performance **[1,2,5,6]**, while for surface perception and the differentiation of surfaces the sensory system within the skin with its different sensory cells is decisive. These cells react differently to stimuli and basically they perceive three qualities:

1. Temperature
2. Adherence
3. Pressure

Furthermore, the detection of motion is also important. Proprioception (position sense) provides the brain with information about the movement and position of the limbs and the amount of power applied by individual muscles. Primarily, proprioception enables us to regulate the position of an object so that it can be manipulated whilst being investigated. Furthermore, it adds to the system a new and important quality, namely, the effort. This is vital with the regulation of hardness, weight and with the interaction with objects. The haptic sense is therefore simply a modality with four qualities:

1. Temperature
2. Adherence
3. Pressure
4. Effort

These qualities enable nearly all haptical sensations to be described. Furthermore, these qualities possess specific attributes. For example, the perception of temperature can only be perceived in a very restricted way as an absolute temperature **[1]**. Here, the thermodynamics of the skin plays a decisive role. Furthermore, the distribution of the different types of sensory cell varies over the skin's surface. Consequently, on the finger tips and palms, pressure differences and vibrations can be very well perceived while the density of the thermo-receptors is rather low in these areas **[6]**. Generally, the thermo–receptors are more dispersed and therefore provide a much coarser spatial resolution than the pressure sensitive cells **[6]**.

In order to develop a haptical interface it must first be decided which quality should be used and onto which part of the body the interface will be applied. In our work we have provisionally concentrated on the hands because these **[2]** are most suitable for the manipulation of objects and are therefore ideal for interactions. This choice has consequences for the spatial resolution of the simulators as well as for the spectrum of the intensity.

The purpose of such generally valid considerations is to identify the most important criteria for the differentiation of objects, surfaces and materials so as to create both a basis for future simulations and a descriptive language for haptic qualities. This "*Markersprache*", as we call it, is provided and tested on the basis of real material samples regardless of their technical conversion. This guarantees a very comprehensive capability without restrictions due to technical obstacles which might become obsolete in a few years. We will in any case create an accompanying technical conversion for the areas which we are able to realize.

A good example for the construction of the *Markersprache* and the haptical effects resulting from it is a raster-rotary-regulator. The mechanics of the regulator are immediately apparent due to the course of the strength curve **[7]**. Simultaneously, there is much additional subordinate haptical information or perceived stimuli which provide information about the materials used and their interaction. This information is necessary, primarily for qualitative decisions, and it is therefore extremely interesting for both the design and development.

Nevertheless, recent simulators take into consideration only the reproduction of the primary strength curve and so provide a simulation of only the mechanics. This is partly due to the restrictions of the hardware. A far bigger problem is concerned with the question: which qualities or information are vital for the representation of different materials during different interactive manipulations? Finally, there is the question how can the creation of haptical displays be made easier through the use of these data?

In our opinion, a comprehensive summary of the typical material qualities, the so-called markers, will provide the basis for haptical display design. These markers can be organised into a library of effects with their dynamic strength curves according to the surfaces and forms so that they can be combined or changed with the design of the effects. In addition there are the typical strength curves of the simulated mechanics or a selected behaviour pattern. The final strength curve can only be calculated with the actual independent interaction and movements which play a decisive role because the manipulative exploration of the objects is a dynamic process.

This division allows the classification of typical object qualities and considerably simplifies the creation of haptic-feedback. In this case it is possible to change the material characteristics with a constant primary strength curve or its reverse. A haptic-

feedback interface must not be designed completely anew, because pre-existing components already exist which can be adapted and combined in a new design. The effects library is saved and stored as dynamically changeable software. The single effects as well as the accompanying data bank are already completed in this, the first test phase, nevertheless, they must still be thoroughly checked. The test phase will reveal whether the selected criteria are suitable for creative and technical conversion or whether they must be further modified. However, the most important question is, how maximum flexibility can be achieved with the greatest possible design comfort? Success will only be possible so long as there is close collaboration between all the members of the enterprise so as to bring a development project as close as possible to completion and its wider application.

Conclusions

The partners of the research group haptICS range across research, teaching and economics. This symbiosis enables a continual development of the results because their application in teaching enables the concept to be tested for its market feasability.

The first results in terms of project monitoring and workshops have already been integrated into the curriculum at the HfG Schwäbisch Gmünd and students have also been introduced to the concept of the haptic-interface-design. Simultaneously, the development of a haptical interface for the cockpit of a conceptual car in cooperation with Faurecia Interior Systems GmbH guarantees the relevance of the haptICS project for the requirements of the automobile industry are also being explored.

The constant increase of the information work load means that it could be more safely managed if it could be spread and perceived over several user interfaces employing different modalities. It is precisely here that haptical interaction can make a substantial contribution. Although the development of haptical Displays is in its initial stages, we predict that its future importance is already significant.

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Séverine Rouillan and Frédéric Lagarrigue

Between dance and design

The gesture as a creative support for a European design

Abstract

We believe that, above all, design constitutes a conception of the world. Essentially it is an artistic discipline based on a whole gamut of disciplines. As with philosophy, sociology, fine art and art history; design imagines, recounts and calls into question our relationship with others and with our environment.

The experimental devices that we have created explore different possibilities within design research, dealing with issues such as trans-disciplinary creation and unexpected artistic complicities (dance/design, music/design). In other words, we are developing new attitudes which are likely to benefit creativity and redefine the theoretical and artistic boarders of contemporary design.

The workshop: *between dance and design, the gesture as a creative support for a European design* is an example of this approach. The choice of dance as the "complicit discipline" links up well with the prospective dimension of our new research. Is dance simply an indexed movement? The issue of the perception of dance raises the stakes. A type of reception which changes from the traditional interpretation of the art (historical, critical…) and which places itself amongst the perceptions of the receiver.

When one is a designer, living the dance experience it is, above all, a way of locating one's own subjectivity. We could affirm then that designing is showing what design does to us. As an inciter and creator of new ideas, the choreographed gesture opens new horizons for creativity: an astonishing matrix – the movements of the body can create an object!

The object becomes a median, an interface that benefits new gestures. The question is; which shapes will these new "every day gesticulations" take?

As expected, the confrontation allowed us to further define the constantly moving boarders within today's design. It also allowed us to explore other ways of carrying out a project; rich in terms of creativity and artistic innovation.

The development of design teaching in the heart of a human sciences university is complex. The difficulty of existence for these universities leads them to consider design simply as an opportunity to be recognised, so that it can be assessed by market value and financial results; only natural in the industrial era.

On the contrary, we think that above all design constitutes a conception of the world. Essentially it is an artistic discipline based on the whole gamut of disciplines. As with philosophy, sociology, fine art and art history; design imagines, recounts and calls into question our relationship with others and with our environment. From an interactive point of view, it exploits our capacity to analyse subtle signals and sensitive experiences in particular situations in order to create innovative objects.

One of the models of this design philosophy is defined by Edith Heurgon in her work entitled *Design et prospective du présent, pour co-construire des futures souhaitables.*[1] She agrees with this idea and insists on the need *to develop a reasoned and sensitive capacity to see what is invisible in ordinary people's behaviour in order to build together a desirable future able to allow new ways of being in the world.*

The experimental systems which we set up several years ago, as part of how we teach design at the University of Toulouse, le Mirail, rely on a pedagogical approach to design which is open to the creative and innovative challenges of the discipline. These systems explore the possible differences in design research from the question of cross-discipline creations to the unexpected issues of artistic complexity (dance/design, music/design) resulting in new attitudes which are able to increase creativity and rede-

fine theoretical and artistic boundaries of contemporary design.

The workshop: *Between dance and design: Gesture as a creative support for a European design* confirms this approach. Through the body and movement, common themes of both dance and design, such as the perception of sliding and methodical interactions, as well as the reading and perception of a movement can contribute to how we consider design.

Research on themes related to gestures has been carried out within the field of social sciences for a long while. A better understanding of the gesture was required in order to develop the exercises within the pedagogical program, and on the texts of which we have based our research. Amongst others there is the work of Susan Goldin-Meadow, *Hearing gesture, how hands help us think*[2] which has helped us to determine the nature of relations and possible meeting points between dance and design.

Once having defined this particular artistic complicity, we moved on to the gesture as a "creative tool" for design. The question is why and how the choreographed gesture becomes a matrix for the design of innovating objects. In other words, the aim is to consider the creative potential of the gesture when it comes to generating new forms and new uses rather than on the adequacy between the gesture and predefined object. Our analysis of the projects from the workshop has enabled us to confront our assumptions and develop concrete experiments in order to evaluate the outcome of this trans-disciplinary program.

The project *Between dance and design* was carried out as a Socrates IP intensive program financed by the European Commission. It received support from the DRAC (Direction Régionale des Affaires Culturelles de Midi Pyrénées*)* and also benefited from the expertise of Annie Bozzini, Director of the CDD (Centre de Développement Chorégraphique*)* in Toulouse.

A / Dance as the "complicit discipline"

1 / PERFORMANCE ART, BODY ART

We considered what the aims should be of putting together two disciplines such as dance and design: The first is linked to the performance arts which are played out in front of an audience over a predetermined period of time. The second is concerned with giving shape to objects that make ours a human world. Indeed, both dance and design bear witness to our culture, but their juxtaposition seems incongruous as long as their frames of reference are opposed. The momentary, exceptional representation of the one, and the triviality of everyday life of the other. Therefore, only by going beyond these two definitions of dance and design will we be able to understand what these two disciplines have in common. In other words, to reduce dance to a performance discipline would be to forget that it, especially, is a body language. Dance is linked to a primitive form of communication. It is a way of conveying feelings and emotions through the body in everyday life. For example: dancing to entertain, dancing to seduce, dancing to celebrate a victory, or even dancing to prove a conviction. The body is implicit, it is an instrument. You can see the importance of the hip-hop movement in the outskirts of our cities. A place of regulated expression, yes, but it can be understood by all of us. It is an expressive place where the body moves freely and where successive experiments contribute to the creation of a new language. As a consequence, this primitive state of bodily communication paved the way for other complex forms of communication such as Slam.

The choice of dance as the "complicit discipline", which relies on this aspect of body language, links up well with the prospective dimension for our new research.

We were able to develop this idea through Marcel Mauss' work entitled *Manuel d'ethnographie*[3] in which he deals with the everyday movements of human life so that they can be analysed from a technical angle. He has called it "the body's techniques": how to lie down, wash oneself, swim, etc. Every gesture is characteristic of its situation and has proved its efficiency: a movement follows an aim…and the body is at the centre.

The anthropological approach can provide a key to a better understanding of not only what is involved in dance but also help us towards a better definition of a design object and its aims through the new perspectives provided by these related disciplines. They can certainly contribute to a more precise definition of a shape. However, we would also like to give another viewpoint, which is that we want another way of looking at the relationship between dance and design.

2 / "DANCING IS SHOWING WHAT DANCE DOES TO ME"

According to Susan Goldin-Meadow[4], gesture differs from speech because speech refers to a recognizable codified system; gesture, on the contrary, communicates its meaning in a global way. The comprehension

of spoken language depends on the articulation of meaning at various levels (phonemes, words, sentences…). Gestural communication has fewer restrictions and evolves more freely, creating other expressions with new significance through its temporal forms or trajectories, and its variations in space.

We have seen that dance cannot be reduced to a performance art. It searches and exploits gestural possibilities. Dancing constitutes one of the body's techniques to express a particular state of mind, it is, to some extent, an instrumentalization. If we assume that the gesture can be defined as an indexed movement for efficiency (as translating an emotion, a feeling…) then this is one of the ways in which it is possible to link dance and design.

The question of significance is present within the choreographic space, and also when it comes to gestures that connect me to an object. For example, let us take a carafe with a broad base whose weight obliges me to use two hands to hold it. The action of filling someone's glass with water consequently becomes *offering* him a drink: the shape of the object influences the gesture which again reflects the significance of the action.

Is this approach still too simplistic?

Is dance just quantified movements? The issue of the perception of dance, and especially the perception of contemporary dance that we are concerned with raises the stakes.

Indeed, how does one consent to being touched by the experience of movement? What happens when a dancer dances? Stéphanie Aubin affirms that "*Dancing is showing how dance makes me feel*"[5], as if dance showed everything about the dancer and the spectator. It is the paradox of a language spoken through a body on behalf of the body. In other words, it cannot exist without its means. The body dances and outside of its reception (the spectator and the dancer) shows how dance makes me feel…within this "me", and so the subject's own subjectivity expresses itself.

This poetic approach is described by Laurence Louppe in *Poétique de la danse contemporaine*.[6] She perceives dance as an inter-subjective logic relying on the resonance between the subjectivities of the spectator and the dancer. It is a type of reception that changes from the traditional interpretation of the art (historical, critical…) and which puts itself amongst the perceptions of the receiver. It is a strange situation in which the roles of giver and receiver are blurred by an inter-subjective reception which, in fact, makes us wonder: who is dancing?

3 / DESIGNING, IS IT SHOWING HOW DESIGN MAKES ME FEEL, OR WHAT IS IMPLIED WHEN DESIGNERS DANCE?

Empathy

Surprising substitution! What could be more classical in the project? Isn't the designer playing the role of the future user in order to create his object? Thus, a stumbling block emerges in order to bring dance and design together: empathy. Indeed, the designer's ability to put himself into someone else's shoes allows him to take the user's place and to create a movement from before to after. Isn't this another way of blurring the giver/receiver roles? Isn't it another way of shifting this dichotomy by replacing the other in order to respond to his needs?

The designer's empathy relies on two prerequisites linked to different levels in the choreographic universe. This empathy implies the designer's capacity to develop an exaggerated sensitivity in order to decode what is extraordinary, magic and poetic in ordinary people's actions and behaviour. In an interactive format, the empathy becomes meaningful when the designer attributes it with an even more personal reading or a tried-and-tested sensory experience. This allows him to go beyond the simple replacement to an initial surge towards the project, towards creation. The creative act relies then on these two assumptions: firstly, to put oneself in the place of another in order to "reveal what is invisible" and, secondly: to try out by touch the revealed situation.

Living the dance experience when one is a designer is primarily a way of locating one's own subjectivity by living the experience of movement by the body and for the body. We could affirm then that designing is showing us what design does to us._

The comparison of design with dance places the challenges of movement in design into a new territory: movement becomes the means by which one goes beyond the perception of a given situation in order to physically feel an experience. A choreographer can, through movement, provide another direction and way to explore the possibilities of designing an object to create new object types,

Doing and redoing; movement as the precursor of the series

Dancing is also repeating and redoing in order to perfect a movement to perform again in another moment; another context; for another audience and for new "perceptions". A repetition of life's everyday

gestures, the trivial magnified through the dancer's movements; a sensorial experience lived and exhibited during one evening, one week or one season.

Mass production belongs somehow to this logic of repetition – whether we deal with craftsmanship based on a technical competence which is conditioned by the repetition of actions and skills; learning by doing; or even industrial production. In this context, repetition means a standard, or the presence on the market of countless identical or similar objects. These numerous objects each of which are able to bring about in the user a single action; "everyday choreography" played out by anonymous dancers.

B / The gesture as a possible counter shape of the object

1 / THE OBJECT INSERTED INTO A GIVEN CONTEXT

In order to redirect the reflection towards our experimental measures, it would be useful to take a further look and question the theme of the gesture. We have already defined the gesture as an indexed movement, capable of expressing an emotion, a state of mind, a feeling. Let's now try to understand why it might be interesting to use the gesture as a tool to create a physical shape.

An object is never perceived as an isolated item, it always exists within a coherent sign system which allows it to be read. As Baudrillard[7] has emphasized, in order to understand an object we depend on psychological and social analyses of the relationship between the object and its user. Our perception of an object also depends on its historical and cultural connotations. Polysemous as it is, the object concentrates a beam composed of different significations linked to a geographical area and a historical period.

2 / THE GESTURE – FOCUSING ON THE CONTEXT

Working on the gesture consists of focusing on one of the items within the sign system which surrounds our perception of objects. Indeed, to isolate the gesture from its interaction with the object is not only zooming in, not only focusing on one of its parameters because by approaching the gesture through a perceptible experiment, we are able to identify individual relations in the given context. By trying out new gestures in everyday situations, we react in similar ways regarding what characterizes the situation (spatial, temporal and relational elements…) and in regard to the materialisation of a future object. The gesture becomes the counter-shape of the object; even a negative one might say. An *indexed* negative though, i.e. registered in one of the object's possible dimensions due to its use.

To a certain extent, our work on the gesture is similar to working with moulds: one explores the future object by looking into its possible counter shapes. As an inciter and creator of new ideas, the choreographed gesture opens new horizons for creativity– an astonishing matrix because the movements of the body can create an object!

3 / FROM THE APPROPRIATE TO THE GENERATING GESTURE

It is not new to take an interest in the gesture within the field of design; other approaches have been developed based on this strategy. Indeed, designers who have approached the question of the tool have been interested in the role of the (ergonomic) gesture in our discipline. Accordingly, the aim is to find the *good gesture*, to study how an object which exists within a vast system can help the user to become more efficient when it comes to carrying out a task.

The issue of the good shape is thus replaced by that of the appropriate shape. The question was raised by Plato- whether to choose a golden spoon or one made from the wood of a fig tree in order to make a mash. Socrates chose the one made out of wood because the golden spoon would be likely to break the pot and to spread into the contents. In other words, he chooses the appropriate object. This poetic text is interesting because it shows how attention is paid to the *right* gesture.

The designer bases his reflexion on the quality of this gesture and the direct result of this is the shape of the object. Ultimate perfection is to reach the *right shape* whilst maintaining the reasoning above. We wish to initiate a slightly different approach by extending the proposal. The issue of the gesture inserted into a given context is based on the double subjectivity of a work when the designer dances, and it repositions the previous reflexion. It is no longer about an appropriate gesture but about generating one, and this opens up new possible directions and significances. The object becomes a median, an interface that benefits from new gestures. The question is; which shapes will these new "every day gesticulations" take? This prospective dimension is what particularly interests us in the experimental program developed below.

4 / THE INTERFACE

The designer needs to work on the interface in order to mediate our relation with the object. In general, the interface simplifies it, especially in the case of technical or electronic objects. The aim is to render the user-mechanisms of the object easier to read: I carry out a certain action, a certain gesture, and this gives a certain result.

If we choose to see the gesture as a vector which is able to generate other usage methods, then the role of the designer is no longer limited to enhancing a given dialogue and use. It aims at re-enchanting our relation with the object by inventing new relations:

- either by dematerializing the interface (when a greater feeling of fluidity appears). In this case, the object becomes an object of desire. We speak - the telephone composes, we stretch our hands forwards and the water starts running…
- or by creating a distance between the action taken and the result. In this case, one might have a strange feeling of a gap, almost magic as Pierrette Gurnard[8] emphasises it; *the case, the screen, the keys, the switches, the control knobs- they constitute the new bond between man and the function of its use. The extent of the gesture has nothing to do with the action operated by the machine: the pressure of a finger can as well compose a telephone number as the opening of a door or even turn on the television.*

C / Re-enchanting our relation with everyday objects, example of implementation through teaching

1 / PRESENTATION OF PEDAGOGICAL MEASURES

Context

During the last three years we have tested the approach to design through dance within the framework of project teaching at the University of Toulouse le Mirail. However, it was within the context of a Socrates Intensive Program that it was further developed, and this is the project that we wish to present to you. The program took place in January 2007 and was carried out in collaboration with University CEU of Valence in Spain (associated with the design group Culdesac), the Universitad degli studi di Firenze in Italy and the choreographers Boris Charmatz, Manuela Agnesini, and Rachel Garcia. The Socrates IP was organized as a two-week workshop with various alerternating exercises of dance and design.

Development

The different exercises proposed by the choreographers progressively approached the concept of surface, volume and context. Through these themes, working on the body and on movement, the students examine and experiment with the existence of every day gestures and their multiple and polysemous repercussions.

images 1 & 2 : a choreography exercise with Boris Charmatz

Consequently, the gesture is perceived like a complex "choreographed" element interacting with the global environment and the immediate use. The choreography exercises are carried out in parallel with design exercises; the students are brought to intervene on one or several of the following concepts: context / form / gesture, and thus to reinvent possible ways of connecting with them.

2 / 1st EXERCISE:
READ A BOOK, PROPOSED BY BORIS CHARMATZ

The students used simple situations, for example: reading a book while dancing and also explore various alternatives, such as: read a book while whispering into someone's ear; or three people reading the same book at the same time; or propose a reading by transforming into a reading desk for someone else, etc. Through these exercise series, the students

were able test the mechanism of interrelationship where the book is used as pretext. In this context, the traditionally banal and daily activity of reading becomes the framework for experiments with new gestures which crystallize relations, feelings and sensations (attention, sympathy, tenderness…).

3 / 2nd EXERCISE:
THE SURFACE / TOUCH, DON'T TOUCH
Based on the body exercises on the surface theme, the students are requested to propose "two tactile devices" likely to modify (to either accentuate or deny) our relationship with an everyday object through physical contact.

For the first proposal, the intervention must be carried out directly on the object (form, material, colour, actions: removal / addition / multiplications…) in order to re-materialize the moment of contact and the point of impact between the object and the user.

The second proposal consists of imagining a complement to an object (tool, addition, extension…) so that it is possible to be in relation with the object without needing to physically touch it.

The first exercise exemplifies the points made in the earlier sections of this paper. The interventions on the shape, the aspect and the appearance of the object have immediate effects on the gestures and the context of its use. New bonds are woven between the user and "the object in disguise" for each proposal. They show potentially new uses, to some extent one could say that they propose an infinite number of usable variations.

A citrus fruit press was the example chosen for another exercise during which the material of the receptacle was changed and replaced by sponge. Not only does this simple action completely modify the gestures related to the use of the instrument but it also changes the emotional relation we have to it. On the one hand, the fruit juice-making process is reinforced as there is now a need for two successive pressures in order to absorb the liquid: the fruit on the press, and the sponge above the glass to release the drink. On the other hand, the "sponge" material generates a repulsive effect that is hard for us to control. It is a non-food material, generally associated with domestic jobs, and thus, normally, not convenient for this type of use. Another intervention with the same object consisted in ballasting the bottom of the receptacle, and thus making it possible to use only one hand in order to press the fruits.

4 / 2nd EXERCISE:
VOLUME / CONTEXT / WHISPER TO A FUEL PUMP
In this exercise, the main theme is the scale of the gesture. "Micro gestures" are on the scale of a whisper, or a finger touch while "macro gestures" are on the scale of the body and the environment. The aim is to understand how the gesture can exist within its own proper space/volume. Furthermore, how is the volume in which the gestures exist conditioned by its own context and significance: *I whisper to the fuel pump.*

How does the object generate its own private space? How does the interaction between this volume and the user determine the significance of the action taken and its connotation (public, private, intimate, sexual…). We can consider that working on the volume / in the space around objects (concrete physical volume / abstract volume generated by the uses and associated actions) and on the interdependence has a significance. The process thus developed somehow brings us back to an elastic sense which again is connected to the objects' proper space.

a / Performance

1. go to the city centre.
2. choose a context with locatable gestures from your everyday life.
3. four notions: sexy, carefully, quickly, friendly, – within the chosen context, explore the possibilities of changing the nature of the gestures while using an object in an environment. Personally try out all the possibilities.
4. film the performances, and return with the videotape.

b / Re-action

1. among the explored possibilities, choose the most interesting one.
2. according to the selected concept (sexy, carefully, quickly, friendly), transform the object in order to enable the user to modify the gestures related to the use as well as the user's relation to the context of the use.
3. create a basic model and a visual communication of your proposal.

Example

Based on a simple situation like drinking coffee, the students carried out experiments on the gestural micro-modifications induced by the change of the context (friendly, carefully, sexy, quickly) and the

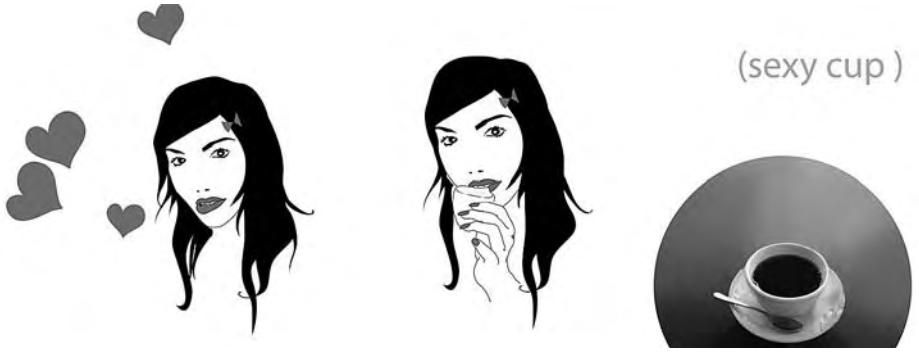
action to be taken. Secondly, they proposed alternative forms and prostheses for the given objects (coffee cups, ashtrays, lighters…). For example, the student interventions for the *sexy* situation consisted of adding embroidery to the handle of a coffee cup. This simple act in itself conditions the perception of the object and the associated connotations. When the gesture is the thematic basis then the elements are likely to modify the perception of the object which are analyzed and then revisited. The choreographic experiment is used as an instigator for a creative act, which again modifies the gestural relation that we have with an object while we use it. Thus, the embroidery which constituted the handle of the new cup requires special attention when one picks up the cup, and this attention positions the gesture within the *sexy* register. In addition to this, the chosen material for making the handle connotes underwear and the female universe: *lingerie* for cups so to speak. It is all about using the gesture as a starting point and then returning to it in a better but different way.

Conclusions

The workshop: dance and design was carried out on an international scale and constituted a double cross-over; intercultural and trans-disciplinary. We have been able to exceed the expectations of our purpose (which aimed at responding to a predetermined schedule of conditions) and to explore other possibilities by considering design as an artistic laboratory.

The workshop was an extraordinary trans-disciplinary occasion which enabled us to test our hypotheses concerning the different possibilities provided by the interaction between dance and design. As expected, the confrontation allowed us to further define the constantly moving boarders within today's design world. It also allowed us to explore other ways of carrying out a project which was rich in terms of creativity and artistic innovation as can be seen through the numerous experiments, the different student projects (of which some are in the prototype phase), and the videos which were shown during the workshop. The inter-cultural workshop modified our perception of not only our body and of small everyday events, but also the richness brought by cultural diversity in the project phase and during each of the different stages. Projects similar to the workshop *dance and design* will be repeated in 2008 and 2009: two opportunities to continue and ameliorate the experience through enhancing choreographic and university collaborations.

images 3 & 4 :
sexy cup



More ambitiously, we are currently working with the CIAM, Centre d'Initiatives Artistiques de l'Université de Toulouse Mirail and its director, Jacques Bétillon, on the creation of a European program: a Cultural European Factory named FABREC. The project is equally based on an interdisciplinary cross-over with contributions from several artistic disciplines: theatre, literature, design, music, cinema, and the intercultural aspect with five European partners: Poland, Turkey, Italy, Germany and Austria. It is a new intellectual and artistic challenge that we can't wait to start working on!

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Heike Goeller

Designing for different cultures, a designer's predicament?

Abstract

It is crucial for a designer designing for the global market to understand the value systems and factors that influence the use, the appreciation, and success of a product or space.

A series of studies undertaken at the Department of Design, Ohio State University has identified the complexity of the subject matter, revealing the shifting nature of cultural settings from single- to multi-layered factors that influence our perception and judgment. A designer aiming to develop meaningful design concepts that support the physical, as well as the psychological needs, cannot exclusively trust his own perception, but must respect the social and cultural context for whom he/she is designing.

This paper focuses on identifying core aspects to be considered when designing for a different culture, and outlines a research methodology for investigating culturally specific data. It draws correlations between '*designing for experience*' and design methodologies for '*with the user in mind*' with the aim of encouraging the investigation and referential use of people's innate, subconscious, culturally based manifestations.

Introduction

Culture is defined as the complex whole of a society, which includes knowledge, belief, laws, morals, rituals and costume as well as the habits and capabilities acquired in a particular environment as a member of that society (**1**). People define themselves by where they come from, their religion, language, history, values, and the way they live. Our need to belong and our need to know who we are is served by identifying ourselves with cultural groups explicating our identity by knowing who we are not. Social structures, value related goals, philosophical pretexts and paradigms differ greatly from culture to culture. In the background of our consciousness all these factors influence our actions, judgments and preferences; they exist and 'operate' and dictate what we value, pay attention to, feel comfortable with, surround ourselves with, buy and use.

In a matter of two decades, the originally far-fetched notion of a designer educated, shaped and conditioned by one culture, but practicing design and developing conceptual solutions for another culture has become a reality that we cannot escape from today.

Globalization trends, alongside a new awareness and, hopefully, appreciation for cultural diversity,

demand a better comprehension of the factors that shape us. For those of us practicing design with the goal to provide our audience with the best possible solution, it has now become pertinent to find solutions that not only serve specific functional purposes, but also foster emotional connections and provide meaningful experiences to reach beyond the obvious and to be informed by the factors that influence people's subconscious.

Design Relevance

For a design concept, product or space, to be successful it is not only essential to know the practices and context of use, but also the inherent references and mental connections made by the prospective users. During the typical design development process designers confront themselves and translate data from a multitude of sources according to their educational level or level of understanding, experience, and (cul-

tural) perspective/s. Furthermore, given the same technological sources and production options their design solutions will vary greatly. The three major design and product context related domains, shown in Figure 1 below, are those from which data is typically drawn and will become part of a product's operational space once it is on the market.

Influencing factors

It is the cultural space that is most prone to misinterpretation. This is because while gathering information related to the product space, its relevance is judged based on a designer's own inherent values and expertise. Over the years at the Department of Design, Ohio State University, a series of studies have been conducted which have focused on identifying these variations of interpretation ranging from comparisons of organizational structures (**2**), space organization preferences (**3**), image connotations (**4**), and signs of status (**5**), etc.

What are the factors that most influence, not only a designer's perception, but also the users' acceptance of-, their handling, and identification with: an artifact, a message, product, or space? Therefore determining these factors which are part of an individual's information and decision-making process and how their interpretations vary is clearly very important. The following figure 2 shows the factors involved in this ongoing evolutionary process. A process that uses mentally embedded autonomously operating systems, along with physiological rules, which give sense to the data provided.

Taking into consideration that wherever we are and wherever we go; we carry with us an assortment of mental concoctions which have all been established to provide support and ease our interactions with surrounding environments. These concoctions, or metal maps, which serve as filters; guide and control an individuals' interpretations, and govern their viewpoints, appraisals and convictions. Studies (**6**) show that as a result, we might only be able to see, so as to "visually comprehend," what we have seen before and therefore can make sense of based on our previously stored information. When quick decisions have to be made, especially in emergency situations, we tend to rely on information "learned" originally, that is, when we first encountered a similar situation.

Therefore the design of handling emergency tools and being able to correctly associate the information provided by guidelines for fire escape situations may prove to be crucial. Furthermore, the fact that a person's personality is set by the age of 5, and personal values are established by the age of 10, and are only capable of modification by major emotional offsets; the profoundness and inevitability of the impact can be imagined, especially as most of these mental maps operate 'in silence', that is uncontrolled by our conscious thought processes. Thus the environment, the people, the values, the social structures, the beliefs, the laws, and rituals that they have been exposed to by the age 10 have shaped them for life.

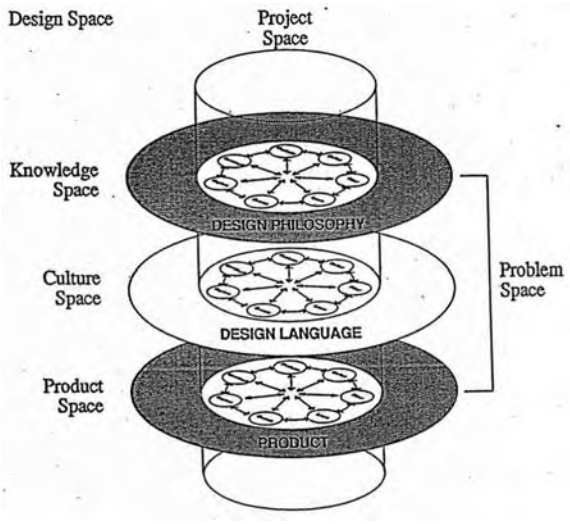

Figure 1: design space

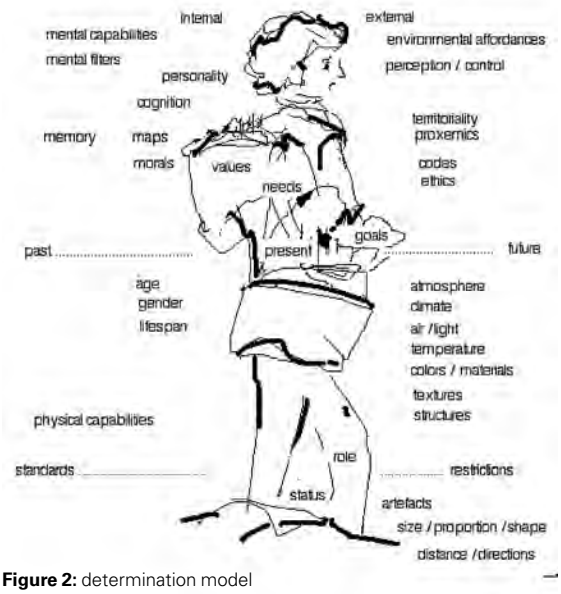

Figure 2: determination model

Differences

What do we know about how we differ? Edward Hall (**7**) in his series of books including 'The silent language' and 'Personal space' has outlined some of the factors. There are apparent categories, the most obvious being different languages. Furthermore, linguists recognize that behind the phonetic differences there are fundamental differences in thought processing. There are variations in meaning as a reflection of the paradigms and the visions people have of the things surrounding them and existing in their particular culture. Other categories may not be as immediately apparent, but can be sensed and reveal themselves through observation and yet others might remain hidden and only become apparent when considering the context.

People differ:

In the way we do things, operate, work, eat, share, read and write, our behavioral patterns, and reading order

In the way we express ourselves and how we communicate: language, art, crafts, and clothing

In what we value: our appreciation for costumes, our morals, beliefs and codes.

In the way we relate to each other: manifested by social organizations, social structures, established hierarchies and rituals.

In the way we use space: space boundaries, notions of privacy, territoriality, and notions of time and place.

Take for example our notion of time: everyone who has travelled the Americas will surely have encountered the distinct differences in the perception of time between those living in North America and South America. People living in the northern continent look at time as an orientation and a functional organization system to structure their activities, because preciseness is pertinent. Meanwhile, those living in the southern continent look at time as an orientation system with no specific consequence on schedules. In the south, 'now' means maybe later, 'tomorrow' means sometime in the future; the notion of being 'on time' does not exist, 'to be late' is undefined and varies in interpretation.

While our differences in handling time might not be of great significance to a designer, nonetheless, in dealing with clients, the implications and resulting behaviour in the following case may be worth considering. When someone is used to interpreting being as late as five minutes past the scheduled time, with the connotation that it is degrading to be made to wait, then a professional meeting may be off to a very bad start. Similarly, the information about how we culturally differ in using space and setting spatial boundaries may be critical. for a designer creating interior environments for the global market. Americans and Europeans are at awe but also, at times, shocked by the ability of the Japanese to screen out information. Their ability to establish invisible boundaries using mental blocks to guarantee privacy is manifested in their preference for using paper screens to separate spaces, whereas Americans and Europeans prefer physical separations between individual members of a group and need subdivisions for single activities, and consider the individual control of privacy a fundamental right. According to Hall, personal distances which are considered comfortable vary greatly from culture to culture. North Europeans (Germans) and North Americans prefer talking to each other standing about one arm–length apart, while South Europeans (Italians) and North Africans prefer one half of that distance and feel quite comfortable in environments that feel crowded and too tight to others.

We know today, that what we surround ourselves with, what we appreciate, and what we feel is right or wrong is administered by our values. These values are formed during our early years and they could be called our primary culture–based values. If these values highjack our judgments then the acceptance and success of any design concept is dependent on its ability to reach and satisfy these hidden values that influence our decisions which we consider adequate, comfortable, enjoyable, suitable, and desirable.

Methodology

As part of a study (**8**) we have established a classification system and developed a worksheet aimed at developing a better understanding of the factors and domains which exist in a given culture and which contribute to this shaping process. The worksheet allows a designer to gather culture-specific information that can be used to provide the background for the development of culture-sensitive conceptual ideas. We determined that each culture consists of a multitude of domains that, according to their ability to resist or embrace change, were grouped into three major categories.

There are cultural domains that can be considered as being very stable. These domains belong to the first category and change very slowly. They include geographic and climatic patterns and the surrounding natural and anthropographic environment, climate related phenomena, contextual conditions such as the surrounding mountains or open landscapes; the kinds of trees, plants, animals, people's race, and also harvesting techniques.

The cultural domains in the second category are gradually changing and equally embedded in our memory and these include: religious beliefs, taboos, rituals, epics, language related scripts, words, dialects, family roles and social structures, festivals, social rituals, and architectural expression, cities and villages.

The third domain category includes the differences that one might think of first. This category includes any form of artistic expression ranging from paintings, sculptures, photography to dance, music and theater. It includes artifacts, and any domestic, business, ceremonial or leisure related objects; rhetoric's' including literature and humor; political ideologies and issues, but also fashions, styles, services, products and advertisements.

The following charts were established to serve as worksheets for gathering information in each of the above three categories. They are meant to identify manifestations of forms, colors, textures, patterns, sounds, smells, and tastes, but also events, artifacts, personalities, expressions, notion, or moods existing in a specific culture.

	Manifests							Intangibles Constructs			Tangibles Constructs			Implications
	Forms	Colors	Textures	Patterns	Sounds	Smells	Tastes	Words	Notions	Moods	Events	Artifacts	Personalities	
GEOGRAPHIC Topography, Mountains, Seas, Rivers, Forests, etc.														
CLIMATIC Climatic Type, Seasons, Phenomena (Rain, Snow, Dust, etc.)														
NATURAL Trees, Plants, Animals, Birds, etc.														
ANTHROPOGRAPHIC Race, Features, Anthropometrics														
AGRICULTURAL Crops, Fruits, Vegetables, Harvests, Techniques, Implements, etc.														
	FORMAL VOCABULARY							PREOCCUPATIONS			REFERENCES			

Table 1 lists the domains that are very stable.

	Manifests							Intangibles Constructs			Tangibles Constructs			Implications
	Forms	Colors	Textures	Patterns	Sounds	Smells	Tastes	Words	Notions	Moods	Events	Artifacts	Personalities	
RELIGIOUS Beliefs, Gods, Rituals, Prayer, Taboos, Epics, etc.														
LINGUISTIC Spoken word, Written word, Dialects, Scripts.														
SOCIAL Social Structure, Festivals, Social rituals (birth, fertility, marriage, death)														
FAMILIAL Family structure, size, Patriarchy/Matriarchy.														
ARCHITECTURAL Cities, Towns, Villages, Community built-form, Individual built-form.														
	FORMAL VOCABULARY							PREOCCUPATIONS			REFERENCES			

Table 2 lists the domains that are gradually changing

	Manifests							Intangibles Constructs			Tangibles Constructs			Implications
	Forms	Colors	Textures	Patterns	Sounds	Smells	Tastes	Words	Notions	Moods	Events	Artifacts	Personalities	
ARTISTIC Plastic Arts (Painting, Sculpture, Photography, etc) Performance Arts (Music, Dance, Theater, etc)														
ARTIFACTS Objects: Domestic, Business, Ceremonial, Leisure.														
RHETORICAL High Literature Folklore Humor														
POLITICAL Ideologies, Issues, Personalities.														
COMMERCIAL Products, Services, Fads, Fashions, Styles, Advertising.														
	FORMAL VOCABULARY							PREOCCUPATIONS			REFERENCES			

Table 3 list the domains that are rapidly changing

If we follow the typical design process the question is: at what time in the development of a product will it be beneficial to access this kind of information? Ideally, this area of additional investigation is addressed along with the typical steps taken within the different design phases. The following table (Table 4) illustrates the design process steps during which it is recommended to incorporate culture specific information.

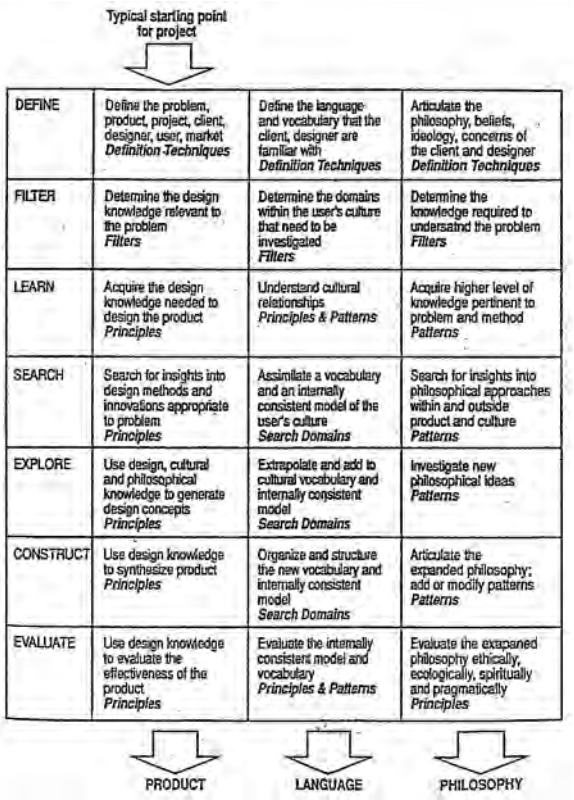

Table 4: process

The examples gathered here as part of this investigation will provide the designer with a collection of cultural elements that can be used for either just clarifying the anticipated product's context of use, or for incorporation into the design concept itself. During the design ideation phase, components of these found elements can be reiterated, abstracted or transferred, and re-introduced to create new interpretations with the potential to lead the designer towards real design innovations. Pan Yun He, Professor and former president of Zhejiang University, China, in his paper "The introduction of culture as a fourth design approach", has already outlined several methods for the use of this information to develop culture sensitive design concepts. He points out that the possible interactions are based on perception, emotion, and comprehension. An object's visual attraction will be greatly enhanced through the correlated imagination and memory based emotional connections made (**9**) by referring, embedding, or citing cultural forms and formal content,

Conclusions

References related to the formal vocabulary, according to our categorization, can change rather quickly and so following these recommendations does not necessarily guarantee that a design concept will be automatically successful in any particular culture. Internationally operating businesses, Internet chat groups, and the ability to visually access sites and events far away is increasing the rate of this change. The awareness of this technology-based, potentially radical shift has increased the interest in studying life-style groups existing in each culture in the form of loosely related interest groups. During recent years concept stores and consumer product designers have been especially confronted with this phenomenon, while the fundamental difference between lifestyle and cultural groups, from our point of view, exists in one being voluntary and the other being innate. Lifestyles groups usually adopt standards derived from the category of cultural domains that rapidly change and do change, as one can even be part of a variety at the same time. The underlying modus operandi, however, the 'backbone' codes that serve as criteria for our conception of the world, our self-reliance, and individual autonomy remains relatively stable and is ready to surface in critical situations. Although these codes consist of a mix of domains from all three categories our self-reliance depends on the structures that have been shown to change rather slowly,.

Thus, one is able to develop a deeper understanding for both the differences at work and their potential application only through the deliberation of the meaning of these collected manifestations in the context of their use in a specific group. This process of reflection might enable us to extract and become conscious of our own guiding principles which, once we are aware of them, we can then choose to dismiss for the time being. We can temporarily suppress the use of the ones that assert meaning derived from our own sublime context collection by focusing on our own analytical modes of thinking.

Today, a changing system of culture and composite lifestyle modes that seem to function in layers and provides even more multifaceted references, make

it difficult for us to predict connections. Even after having received a good education technologically we can no longer pretend that we know it all. Therefore, finding the right correlations in a multicultural society must be part of a multi-layered research process. A process that at various demarcation points of the design development phase uses a combination of methods to solicit feedback and is geared towards eliciting mental connections made by anticipated stakeholders.

Liz Sanders, adjunct Professor of the Department of Design, has for years been an advocate of accessing experience-based information to help formulate a projects' scope. The approaches tested by her (exploring what people do, say and make (**10**)), have changed the interpretation of the role and responsibility of the designer. None of her approaches rely on the standard quantifiable information gathering methods because they have not been able to provide insights into the mental connections that people make, nor outline the aligned emotions and judgments. Her approach, however, solicits a range of qualitative information that allows us to discern what is meaningful to a particular group and what is not.

We are introducing to students various methods of supporting culture sensitive solutions early in the interior design program. Prior to any organizational design decisions, visual reference code maps are created depicting cultural contexts, emotion-evoking atmospheres, and anticipated moods. These maps serve to provide not only direction but also control during the ideation process. In addition, developments of verbal and visual scenarios have become essential steps to be taken following one's familiarization with the project's culture-space. Ideally, the maps and scenarios also clarify a project's anticipated operational space within a team, and can be used to discuss connotations. The established visual scenarios can then be evaluated, and re-evaluated by potential user-groups and stakeholders. Regardless of distance, the Internet may be of help in quickly reaching people for the purpose of incorporating their understanding into the design concepts.

Gabe Esquivel, a colleague in the program, has shifted his educational focus towards the study of the relevance and reflection of interior design related 'affects'. We feel responsible for the creation of environments that do support functional requirements, consequenrtly, we also set the psychological framework that is felt by the atmosphere of a given setting. Dr. Brennan, in her book, '*The transmission of affect*', confirms the interrelationship of all the factors that have been outlined in figure 2, by pointing out that an environment's "*'atmosphere' has to take account of physiology as well as of the social, and psychological factors that generated the atmosphere in the first place*" (**11**). Creating emotion evoking environments has thus recently become central to our educational objectives; an objective that cannot be achieved without a thorough investigation into the atmosphere generating components themselves and the deeper meanings of the core factors that lead to emotional reactions.

We have argued from the beginning that we should be successful in providing our clients with concepts that are meaningful to them since a primary aim is that they will be able to connect emotionally to the design. This is because it is through our intuitions and emotions that our deep layered (primary-culture-based) references are expressed. By so doing, maybe to the surprise of our own conscience, we might even learn about the layers of our own associations that will help us discern variations, and will also alert us to the decisions which we make based solely on our own affinities.

Work in progress, examples

The following are examples of work in progress illustrating differences, but also applications of the method discussed. Only a small sample will be shown here, as they can only be appreciated if seen in color.

In Table 5 we attempt to compare the culturally specific variations in opinions and paradigms for four different cultures. These tables focus on the underlying guiding principles that, once understood, may help to identify the social parameters of a specific cultural context and thus the objectives for a particular design concept for it to function successfully in its context. As has already been discussed, It is important to keep in mind that each culture consists of a multitude of variables. The limited selection here lists only the most characteristic qualities and features.

An application of the methodology discussed here is shown in the visual scenarios picture series. They are examples of project context information developed by interior design seniors as part of their familiarization process in preparation for concept ideations, providing cultural code maps for visual reference, and image collages for depicting anticipated emotion-evoking atmospheres. See picture series 1: visual scenarios

CULTURE	HISPANIC - MEXICAN	AMERICAN	EUROPEAN	ASIAN
aspiration	more is better	more is better	less is better	less is better
social values	family oriented	individual oriented	professional group	social group
philosophy	peace. religion. work	power. money. celebrity	quality of life	past /future balance
favorite game	dominos	poker / gambling watching football	hiking walking	
core food	tortillas	white bread/ red meat sugar - elim. of bitter	noodles, potatoes red meat	noodles, rice, vegetables
dream-state	a better life	becoming famous	professional fortune	achieving master
favourite	gathering	tv and shopping	traveling	socializing with
pastime	for celebrations	consumption of goods	socializing with peers	prof. peers
dance	high energy	group dancing	couple oriented	single person oriented
expression	tension building	continuous rhythm	repetitive rhythm	demo of harmony
advertisement	family oriented	individual power	role and	spiritual connection
focus	dream oriented	action images	performance oriented	images
adaptive use		church = restaurant	castle = youth hostel	
church interiors	colorful, ornate celebration of death	non-specific colors non-specific style	focus arch. Structure non dominant colors	color / nature reference
religious	statues, replicas	signs	symbols repres. Deity	natural elements
references	representing deity/s	representing deity		representing deities
house paints	white, pink, aqua	pastels, browns, grays	white, naturals	naturals
connot.: white	death	sterile pure	pure clarity	mourning
green	artificial	natural	natural	fresh precious
striving for	a better life	status	quality	harmony + excellence
orientation		youth oriented	adult oriented	seniority oriented
perception	form + surface	form + surface	detail oriented	detail oriented
orientation	oriented	appearance	function	
interface man	support oriented	fast usage oriented	precise performance	controlled nature
product		quick sell	skill + performance	skill
	medium term	short term	long term	long term
attracted to	colorful	"slick"	geometric logic	natural randomness
main design	affect	sellable	rational functional	functional + spiritual
objective			emotional	
plans / goals	medium range future	now, instant gratification	medium to long term	long term

Table 5: cultural paradigm variations

The subsequent examples shows student study results initiated by Prof. Gabe Esquivel. The focus of these studies is on the creation of emotion-evoking interior environments using computer visualization techniques. The major educational objective is to determine variations and options for comparing their own interpretation with those of others while studying the 'affects' that connect to viewers' intrinsic culture based connotations. This provides opportunities for the introduction of a new aesthetic in interior space design. See picture series 2: 'affect' interiors

KEYWORDS
Design research, design process, design methodology, visual scenarios, cultural domains, judgment influencing factors, user participation, experience design, emotion-evoking design

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Tables and Figures

Figure 1: Goeller, Vanka, 1990, OSU thesis
Figure 2: Goeller: 1985/2007, Design 554
Table 1,2,3 and 4: Goeller, Vanka, 1990,OSU thesis
Table 5: Goeller 2007. Cultural paradigm variations
Pictures: series 1: Goeller 2006: Design 661.08
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Erika Cortés

What contemporary life brings into design

From a peripheral perspective

Abstract

Contemporary societies cannot be defined as pure; our context has been formed multi-culturally. Furthermore, they are influenced today by a constantly changing rhythm, which we experience due to the speed of the media, technological advances, and so forth.

That is why every society has a unique culture that is the result of its own circumstances; if the circumstances should change due to the environment, population pressure, or historical events, then the culture also changes. [**1**]

The aim of this paper is to create an awareness of cultural issues among designers. Designers must pay attention to these issues during their creative processes because they cannot ignore the fact that everything we see, touch, interact with, and think about is part of our cultural atmosphere and that this quality becomes the major adaptive mechanism for our species.

Introduction

Design as a concept and practice has suffered many transformations because its evolution through time has followed different interests.

However, nowadays the trend in design is about reacting to the speed of development, trying to catch its rhythm, yet without succeeding, and ending up with mutations that are the result of a restricted understanding of the contemporary world of behaviour.

Many questions emerge from this situation and all of them point to one main topic: how can we understand the impact that design has on people, companies, and society?

A good way to begin is to question the awareness of design's impact on complexity, because it seems that for most of the time designers forget about the interrelationships within the design profession and with every field it touches upon either directly or indirectly.

This paper constitutes a theoretical foundation that has been gradually structured to develop research with the purpose of understanding how our current age is causing changes in different spheres, specifically within design and social matters and within a given context, but also at the periphery.

Inquiries about design

It is important to point out that today's complexity is taking us to a reality with unimaginable links; even the smallest events can generate big transformations. *"Complexity's paradigm results from new concepts, new visions, new discoveries, and new reflections interconnected in ways not yet explored."* [**2**].

This paper focuses on going beyond the limits of design to link information from distant fields to enrich our contemporary view and incorporate it into our design thinking. It also proposes that we should respond to contemporary complexity by changing lineal thinking into an interwoven structure open to understanding the contemporary universe through our design capacity for gathering data from different spheres. This should be one of the first steps for halting the global consumption of mass produced goods. [**3**]

Human beings do not belong to a universal group, at least not in the physical sense. However, the fact that we all belong to only one human race cannot be denied. Nevertheless, in cultural terms we do come from different roots that make us different from everyone else around us, meaning that the personal package of our identity is in a certain way unique.

Even though we are living in a global society and have regrettably experienced cultural losses within our communities, human beings, by nature, need to be members of a group with whom they can both identify and feel connected to. As a consequence life's rhythms have lead us to adopt social transformations. This reason has resulted in the search for new ways of interacting socially apart from sharing common objectives, ideologies, or roots.

Consequently, within our multicultural societies, there exist minorities who demand a quick response to preserving and rescuing their cultural identity. Until now they have survived by adaptation, but not in a pure way because of their multicultural social background. However, they set and follow clear objectives, struggling to preserve their identities as well as their local technologies and ancient knowledge.

How should we face contemporary[4] life?

In recent years there has been a constant demand for us to change our attitude, because we cannot continue to live following the same old patterns.

Nevertheless our social, economical, political and cultural dynamics are all interconnected. The realities we live out in the first world and in its periphery are different. This is reflected in the way design is developing, because we do not start with the same circumstances, nor do we share the same means.

The three worlds during the Cold War era (1980); first and second world on dark grey, third world on soft grey.
Source: http://en.wikipedia.org/wiki/First_World

At the periphery, we have not yet implemented holistic thinking for understanding the context sufficiently broadly. We have not yet realized the importance of the multi-directional relations for exploring effective ways of gaining potential information related to design by using macro-level theories covering wide areas or fields, mid-level theories covering specific ranges of issues, or the micro-level theories that focus on narrow questions.

One of the first steps that we should make is to take advantage of every source that will place us within the immediate context. These sources are provided primarily by the social sciences and their distinctive contribution enables us to understand and manage design issues with reference to the product, systems, and the context.

Cognitive psychology is another important subject that should be constantly kept in mind. This is related to the field of ergonomics, has become increasingly important in the design process, and provides important insights into the way people process information cognitively This makes it a powerful tool for designing usable products, buildings, and systems.

In the first world, designers already use these tools although they do not guarantee making any discoveries about the context. On the periphery things are very different.

There is a common trend that ignores the context and perceives users as a homogeneous market, failing to recognize the importance of their particular needs. Most needs are to be found within the cultural field, which has not yet been fully explored. This represents a starting point for an approach to the study of human groups through observation, analysis, and, after identifying the response patterns for specific profiles, interpretation.

The necessity of focussing more attention on those disciplines that will lead us to a more holistic approach in design is now irrefutable. Disciplines such as social psychology, sociology, and anthropology provide techniques for examining the relationships between people and design. These patterns of relationships can provide guidance to designers, enabling them to design both better products and built environments, by making both the designers roles in people's lives and the users' requirements more understandable. These include the user's ergonomic requirements, such as usability and accessibility, as well as functional and aesthetic issues, which together will determine the overall

design quality in terms of the experiences it generates. However, we need to go beyond these factors to look at issues related to how a design fits with different lifestyles and users' aspirations.

The theory and practice of design evolve as the world changes, passing through transformations of methodology, acquiring new conceptual tools, adapting to new sources of knowledge and changes in the materials that are used in the development of new products.

One of the most relevant transformations occurred during the 80s when design thinking started to explore integration with the social sciences, resulting in a change in the discipline's main concerns. As a consequence, and as interest in their real needs increased, it became more important to understand the users of design This development was supported by knowledge from disciplines that focussed on analyzing human beings and their interactions with both objects and the configuration of material life. The ideas that emerged from this integration **[5]** promoted new ways to create knowledge, and the strategies of coexistence stimulated new concepts and tools for examining new trans-disciplinary and trans-cultural matters.

However, the initial objectives of this endeavour were not taken completely seriously, and as a consequence the resulting information was incorrectly biased, followed the tendencies of globalization, and led to its main orientation being toward growing markets. The background information that resulted from the new thinking processes was not used to its full potential and as a consequence the quality of the designer's capacity for abstraction decreased and became misunderstood. Instead of generating adaptable ideas for local needs, as should have happened, we ended up by abstracting diverse alternatives and began creating goods merely for mass consumption. **[6]**

It is a reality that "*the market is the heart of the matter, for it is where we have to go in order to make mass production compatible not only with design excellence but with minority tastes. Our production technology has been a mixed blessing; but what other kind of blessing is there? The question is: how can the mixture be enriched? Perhaps the market can be made to yield more satisfactory answers than it has thus far, if only designers can put it out of their minds for a while*" **[7]**. The point is to support the trend of giving importance to the market position or niche and to acquire new ways of understanding product development, innovation, and design. As a consequence we can recover the meaning of values.

However, not every contemporary field has only bad sides; in terms of design we can take advantage of new technologies to produce products at the lowest prices and embody our knowledge of cultural profiles within a certain level of personalization.

Re-conceptualizing

In the field of theoretical design, the re-conceptualization of the discipline is essential. This can be achieved by re-building its basis, enforcing its methodology by the adoption of new research tools, setting a new (critical and ethical) agenda for it, and establishing a different relationship between knowledge, reflection, and interpretation, and design **[8]**.

In order to achieve this goal without getting lost, we must pay attention to the methods that have been used before in different spheres where important results have been achieved. For example we have to make good use of work experiences so that through feedback we can adapt tools better to their functions or totally transform them..

It is particularly important to promote the study of the social sciences in design and to emphasise cultural matters since these are can provide information about human groups, behaviours, ways of interaction, ways of expression, etc. It is becoming increasingly important for the designer to know about thee areas and consequently, in order to access the knowledge of these unfamiliar areas, we need to improve our skills as researchers, become much more curious, and adopt approaches to cross-disciplinary thinking. It is in this respect that we can learn much from fields such as cultural anthropology and ethnography and from their methods.

As researchers designers can focus on a detailed description of a culture-sharing group or individual, analyse themes or perspectives to make interpretations, find the meanings of social interactions, and then be able to make generalizations about human social life. Because it is important to have a grounding in cultural anthropology and the meanings of social-cultural systems as well as the concepts typically explored by ethnographers, a designer would need a research profile in order to accomplish this. The reason why ethnography is also an important part of social sciences and a valid source for design is because it provides methods for describing and interpreting cultural or social groups or systems.

To establish patterns, the ethnographer engages in extensive fieldwork, gathers information and helpful materials for developing a picture of "rules" of the culture-sharing group by observation and interviews.

We could continue exploring discipline by discipline and find that they all represent a potential field of knowledge that can be used to enrich design.

It is a fact that the disciplines and tools that help designers to explore a social or human problem at a deeper level are infinite in number, and it is impossible to manage that amount of knowledge.

However in considering this; the implementation of qualitative research as a process based on distinct methodological traditions represents one of the best tools with which researchers can build a complex, holistic picture, with analyses and detailed descriptions, and still conduct the study in a natural setting. **[9]**

Now, if a designer cannot become complete researchers, at least he has to keep in mind the main principles. He must learn how to observe people and how to interact in ordinary settings while attempting to identify pervasive patterns like life cycles, events, and cultural themes. He must discover how to transform that information for use in creative processes to generate an empathic design of products or services, symbols, meanings and experiences that fulfils the necessities of a given group.

Methodology

A specific design methodology appropriate for the complexity of our times has not yet been created; there is flexibility for structuring the process, and there are alternatives in the choice of tools for gathering specific information.

Therefore, ethnographic work is vitally important for the achievement research objectives, because it relies on the necessity of formulating a task and preparing a report from written, descriptive, and oral sources.

As a consequence, I have focused my own interest on exploring a research methodology for understanding the origins of autonomous groups within societies that pays special attention to how they adopt or transform patterns of their own identity and at the same time allowing them to retain meaningful cultural elements that conflict with the conformities of their own new identity.

The basic points for conducting this research are:

1. Documentary knowledge, based on previous research to create a data base that allows us to understand the origins of the reality of the moment, supported by a contextual history.
2. Preparation for field research by creating notes for different purposes by:
   - awakening reflection as a guide for observing the context of study
   - establishing the contents of possible contextual interviews
   - organizing research
   - having a previous idea on research findings
3. Immersion in field research, which provides the researcher with a wide range of arguments about life, existence, and emotions.

This methodology has been studied and improved in order to apply it to reality. In this case I am looking forward to using it to approach an autonomous group (not selected yet) that has emerged from a social reaction, and whose main concern is to rescue their identity, not only by adopting features of their own backgrounds, but by creating it through updating local techniques and utilizing ancient knowledge.

Temporary conclusions

This paper defines the structure and basis for embracing a much wider scope within the activity of design.

It identifies design strategy variables for multiple solutions for facing constantly changing contexts, providing them with flexibility in response to circumstances.

The research plans to analyze first-world design solutions before their implementation at the periphery, using a wide diversity of methods for observing and interpreting a specific culture or community and finding new perspectives about changes in architecture and design under social influence.

We should not be afraid to wish that everyone in the world would become a consumer. The poor need more than food and shelter. They ultimately need to be able to make choices for their material and immaterial wellbeing. Connecting the poor to the world's grid of creative communities is certainly part of that enormous task. They should become consumers and they should become producers (Toepfer, 2007). **[10]**

There is not a final conclusion yet, because reflection on these topics is endless. In my particular

case the search goes on, because the implementation phase has not yet started.

As a consequence of my studies of both architecture and design, but with a very strong interest in that social and cultural context that makes new and alternative design both possible and useful for the development of new social interaction groups, I intend to create possibilities for the integration of design with anthropology and social studies to gain completely new perspectives on how our discipline, whatever its specialization, can work to promote the preservation of cultural identities.

Keywords

Social transformations, complexity, emphatic design, cultural rescue, cross-discipline, anthropology, ethnography

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Poster abstracts

Yanta H.T. LAM

The industrial design development in Hong Kong (HK) and the influence on China (PRC)

Industrial Design in Hong Kong was originally introduced in 1960s to support the development of local industries, and as such Industrial Designers were nurtured to practice in a supporting role. After years of hard work and experience, and subsequently owing to the economical changes in Hong Kong in the late 70s and 80s, Industrial Design has become a profession in its own right, yet it is still playing an important role in the economic development of Hong Kong.

In 1979, a group of Hong Kong Design educationalists and participants made a one-week visit to Pearl River Delta of PRC. This visit marked a key development of modern Design education in South China.

The Open Policy of China of the 1980s changed the characteristics of HK industries and allowed them to become more diversified: from production of consumer products in the past to the present situation of allowing innovation and products/systems that accommodate different levels of needs.

In recent years, some overseas design firms started running their business in Hong Kong and work their ways into Mainland China. Local manufacturers at the same time are developing and many have become internationalised, with strong cross-disciplinary in-house design teams to develop new and innovative products.

HK Designers therefore are facing challenges and opportunities coming from the Mainland, and from overseas. On this assumption, the HK Design education and practices are reviewing to prepare for the changes. Among the many considerations, the method of reinforcing understanding of users in the PRC is taken as a new tool in Design process. It probes user's relevant cultures, the living habits and behaviours, and how such information could relate to Design. To ensure success of the method, cross-cultural experts of Design and non-design disciplines work together to bridge many gaps of knowledge.

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User centered design in public transportation

14 million passengers currently travel by regional bus in the Aarhus Regional Authority, a number which has been stable for several years. But despite this encouraging statistic, regional public transport faces major challenges in the future. Many operators throughout the country have experienced a drop in passenger levels and passenger expectations for the product they use have changed. Promptness is no longer enough, as services tailored to individual needs are now what is wanted, which has given the Authority cause to give thought to how it can maintain passenger levels.

In the spring of 2006, the Aarhus Regional Authority, Aarhus School of Architecture and bus operator Arriva joined forces to develop and improve the traditional bus concept, with particular focus on the users. The process involved and results of the project are presented in the paper.

The proposals the students came up with will give Aarhus Regional Authority and Arriva new understanding of the public transport of the future, by focusing on the bus of the future, and performing user-surveys. The project ran through the entire Spring 2006 term at the Institute for Design of Aarhus School of Architecture and involved around 50 students from the 3rd and 4th years at the Institute.

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Katri Ristal

The story of how Estonian Academy of Arts created Design Innovation Centre and became the leading design body in Estonia

Design Innovation Centre of Estonian Academy of Arts together with Designers Union and Museum for Applied Arts have announced academic year 2006/2007 the Design Year.

The idea of the Design Year is based on the recognition that 2006/2007 will hold a number of distinctive events and also the increased need to raise the common design-sence.

Design education in Estonia became 40 in fall 2006 and international conference for design researchers and scientists was held in August.

According to the study by Design Innovation Center, the main reason for Estonian business/product developers not using designers services is ignorance and inability to expect any cooperation from the designers in product development.

Having this knowledge and many supportive activities on hand, Design Year wants to raise the over all knowledge of design and the supporting industry, thus helping to promote the use of design in many areas of life and business.

Activities during the Design Year: travelling exhibition "Design comes to visit", seminar "ABCDesign" for businesses, workshops for kids, design extra at business daily, weekly design minutes in national tv, radio broadcasts, web page.

Estonian Academy of Arts founded Design Innovation Centre in 2004 with the main purpose to further develop innovative and modern academy. Since today centre has applied funding for many project amounting over 1,5 million Euros, provided entrepreneurship and IP education and support services for staff and students + opened topic-related webpage/blog, started successful design seminar series FutureSense for businesses, published "Understanding Design" by Kees Dorst in Estonian, gives out Young Designer Award SÄSI, coordinated various projects (poll about design use in Estonian companies, e-learning, World Summit Award pre-selection, etc). Centre has started to work out frames for cooperation between departments and companies and is going to launch designer's database in spring 2007. 5 full time employees incl lawyer, entrepreneurship consultant, project consultant.

Centre's activities are funded mostly by EU Spinno project and various smaller projects. Base funding comes from Academy.

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Mirja Leinss and Enrico Constanza

Telling a Story on a Tag
The importance of markers' visual design for real world applications

Tag recognition can be a convenient and quick information access method for mobile applications. Tags act like URLs allowing users to leave and retrieve digital information associated to physical objects or locations. Visual tags can be recognized using standard digital cameras, now common on commercial mobile phones. This paper demonstrates an application of d-touch, a visual tag recognition system running on Symbian OS phones that leaves considerable freedom in the graphic design of the tags. The design process for visual tags is presented, highlighting the importance of the visual design of tags and the way technology changes the nature of design in this project.

INTRODUCTION

Mobile applications can provide ubiquitous information access through the increasing connectivity and multimedia capabilities of mobile phones and PDAs. Visual tags, also referred to as markers, are graphic symbols that can be read by a standard digital camera, like the ones embedded in camera-phones, and decoded through a computer vision algorithm that can either run locally on the phone or on a remote server. In all of the existing systems, information is encoded in the geometry of the marker (i.e. its shape), as a consequence the markers visual design is determined solely by the system specific encoding algorithm, without taking into account any aesthetic criteria.

D-TOUCH: TOPOLOGY BASED VISUAL TAG RECOGNITION

d-touch is a visual tag recognition system that encodes information in the topological structure of its markers, rather than the geometry. As a consequence, the visual design of the markers is less constrained and can be governed by aesthetic principles: form and function, rather than just function. d-touch markers are composed of black and white regions (connected components), the adjacency structure (or nesting) of these regions can be decoded into a numeric ID.

The markers can be decoded purely through their topology, but it is optionally possible to also take into account their geometry. This option can produce a larger number of different identifiers.

CONTEXT: THE ELECTRONIC LENS PROJECT

d-touch was used in the Electronic Lens, a social networking application developed at the MIT Media Lab. The application enables users to create location based discussion and communities. Citizens can share information and opinions – which are related to a specific place in their city – and participate in discussions of public interest in a democratic way.

The project in its initial phase was tested in April 2006 in Manresa, Spain with the support of the Generalitat de Catalunya (the Catalan regional government) and the Ajuntament de Manresa (city council). In a workshop setting, a group of 16 local high school students tagged buildings in their city and used the mobile device application during one week to explore new ways of communication.

DESIGN PROCESS

When designing the physical tag for the Electronic Lens project, the aim was to tell a story by transforming the markers into sets of icons and communicating visually the general idea of the project in the design of the marker. Supplemental text, illustration and logotypes that had no technical functionality were also used to complete the design from an informational and aesthetic point of view.

The design is visually coherent and the technical functionality could be completely hidden into it. All the technical constraints were fulfilled without any visible detriment as a result of an iterative optimization process. The final design included 3 sets, each of 4 icons, each set embedded in a d-touch marker. The logotype of the government and the red pregunta'm ("ask me" in Catalan) did not have a technical function but are essential part to communicate the project and its official aspect. Different types of tags were iteratively designed – evolving from a pure, abstract data code to a carefully crafted design, with an "invisible" data code that leaves space for communication graphics.

The functional aspects of the tag constrain the design to the use of high contrast, positive and negative planes and modularity, as well as use of matte materials because of camera recognition issues with reflective surfaces.

CONCLUSION

Liberating the design of visual tags from being data codes, and making it a visual medium that allows to tell a story or give a glimpse of what is hidden behind the tag is a very powerful way to improve the user's experience. The personalization of visual tags offers an additional channel to communicate the identity of multimedia projects.

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Daniel Aeschbacher

BionicDesignProtocol© - the method for best sustainable design
An integral approach for an effective new design development

About fifty years ago, bionics was introduced as science in the U.S.A. with the objectives a) to help translating findings and knowledge generated from observing nature into products to benefit man, and b) to facilitate a platform for projects which required interdisciplinary teamwork.

Bionics has been at the source of many successful results. Yet its full capacity remains largely unknown. The reasons for this short coming are manifold. Part due to the popularization of successful bionic projects and a general concern about ecological issues, bionics has recognized in recent years as means to provide future proof solutions.

BionicDesignProtocol© is designed to be universally transferable, to provide the structure for interdisciplinary functioning and facilitate the platform between nature and man made intentions, to accommodate accelerated knowledge growth. Criteria for a sustainable development are at the core of this new method.

HOW IT WORKS

BionicDesignProtocol© combines the classic bionics with a professional design method and the protocol which secures the systematic application of sustainability and quality throughout the development process.

The double loop consisting of loop A and B, are subdivided into phases. Between the two loops is the 'Transfer Zone'. With a 'Qualitative IS-Assessment_ checklist' the positioning of the project on the loops and with it the scope of tasks are determined. Loop A focuses on "research and innovation" and B on "applied design development".

Loop A provides the platform and structures for the collaboration of a multidisciplinary team. Tasks are assigned and the different teams begin their research and analysis for partial natural and synthetic systems and define possible synthesis. After a first exchange of findings, the formal analysis of selected functions based on the 'bionic argument' continue until to the next exchange platform. The work in loop A ends with the ideation process and concepts of different magnitude based the various findings. In the 'Transfer Zone' it is decided which concept to pursue in loop B or A, for more research, possibly with strategic impact.

Loop B corresponds with conventional product development methods.

CRITERIA ON SUSTAINABILITY

Criteria on sustainability are grouped and positioned by life-cycle phases and their economic-, social-, and environmental quality and are assembled in a chart called 'Sustainability measures'. Because not all criteria are of equal priority nor relevancy for the BionicDesign-Protocol©, a customized checklist can be put together in the 'Qualitative IS-Assessment_checklist'. To know which sustainability measures to apply when, they need to be related to the 'double loop process' and merged with their phases.

PERSPECTIVE

BionicDesignProtocol© is a new method. The objective of this paper is to present this unique and effective up-to-date method, and find partners interested to do pilot projects.

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Student abstracts

Rhys Thomas and Sean Jenkins

Inclusive design

Inclusive design is all about ensuring that services, environments, interfaces and products operate properly for people of all cultures, ages, and ability. This area is becoming more interesting than ever before to design students and professionals.

Elderly and disabled people do seem to find modern technology complicated, many useful devices hard to use, and they might even be reluctant to learn. They might find it extremely hard to use a product simply because, when it was being designed, their needs weren't taken into account. This paper considers the nature of inclusiveness and its importance to present and future generations. The majority of people in Europe are middle aged to elderly, people with disabilities are not always adequately considered, and Europe is also one of the most culturally diverse regions of the world.

Information about the problems faced by these groups is important for inclusive design, and research and understanding is vital to achieve any acceptable result. The paper shows how important it is to transfer this knowledge into design and bring disabled and cultural minorities into the mainstream of society.

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Richard Crocker and Ian Walsh

Biomimetic design: Design inspired by biomorphics and biomimetics

This paper considers the significance of biomorphics and biomimetics as primers for industrial design, by examining three ways in which nature can drive the design process.

Firstly, by carrying out semiotic research on creatures we can influence the aesthetic qualities and form of a product. This is biomorphic design, and it affects the way products catch the attention of users and the message the designer is trying to convey.

Secondly, by looking at the biomimetics of creatures we look to nature for ideas that may be adapted and adopted to solve problems or invent new technologies or materials.

Thirdly, we can also look back to nature in design to help with the environmental problems we face today. Mankind must rapidly change its relationship with the planet, because phenomena such as global warming and pollution indicate that a major shift in the balance of nature is imminent.

We discuss why this is happening and consider the semiotic, technological, and environmental issues. The results are illuminating and we believe that the lessons learnt must be applied to contemporary and future design.

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Andrew Langdon and Ian Walsh

Sustainability

Increasing pressure from environmentalists and society has transferred responsibility for sustainability to the designer. To describe the transfer of knowledge out of design and into sustainability we must first consider the role of the designer in his multi-faceted discipline and see how the design activity has blurred into several skills that are disciplines in their own right.

In exploring the designer's role and responsibility today we describe the many skills a designer must assume in order to complete his tasks; engineer, draftsman, manufacturer, artist, and researcher, to name just a few. It is also the designer's job be a logical thinker and communicator.

Sustainability is every designer's foremost criteria when considering a new product or concept. Sustainable sourcing of materials has become the issue almost overshadowing cost and budget. This results in the designer adopting the new role of environmentalist, and adds a further challenging constraint to those already faced.

We consider the legitimacy of sustainability in modern design and the designer's responsibility for it and ask how knowledge can be transferred from design to benefit societies' demand for products manufactured from sustainable resources. Finally we consider whether, in dismissing one resource in favour of an alternative deemed ecologically friendly, we are merely creating another environmental effect not yet considered harmful to the environment.

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Richard Heale and Ross Head

Express yourself!

Someone recently quoted Abraham Lincoln to me, "It is better to remain silent and be thought a fool than to open one's mouth and remove all doubt". The statement is doubtless a sound and wise piece of advice to help one settle into a job without 'rocking the boat'. But designing should be as expressive as the designer wants and not limit what he sees: the designer should be as expressive as his work, and designing should be used as a tool to show others how the designer sees the world.

Saying nothing for fear of change touches on the reason why I wanted to become a designer. One basic rule of evolution is that time brings more of everything; more freedom, more possibilities, and more constraints. Safety is one of those constraints, not only product safety but safety as a global issue. So then surely wouldn't people (designers included) with a principal loyalty to safety have an effect on design? If every designer worked like this how could design continue, at its best, to do what it does best, which is to excite people's imaginations and create desires?

Here is the view of a student visualising, in 2007, a future in design with less constraints at a time when key concerns are safety and environment – a future in which today's issues will have been addressed and concentration can be focussed on freedom of expression and on the next era of great designers.

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Harriet Brewster and Tyra Oseng

The role of women in design

This paper examines the traditional male dominance of design and how it has discouraged women from entering areas such as product and industrial design, influencing them to choose instead surface pattern and fashion design.

Designers use an extensive volume of published and tacit knowledge to influence new areas through innovation, creativity, and design, either within the same discipline or by transferring it to another. Design needs to create new information about the human condition as societies move from a top-down patriarchal structure to a networked society based upon negotiation and discourse.

This paper searches for differences between male and female design approaches, discusses whether male and female designers can influence each other's work, and examines how knowledge of design is transferred between them. Women are now making an appearance in industrial design with innovative designs of their own. We investigate how female input affects the overall outcome, using as one example the Siemens CL75 mobile phone, for which female designers were commissioned to create a phone by women for women.

By examining the old argument of nurture versus nature, the paper investigates the reasons why men dominate the product design world and how men and women can influence each other within design.

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Liyan Wei and Ren Xianyi

Chinese elements cannot save China's industrial design

More and more people today have come to realize that traditional Chinese design elements are very important for Chinese industrial design and that they have become a hot topic. Generally speaking, Chinese elements include traditional Chinese visual symbols and patterns, traditional Chinese crafts, traditional Chinese materials, and so on. Because it is only recently that industrial design has been established in China and has no independent style as yet, many designers and scholars are pinning their hopes on traditional Chinese design elements. But do these Chinese elements really represent an effective prescription for China's industrial design? Here the author suggests that Chinese traditional design elements cannot be a panacea for the development of industrial design in China. What we need more is a spirit, China's very own spirit, which embraces the spirit of Chinese humanity and liberality, design motivation, and aesthetic ideas.

The paper tells why Chinese traditional design elements alone cannot save Chinese industrial design, why an essentially Chinese spirit must inspire design circles, what this Chinese spirit is, and how to transfer that spirit within design.

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Elly Dawson and Matthew Archer

The transfer of history into design

This paper discusses three exemplary designs and asks if history has influenced their return to popularity or, indeed, their enduring appeal and use.

1. Conscious redesigns of old classics. Why have such designs been redesigned for our times? Do we feel an emotional link with the era of the design, the 60's in the case of the Mini, or is the original simply a good design?
2. Originals that have been brought back for re-use. Why have some designs that are now antiques been reclaimed and restored to their original condition and put back into a modern day setting? Are they better than modern day designs?
3. Enduring designs. Why have certain products not been redesigned? Many were designed in the late 50s to 60s and have endured the changes in fashion throughout the 70s, 80s and 90s right to the present day.

We will show that history plays a fundamental part in design. Some designs will go out of fashion but will return, either in their original form or as redesigns preserving the essential elements that made them what they were. Other designs will remain unchanged, either through neglect or because they continue to fit their purpose.

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- Shandong University of Art and Design (SUAD), Jinan
- Caup Tongji University, Shanghai

CZECH REPUBLIC
- Academy of Arts, Architecture and Design Prague

DENMARK
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- Danmarks Designskole Copenhagen
- Royal Danish Academy of Fine Arts, School of Architecture, Copenhagen
- Designskolen Kolding

ESTONIA
- Estonian Academy of Arts Tallinn

FINLAND
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- Häme Polytechnic, Wetterhoff, Hämeenlinna
- Lahti Polytechnic, Institute of Design, Lahti
- University of Lapland, Faculty of Art and Design, Rovaniemi
- EWTEK, Vantaa

FRANCE
- Ecole de design Nantes Atlantique, Nantes
- Institut d'Arts Visuels (I.A.V.) d'Orléans
- Ecole d'Art Maryse Eloy Paris
- Ecole Boulle, Paris Institute of Art and Design France
- Ecole Duperré, Paris Institute of Art and Design France
- Ecole Estienne, Paris Institute of Art and Design France
- Ecole de Communication Visuelle, Paris, Bordeaux, Aix-en-Provence and Nantes
- Ecole Supérieure d´Arts Graphiques et d´Architecture Interieure-Design ESAG-Penninghen, Paris
- ENSAAMA – Olivier de Serres, Paris
- ENSCI/Les Ateliers – Ecole Nationale Superieure de Creation Industrielle, Paris
- Ecole Supérieure d'Art & Design de Reims / Reims School of Art & Design France
- Strate College Designers, Paris
- Ecole Régionale des Beaux-Arts de Saint-Etienne (ERBASE)
- Ecole Internationale de Design (EID), Toulon
- Design en réseau, Art and design department Université de Toulouse le Mirail Toulouse

GERMANY
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- Universität Duisburg-Essen, Department of Design, Essen
- Burg Giebichenstein University of Art and Design Halle
- Hochschule für Gestaltung Offenbach am Main
- Pforzheim University of Applied Sciences, Pforzheim
- Fachhochschule Schwäbisch Gmünd, Hochschule für Gestaltung, Schwäbish Gmünd
- Fakultät Gestaltung (Faculty of Design) University of Applied Sciences Würzburg

GREAT BRITAIN
- The Arts Institute at Bournemouth
- School of Creative Industries Napier University Edinburgh
- The Glasgow School of Art, Glasgow
- London Metropolitan University, Sir John Cass, London
- Ravensbourne College of Design and Communication London
- Royal College of Art London
- School of Art & Design, University of Salford

GREECE
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HUNGARY
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ICELAND
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IRELAND
- National College of Art and Design Dublin
- School of Art, Dublin Institute of Technology, Dublin

ITALY
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- Domus Academy SpA, Milan
- Istituto Europeo di Design Milano, Milan
- Politecnico di Milano, Milan
- The University of Rome, "La Sapienza", Rome

JAPAN
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- Tokyo Zokei University Tokyo

LATVIA
- Art Academy of Latvia, Riga

LEBANON
- Lebanese American University, Beirut

LITHUANIA
- Vilnius Academy of Fine Arts, Vilnius

MEXICO
- Escuela Nacional de Artes Plasticas, Universidad Nacional Autónoma de México

THE NETHERLANDS
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- Royal Academy of Art, The Hague
- Willem de Kooning Academy Rotterdam
- Utrecht School of the Arts, Utrecht

NEW ZEALAND
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- Victoria University of Wellington, Faculty of Architecture and Design, Wellington

NORWAY
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- Akershus University College, Blaker
- Oslo National Academy of the Arts (ONAA), Oslo
- Oslo School of Architecture and Design (AHO), Oslo
- Oslo University College, Oslo

POLAND
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- Academy of Fine Arts in Warsaw

PORTUGAL
- Escola Superior de Design (IADE), Lisbon
- ESAD – Escola Superior de Artes e Design, Senhora da Hora

REPUBLIC OF KOREA
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- Kookmin University Seoul
- IDAS (International Design School for Advanced Studies), Hong-Ik University, Seoul

RUSSIA
- Moscow State University of Design and Technology, Moscow
- Saint Petersburg State University of Technology and Design, Saint Petersburg

SINGAPORE
- Temasek Polytechnic, Singapore

SLOVAKIA
- Academy of Fine Arts and Design Bratislava

SLOVENIA
- Academy of Fine Art and Design, University of Ljubljana
- Department of Textiles, University of Ljubljana

SOUTH AFRICA
- Greenside Design Center, College of Design Johannesburg

SPAIN
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- Mechanical Department, Chair of Industrial Design Faculty of Engineering at Mondragon Polytechnical University
- The School of Design, The University Cardenal Herrera CEU, Valencia

SWEDEN
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- Dept. of Product and Production Development, Chalmers University of Technology, Gothenburg
- Faculty of Fine and Applied Arts , Gothenburg University, Gothenburg
- HDK Stenebyskolan, Gothenburg University, Gothenburg
- School of Design, University of Kalmar
- The Programme of Industrial Design, Lund Institute of Technology (LTH), Lund
- Beckmans College of Design, Stockholm
- Konstfack Stockholm
- Institute of Design, Umeå University, Umeå

SWITZERLAND
- University of Art and Design FHNW, Aarau & Basel
- HEAD, Haute Ecole d'art et de design de Genève
- Ecole Cantonale d'Art de Lausanne
- Hochschule für Gestaltung und Kunst Luzern
- Hochschule für Gestaltung und Kunst Zürich

TAIWAN
- National Yunlin University of Science and Technology, Yunlin

TURKEY
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- Anadolu University Eskisehir

USA
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