

Design *for* Sustainability.

Teaching Design for Sustainability in the visual
communication design classroom: Preparing future
designers for the next design (r)evolution

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Abstract

The inclusion of sustainability as a subject of study in design programs is increasingly in demand by educators and students, and by employers, suggesting that the role of future designers is to be involved in design for sustainable futures.

The lack of a specific curriculum integrating design and sustainability issues, in a focused undergraduate course, has been partly a consequence of a delayed process that involves changes in mind-set and in the way design education is seen for the long term. This is in the process of changing, but even in the short term, it could still be some time before the changes are noticeable.

This Master's thesis project is concerned with the development of a curriculum dedicated to Design for Sustainability (DfS) at the undergraduate level. It investigates potential content, methods and tools for a course, or part of a course, framed in the content of Visual Communication Design (VCD) program at the University of Alberta.

In order to support the theories and practices related to design and sustainability, research including a literature search, contact with experts locally, nationally and internationally, and a research trip to institutions teaching Design and Sustainability in Scandinavia (among the leaders in this field), were undertaken. The research also involved delivering pilot projects and presentations, and debating DfS issues with students and instructors in undergraduate classes in VCD at the University of Alberta. Finally, the content, methods and tools for teaching DfS used in this project were tested and results analyzed, in order to evaluate appropriateness and performance, determine effectiveness, the level of comprehension of the general structure, and the level of engagement of students with the concepts included.

Testing sessions emulated traditional, project-based design classes while introducing new dynamics into interactions with the students. The testing sessions were designed to reveal important factors and considerations for future implementation of the work as well as means to introduce the key methods and concepts. The final proposal, based on results of the investigation, consists of a curriculum plan and teaching strategies which are supported by materials and graphics, and are meant to be implemented in the teaching of DfS.

The final part of this thesis project is dedicated to contextualizing further research and implementation of DfS curriculum and the possibility of developing to a more complex curriculum.

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It makes far better sense to reshape ourselves to a finite planet than to attempt to reshape the planet to fit our infinite wants.

–David W. Orr

When we have hope in something, we also have something to say to ourselves; so, too, designing and planning become superfluous when we have nothing to hope for, nothing to say to ourselves. Whereas hope without planning is a particular form of alienated behavior, planning without hope is its most typical form.

–Tomas Maldonado

1. Introduction

1. Brundtland, Gro Harlem. Our Common Future. World Commission on Environment and Development. New York: Oxford University Press, 1987 pp102

2. United Nations Statistic Division, retrieved July 2007 from Demographic Yearbook 2003: <http://unstats.un.org/unsd/demographic/products/dyb/DYB2003/table01.pdf>

3. Climate Change 2007: The Physical Science Basis. Report by WMO-UNEP Intergovernmental Panel on Climate Change. WMO 2007, Geneva

According to the World Commission on Environment and Development, within this century the population of this planet will reach 14 billion people.¹ In this scenario of overpopulation and with the current patterns of global consumption, significant reductions of fertility rates must be achieved in order not to overwhelm the carrying capacity of earth to unthinkable limits (Hawken, 1994, p. 209). Today, with more than 6.5 billion people on earth,² life on the planet is facing one of the most dangerous times in its 4 billion-year history. Humans are witnesses, for the first time ever, of signs of human-driven exposure to extinction of all species alive, not only by challenging the carrying capacity of the planet, but also by moving from a natural, low entropy state to a human-made high entropy one. We have always modified our environments to one degree or another, but the level of ecological damage has increased with the level of civilization and with the scale and kinds of technology (Orr, 2002, p. 15). Scholars and intellectuals from all sciences –exact, social, philosophical–, agree. There is agreement in the global scientific community about how serious the problems are, and there are signs of reaction in the global political community³ and, awareness is spreading among the public in general. Still, economic and political interests oppose and resist immediate action. Intellect and common sense point to the fact that human civilization is arriving at the point at which changes in our life-styles must be undertaken, in the short term, in order to make the long term possible. There is no room for misunderstanding, avoidance or denial about the nature and magnitude of the crisis that humans will face in the coming years. In order to survive, we have to work towards the fit between humanity and its habitat (Orr, 1992, p. 83). Accepting this is the first step toward solutions.

How does design relate to this context: resisting change, supporting change or waiting indifferently, being driven by others' decisions?

Designers can play a meaningful role in creating / supporting these changes. Although design inevitably involves subjective value judgments, and complete objectivity demands dispassionate detachment, designers, being human beings, find it hard to remain either dispassionate or detached about their work (Lawson, 1980, pp. 89-90). Moreover, when design work is heavily involved in complex issues, like sustainability, and design solutions are usually part of the problems that they are trying to solve, designers are challenged to using their thinking skills. It is up to designers, and their way of applying design knowledge with social responsibility, to take the opportunity to play a leading role in re-designing our society to help sustain the natural world.

Today, sustainability has become an issue of paramount importance in any field. “Sustainability is about the terms and conditions of human survival”(Orr, 1992, p. 83). Through sustainability as a prospective tool, the widest spectrum of human activities can find a way to study social, environmental and economic factors, which drive the future of our civilization. Integrating sustainability with design theory and practice is not a way to accommodate design in a new role, rather, it is a way to recall existing design principles connected with humanity’s role within the life cycles of the earth.

By educating future designers in terms of sustainability thinking and sustainable practice we can find a key for design resilience. A curriculum integrating these two forces –design and sustainability– introduces multiple connections and enriches professional practice.

Usually, education provides tools and methods for a professional practice, but the ability to think, have insight, self-criticize and imagine are human skills that should be encouraged and promoted as a source of meaning for every project. Dr. Edward De Bono, leading authority in the field of ‘creative thinking’ and the teaching of ‘thinking tools’, has worked on this theory for decades. We tend to think that thinking skills ought to be natural skills, however thinking, as many other skills that eventually become natural, are not really natural at all, but have had to be learned. Dr. De Bono gives some examples of this:

“There is nothing natural about riding a bicycle. There is a very unnatural and awkward phase. It is only later that the skill becomes natural. The same is true of swimming. We do not swim naturally. It is only when we know how that it comes to seem very natural.”
(De Bono, 1976, pp. 45-50)

The unnatural or artificially induced stage of learning how to develop our thinking skills may be necessary in order to create new habits and new ways of directing attention.

We also tend to confuse information with knowledge and wisdom, with imagination and creativity, and recognizing the differences between them seems to be interconnected with the capacity of developing thinking skills. In this sense De Bono adds:

“Imagination is more important than data collecting, since there is shortage of the former, and a surfeit of the latter. Indeed, information by itself will rarely give a good idea. It is the imaginative skill applied to looking at data that makes the big difference...”

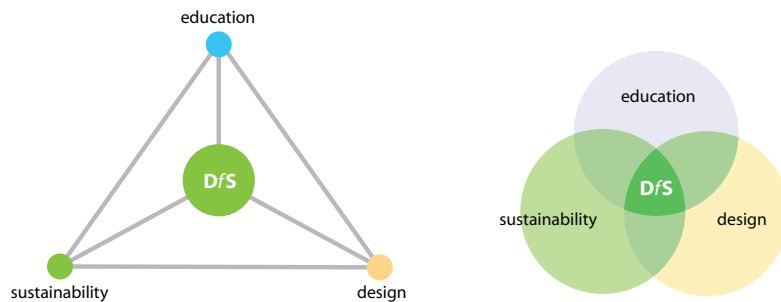
Finally, De Bono suggests some ways of approaching the promotion of thinking habits:

“Skill in thinking is a broad skill...It is much more than knowing the rules of logic or learning how to avoid logical errors. Skill in thinking has much to do with perception and with attention directing. It is a matter of exploring experience and applying knowledge...It involves planning, decision-making, looking at evidence, guessing, creativity and very many other aspects of thinking.” (De Bono, 1976, pp. 45-50)

A DfS curriculum will provide these thinking strategies, applied to design, by teaching a broader approach to problems and reinforcing the use of human skills, such as thinking, to create design thinkers and not only design “doers.”

Design, sustainability and education form a triad upon which a Design for Sustainability curriculum has to be based: design as a process, sustainability as a concept and education as a medium. The results of combining these three areas can lead to new approaches, better understanding, and reinforcement of existing design thinking as a part of the design process.

This visual communication design Master’s thesis project is focused on the ways in which sustainability can be included in visual communication design programs. It is a research and an exploratory project, that investigates the basis of a possible curriculum dedicated to Design for Sustainability at the undergraduate level. The proposal is conceptual, but the documentation of methods and tools to support the implementation in classroom can be used as instructional material. The material involves design issues such as information design and social marketing, among others.



2. Problem Definition: The challenges for future designers

2.1 State of the issue

The problem of atomization and fragmentation of sustainability discussion in current design education, and the lack of integration of design and sustainability, can be addressed by including a focused Design for Sustainability course.

4. U of A Calendar 2005-2006, e.g. Arec 365 pp424, Arec 473 pp425, Hecol 451 pp530

5. Dacks, Gurston, Vice-Dean of Faculty of Arts. Faculty of Arts From Dean's Office bulletin, Spring 2007, University of Alberta

6. Okala Ecological Design, originally published a course guide by P. White, L. St.Pierre and S. Belletire, (2004). Okala Ecological Design Curriculum, Course Guide, IDSA. Okala has recently updated this material as IDSA Okala Guide, Learning Ecological Design and published more valuable material such as Okala transportation CO2 values and reading material for 9 modules of the current Okala Course Guide, retrievable at <http://www.idsa.org/whatsnew/sections/ecosection/okala.html>

7. This teaching guide is complementary to the book The Designer's Sustainability Atlas and can be retrieved from <http://designers-atlas.net/teachguide.html>

The discussion of sustainability issues is present in design classrooms, within many faculties' programs, particularly sciences, agriculture, human ecology and economics, mostly at graduate and postgraduate levels.⁴ There is an increasing interest in sustainability issues from students and educators on campuses in North America and Europe and institutions of higher education worldwide. Proof of this is the creation of "The Talloires Declaration", a manifesto for a sustainable future, created for and by presidents of institutions of higher education. Jean Mayer, Tufts University President, convened a conference of 22 international universities in 1990 in Talloires, France. Since then, many other institutions all over the world have submitted and supported this document, in order to create the necessary policies and frameworks at Faculty levels. Another example is the Icis-Lund project, which is a joint endeavor intended to create the foundation for a innovative new Scandinavian master's program in sustainable design. Both involved institutions, the International Center for Creativity, Innovation and Sustainability Foundation, in Denmark, and The University of Lund, in Sweden, represent two countries that have ratified the Kyoto Agreement. There is increasing interest in sustainability issues. The effects of this process are noticeable in everyday news, lectures, forums and events on Campuses. While this thesis project was being written, a proposal for creating a bachelor of arts program in Environmental Studies, framed in the Sciences, is being evaluated by the University of Alberta governing body⁵, which most likely means that sustainability issues will soon have dedicated courses, independent of area specialization.

There are more examples of educational projects working towards the introduction of sustainable design or design for sustainability. Two of them are described later as analogies in chapter 5: Okala Ecological Design⁶ and the Teaching Guide for the Designer's Sustainability Atlas⁷, both serious work for integrating sustainability to design programs. In the latter, published recently, the author, Ann Thorpe, reflects first "Where is [DfS] in the curriculum?" and argues about the implementation of DfS as a focused course or alternatively, in all courses in design programs:

"A dominant school of thought says sustainable design should not be separated out from the rest of the curriculum, rather it should be built in across all coursework. In essence, "good design is sustainable design." In these cases you find "sustainability" elements in projects looking at a particular context (e.g. marketing strategy, manufacturing or a target market such as mobile communications or footwear), design skill (e.g. design research or model making), or that respond to a particular opportunity such as a design competition or "live" project with a company." (p.6)

This suggests that, as a matter of long-term planning, sustainability should be present in all design courses and, ideally, any design program should be a DfS program. But this cannot start spontaneously and/or without a planned process. It is also true that updating a design program takes time and commitment, and today most design schools are not prepared to include DfS issues consistently. A focused DfS course brings at least the conceptual elements and the appropriate framework to construct DfS within a design program, whether as a course, part of a course, or part of all courses. In this sense, Thorpe also adds this explanation for her own curriculum project, the Atlas, which is a focused source:

“I believe that having sustainable development issues built in across all coursework in all design education is a worthy end goal, but at this stage, for many reasons (not least teaching expertise, the structural inflexibility of curricula, the crowding of curricula and so forth) it is simply not practical at many institutions. Then we are left with “add on” or targeted projects and courses that focus on sustainability, and if we do these well we will get students taking their sustainability interests into other coursework where it is not an explicit focus.”

The purpose of this thesis project is identified in Thorpe’s parallelisms:

“If you are lucky enough to be at an institution where sustainability is built in across all coursework, you can still use this guide [the Atlas] by simply looking through the teaching tools (e.g. discussion questions, briefs) and the topics (e.g. ecology) to find tools that suit your courses.” (p.7)

DfS can be integrated to every course as an ultimate goal, however by starting at this point, without building a focused curriculum addressing DfS issues first, there is a risk of fragmentation and dispersion, which can work against cross-course integration. A curriculum focused on DfS is a key for consolidating sustainability values and developing steps towards integrating sustainability in to design programs in a consistent way.

An example: U of A design programs

The U of A Bachelor of Design program consists of six routes: the General Route, the Printmaking Route, the Business/Marketing Route, the Engineering Route, the Computing Science Route and the Social Sciences Route. Students tend to choose more applied fields like business, marketing or computing science, usually based on short-term goals and profitable practices. This is suggested by the figures found in the Enrollment Statistics from the Department of Art and Design for the period 1991 to the present.

8. Data collected in March 2007 from the Department of Art and Design, Faculty of Arts, University of Alberta

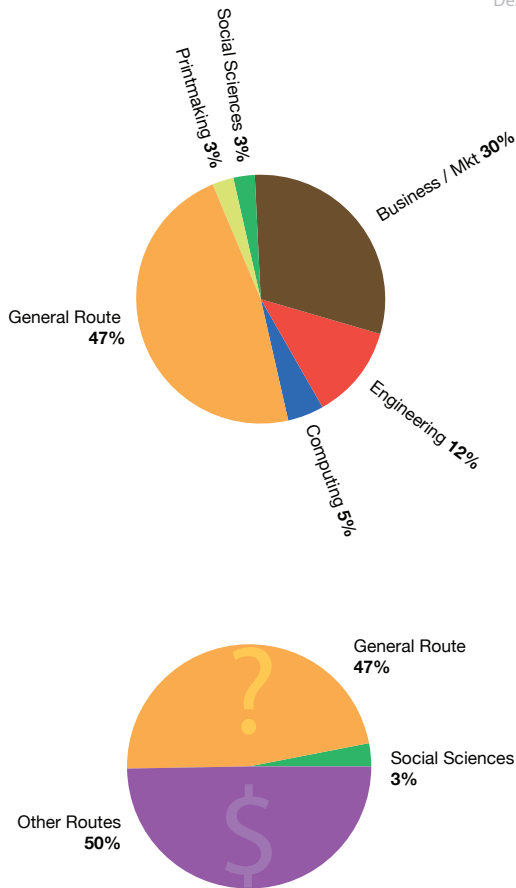
From 1991 to the present only 3% of the general enrollment in the BDes program routes chose the Social Sciences Route, while 47% chose the General Route and the remaining 50% chose the other routes, with high preference for Computing Science and Marketing.⁸ Despite of the growing awareness about Sustainability issues, 3% choosing the Social Sciences route is a small portion of the enrollment.

This does not necessarily describe what happens during the period of study and the period after students' graduate. A question arises at this point: what would happen if they knew, when choosing a route, that sustainability issues were included in the Social Sciences Route, or, what would happen if they could choose a Sustainability Route?

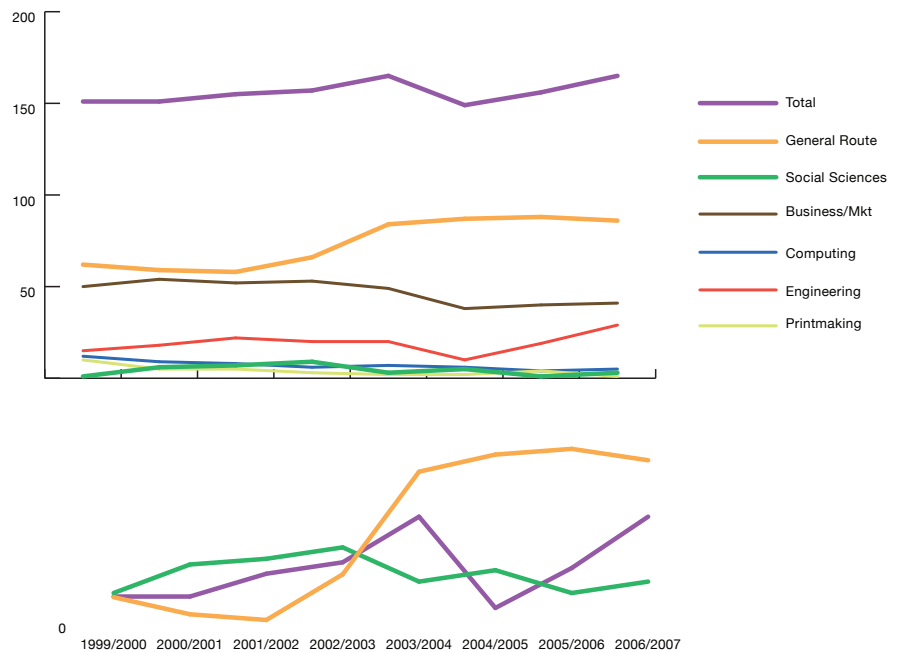
Referring to this important decision in design education Papanek wrote:

“Education can once again become relevant to a society of generalists, designer-planners. The main trouble with design schools seems to be that they teach too much design and not enough about the ecological, social, economical and political environment in which design takes place.” (Papanek, 1985/1971, p. 291).

What should we expect if these complementary, aspects of design education, like sustainability, are taught in one way or another, but not perceived as crucial as they should be by students? This situation harkens back to the times when design programs,



Design enrollment 1999-2007



were hosted by fine arts, social sciences or applied sciences, and at the same time were not sharing some important conceptual issues with them. More often in Europe, but also in other parts of the world, trends indicate that design schools, helped by a growing enrollment, become physically and politically more independent from other faculties. This is also evidence of how important is for design education in those countries to adapt to the changes from the very root of the public's interest. As a result, these independent design faculties find a renewed chance to interact with other disciplines without depending on a different umbrella than design.

Design programs at U of A are an example of co-existence, partnership and interdisciplinary relations. This environment appropriately reinforces the capacity of design to promote links with other fields not necessarily connected with the Fine Arts. A proof of this potential capacity is the content suggested by the BDes Social Sciences Route.

The Social Sciences Route includes valuable courses in Anthropology, Psychology, and Sociology. This list could be extended to include Human Ecology, Environmental, Political Sciences and Economics courses. Still, as it is, this is a broad and solid menu of disciplines to create a foundation of knowledge for a future designer.

Art and Design programs at the U of A currently include sustainability issues in courses that have room for discussion and debate, such as senior courses in History of Art, Design and Visual Culture (HADVC), Visual Communication Design (VCD) and Industrial Design (ID). Only in the VCD and ID curriculum do sustainability issues have a place in project-based work, for instance through materials and production processes. In courses in ID, VCD and HADVC –all of them with a wide range of issues connected in one way or another with theory, practice and design thinking– the content of the curricula and schedules are strained just to accomplish the basics required in a semester or two. The result is a fragmentation of sustainability issues in the design curriculum. An overview shows an abundance of information and discussion about, but limited action connected with, sustainability. This phenomenon seems to be common among institutions teaching art and design in North America.

The atomization and fragmentation of sustainability issues is one of the consequences of our social environment, our western cultural motivations and life-styles based on consumerism, in which recognized institutions are immersed and involved actively as a part of a rich community. That means, our culture is involved in the pursuit of economic success and in this context the institutions are focused on the success of postgraduate students and their career aspirations. This conception of attaching success to profit can be extended to any field including design. This demanding format follows the market rules, which naturally aim to acquire as much as possible with as little as possible in as short a time as possible, with few economic limits. Design education suffers from the same limitations as any other type of formal, higher

education in this context. Professor David Orr, environmental educator and writer, refers to this, criticizing:

“however well intentioned, formal education cannot compete with the larger educational effects of highways, shopping malls, supermarkets, urban sprawl, factory farms, agro business, huge utilities, multinational corporations, and nonstop advertising that teaches dominance, power, speed, accumulation, and self-indulgent individualism.” (Orr, 2002, p. 31)

Driven by economic values, professions like design suffer the effects of reductionism and utilitarianism. The more specialized or specific the design practice becomes the higher the risk is in affecting designers’ holistic perception. Victor Papanek referred to this phenomenon by reminding us that “man is a generalist”, and so a designer, but there is a dangerous tendency to reduce the role and potentials of design by fragmentation and specialization. (Papanek, 1985/1971, p. 326). Inclusion of sustainability issues in design education can help create a more holistic approach to design. Thus, in the process of addressing the role of design working towards sustainability, important concepts that should be included in the education of designers come into play.

2.2 Designers as problem identifiers, and designers as generalists

Traditionally, designers are defined as problem-solvers more recently as problem-identifiers. It is the definition of problem-identifier to which design for sustainability has a direct relation. Victor Papanek wrote “the most important ability that a designer can bring is to recognize, isolate, define and solve problems” (pp.151). Solving problems is at the end of the list, once the designer has analyzed of the origin of the problems. For instance, frequently in senior courses, students receive the information, in the form of handouts or orally, etc, with the problems outlined beforehand. In an effort to emulate a real situation, in which a client introduces the problem, and/or simply suggests the solutions, instructors’ role is to introduce the parameters of the project, making the design thinking process in to an exercise of determining appropriateness and visualization. It is more interesting for instructors to ask students: “what is the problem here and why?” or “what problems are not seen?” instead of “what’s your proposal or solution for this problem?”. Seeking the right questions enlightens design work and elevates the level of results. The process of design involves finding as well as solving problems. In order to be problem-identifiers, designers need a broader view of the context in which the problems come up, and must expend considerable energy in identifying those confronting problems, in a less linear and rather more argumentative process. (Lawson, 1980, p. 89)

In the book *User-Centered Graphic Design*, Jorge Frascara attaches social responsibility to the role of designers as problem-identifiers. In his words, “...visual communication designers can make a significant difference in society. Social responsibility is an active, more than a reactive concern” (Frascara, 1997, p. 20). Frascara also differentiates between two important areas of communication design: “one relates to making life possible, and the other to making life better”. Sustainability practices address issues to make life possible, however this is not understood by the general public, corporations and organizations, who tend to identify sustainability, ecology and “green” products with our market, economy and consumer habits. In other words, making life “greener” is interpreted as making life better, while still maintaining our material values.

Design for sustainability is about making life possible not because life is not possible without design, but because design is not possible within a society without effective systems that can sustain life on earth for the long-term. In this sense, it is necessary to induce the changes –changing people minds from the pursuit of short-term material results to long-term projects that can sustain life– and doing so, also change the way we see our material “attachments”. Visual communication designers have a meaningful role to play in producing this effect in the media, by taking action rather than by reaction. Identifying ways of producing awareness, changing mindsets, and reducing ecological impact, involves more than solving visual communication problems, it means identifying and asking the right questions.

While authors like Frascara emphasizes the user-centered role of designers, authors more focused on contemporary DfS issues like Ann Thorpe argue about the limited utility of focusing on this aspect:

“Designers have typically tried to overcome the absence of substantive consumer input through techniques such as user-centered design... Although user-centered design attempt to understand and improve the true well-being of the ultimate users of design the terminology itself is lacking” (Thorpe, 2007b, p. p.133).

Victor Papanek, reflecting on the role of designers, argued against specialization and expressed his criticism of our cultural tendency to reduce issues by creating more and more boundaries between professions. Papanek held,

“Man is a generalist. It is his extensions (tools and environments), which are designed, that help him to achieve specialization. But by misdesigning these tools or environments, we often achieve a closed feedback loop, and the tools and environments in turn affect men and groups in a way that turns them into permanent specialists themselves.”(Papanek, 1985/1971, p. 326)

Being a designer is being a generalist by default. Since design has, by its nature, to work across disciplines, being a generalist designer demands having a broader view and understanding of the sources of the problems before moving forward and trying to solve them. Usually these problems are hard to address and demanding, in terms of design thinking. Papanek refers to professionals who take these challenges as “reflective practitioners” (Papanek, 1985/1971, p. 77), those designers who are “inclined to engage messy, but crucially important problems”

Being reflective, and a generalist, means not losing sight of the details, but including the details in a wider perception of the issues. This means considering focusing on all aspects of the problem. On the opposite side, reductionism has led to specialization and fragmentation, sometimes presented under the legal format of standardization, with no more connections between fields than their economic links. Specialization is about individualization, however it does not mean more focus on real problems, rather it frequently means the loss of a sense of context. Specialization and fragmentation are connected to the dominating idea of utilitarianism extended across the global economic map. Utilitarian ideas are present in reducing and creating as much uniformity as possible, with the purpose of dominating prices and markets, and therefore the production of goods, and therefore the profits. This uniformity is what has driven design to a crisis of identity, producing more design specialization and less design understanding of the issues in a broad sense. In other words, on a global scale, reductionism is an outdated concept of “one-size-fits-all” ruling over masses, and this idea is so deeply rooted in our society that it has become a dangerous detour in human evolution.

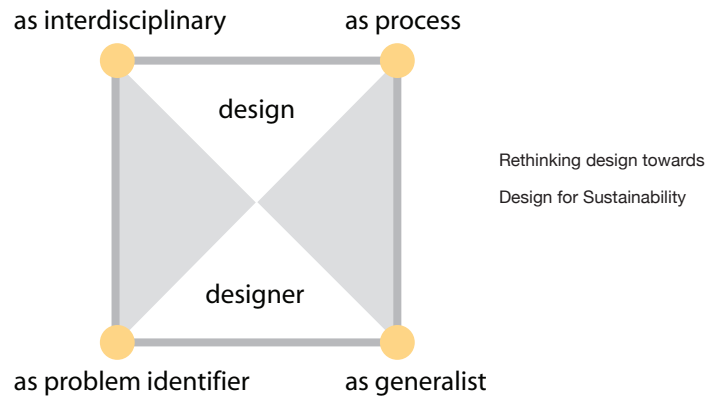
In biological terms, Arthur Koestler described the “overspecialization” of species as a detour in their evolution, contrary to diversifying, and pointed out that over-

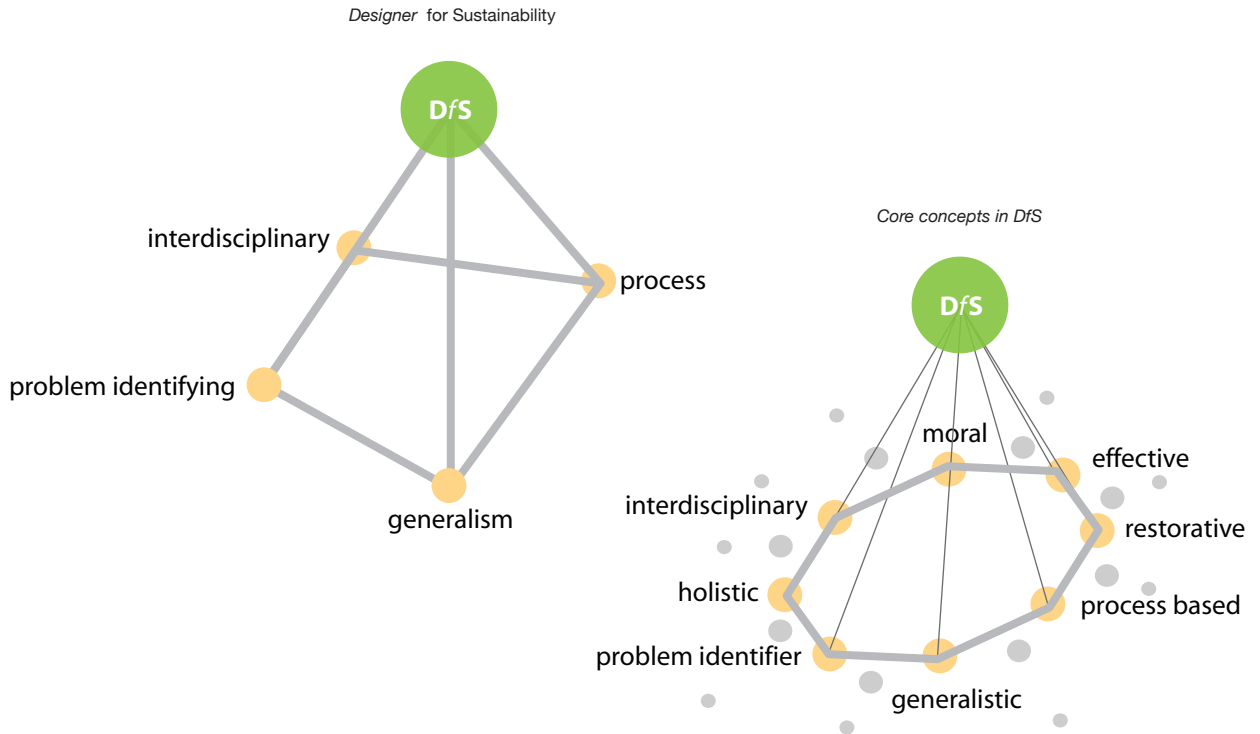
specialization is the principal cause of stagnation and extinction. He remarked that successful survivors are those who have escaped from specialization, including this idea among other neo-Darwinian approaches to the “survival of the fittest” (Koestler, 1967, pp. 161-171).

“Massification” runs in the opposite direction from diversity on which life on this planet depends. Therefore, leaning toward being a generalist and taking a holistic approach to design suggests avoiding reductionism as a side effect of massification.

Speaking in design terms, what Victor Papanek, Paul Hawken, and William McDonough, among other authors, maintain is that a holistic approach is imperative in order to re-design our systems of production, consumption and our place in the web of life on earth.

Holism is defined by the expression “the whole is greater than the sum of the parts.” In design, this means practicing a different way of seeing and approaching things, trying to read the totality and complexity of the issues, while not losing sight of the details or the sense of scale and addressing all the aspects before taking action. In terms of sustainability, it demands a deeper understanding of processes and cycles in the natural world, before taking action toward producing wealth.





2.3 Design and sustainability processes *(parallelism between both processes)*

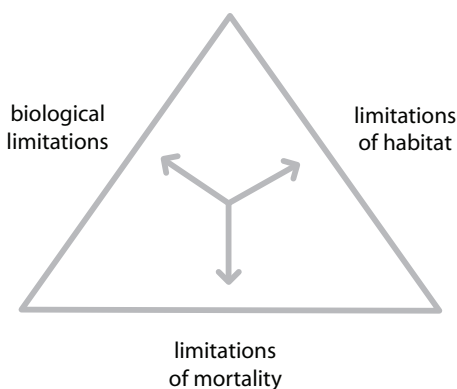
Processes in sustainability are related to natural cycles or natural processes. However, before addressing natural cycles, understanding sustainability demands an understanding of what a process is in the first place. Designers have some advantages in approaching these basic notions, since we are trained to experience design as a process during our education at design school. We learn, or at least assume and experience, that design is a process, rather than just the visible products of our design at the end of the process. It is not only what we can see, but also what precedes what we see in the form of thinking, analysis, planning, sketching, and production management. This is hard to remember after practicing design in the professional field for a while, immersed in a context of reductionism and surrounded by utilitarian systems. But once we remind ourselves of what we learned at school about the value of our design processes –on which the strength of our final designs were based and evaluated– we can easily apply these concepts to gain a better understanding of every project, issue and system no matter how complex.

9. Graphic Design is Immaterial, Written by Matt Soar.
Published on September 6, 2006. Journal of Design in
State of the art. From a short talk presented at the AIGA
Future History conference (Chicago, October 16-17,
2004).

Matt Soar, graphic designer from Concordia University in Montreal, reflexes in recent lectures, that “graphic design is immaterial”;⁹ in part trying to explain the difficulty in defining what design is, even for designers, in order to understand a complex profession in simple terms. He refers to design as something that “it’s not this or that but somewhere in the middle”. That “middle” can be expressed as “the process of design”, as long as the process can be understood as everything between the collection of information and the implementation of the final proposal.

Bryan Lawson, for example, concluded that the design process is endless and there are no optimal solutions to design problems, mentioning that sometimes stated objectives of design may be in direct conflict with each other. This relates to “wicked problems” described later in chapter 4. In sustainability, as well as in design, it is never possible to be sure when all aspects of the problem have emerged. Since design problems can have many different solutions, the design process cannot have a finite and identifiable end. The designer’s job is never really “done” and it can be always improved. Design problems are not mathematical problems, nor puzzles to solve. (Lawson, 1980, pp. 86-88) In this sense, looking at Soar’s definition, the practice of sustainability is somehow immaterial too, it is not a collection of information and the acquisition of awareness, and it is not a precise ultimate goal, rather, it is an everlasting cycle. In terms of sustainability, designers need to analyze different processes or “middles” and look for multiple connections among them. Comparing design and sustainability, perhaps there are more multiple, interconnected processes involved in sustainability than in the usual utility-focused process involved in design. Sustainability interconnections add new paradigms to the design process, moving from linear process to multidirectional processes.

Papanek’s triad of limitations



An extended definition of the design process is “the management of constraints” in which the design process is about dealing with difficulties and managing limitations. In his “triad of limitations”, Victor Papanek addressed these constraints, suggesting that constraints in human beings are related to biological limitations, limitations of habitat and limitation of mortality (Papanek, 1985/1971, p. 73). This does not mean fighting against limitations nor even breaking them, rather, it means understand and working within the limits. On the other hand, former student and educator at Ulm HfG and designer Tomas Maldonado address the valuable role of management in design, defining as “the operative and cognitive behavior by means of which information is transformed into action” (Maldonado, 1972, p. 51). He maintains, “There can be design without innovation, and innovative activity without planning. But neither planning nor innovation can do without the service of management [framework] (Maldonado, 1972, p. 50). However, Paul Hawken places “design” in front of “management”, defining the role of designers more broadly. In his words, “a sustainable world is a design problem, rather than a management problem” (Hawken, 1994, p. preface xiii). These authors reveal the elements for understanding the relationship between planning and process, in order to manage limitations or

constraints.

Design for sustainability involves this complete understanding of common links between design and sustainability; process is one link present in both. However, design intervention is essentially a prescriptive activity, while sustainability tends to be approached from science as predominantly descriptive activity (Lawson, 1980, p. 90). Science approaching sustainability helps to understand the present and predict the future and imply of sustainability issues. Design on the other hand, may be seen to prescribe and create the future, and this process involves not just ethical but also moral responsibility. When sustainability meets the design's approach, questions like *what, how* and *why* are extended to new questions like *what might be, could be* and *should be*.

It is through the role of designers with a broader sense of responsibility, that design has the tools to address the complexity of a sustainable world, and in doing so, to produce changes. If designers are prepared to face the next decades asking the right questions and following the right path, there is not only hope for re-nourishing our profession, but also for collaborating for our collective survival.

2.4 Design as interdisciplinary field

The survival of life, of humans, and designers, depends on our collective sense of resilience.

“Think globally and act locally” has been one of the mottos most embraced by designers and other professionals who advocate to providing solutions and choices in order to become more sustainable or “greener”. In doing so, they not only avoid the overwhelming complexity of global problems which lead to immobility, but also they reinforce the idea that every individual change counting as a part of larger coordinated efforts, which eventually produce a “domino effect” involving millions of other people. This concept means that taking action is about making individual decisions rather than making governments and organizations –which are supposed to represent citizens– responsible for solutions. In other words, it is expected that action starts with individuals before projecting further effects onto communities and societies. The more this interpretation involves politics the more polarized the argument becomes, resulting in individual action with fragmentation on one side and global discourses with no effective action on the other. The key to untying this discord however is not support one argument or another, but rather, by applying a broader approach. Acting locally is not necessarily about individuals. Addressing the problem of sustainability by reducing the discussion to a matter of scale only paralyzes individual and collective action. This sense of paralysis is also common in classrooms, at the moment when the information is delivered. Then students are overwhelmed, and frequently so are the instructors, by the complexity and the multiple interconnections of the number of options to address the problems. Processing large amounts and kinds of information can lead to frustration, skepticism, apathy, rejection, and denying or even anger reactions. When individuals cannot project the individual effort on the collective results, it can produce mental blocks and inaction can follow. This is noticeable when introducing

the problems of DfS to the class, by delivering lectures that show the state of the issues, and by asking questions such as: how did we get to the current situation?, questions involving historical and sociopolitical context, complex issues like globalization, inequality, etc. In design classes, when instructors or lecturers deliver this kind of information, and design is analyzed as a part of the problem, the most frequent reactions are close to anger, frustration and helplessness. Authors and lecturers like David Suzuki, Paul Hawken and most others have now reversed this kind of delivery, emphasizing who is doing what to work towards behavioral change, versus shocking people by how bad things are, and then using that success story to simultaneously describe the problem and the solution. This can be a very powerful method for teaching, avoiding negative reactions.

Individuals have to be guided by a collective sense of right action. This is also true of citizens represented by social organizations. Collective action can only be accomplished by collaborative and cooperative work. Design, far from being an exception, can be an inspiring example of collaborative work. Take the case of an individual designer working independently. Even a free-lance designer is not an isolated practitioner and knows about collaboration and cooperation. He or she will eventually need other designers, web designers, illustrators, programmers, printmakers, and even if a designer has all these skills, he or she will work beside a client, who will provide insights, aims, and usually content from his other own field, from marketing specialists, from text writers, images from photographers and so on. Designers are multidisciplinary agent.

Sustainability issues demand multidisciplinary actions. Just to mention the main issues related to sustainability is proof of this requirement: environmental issues, social responsibility, economic sense, political frames, cultural integration, scientific research, technological development... every field is connected with a sustainable planet in one way or another, because sustainability is about the basis of a benign human role on earth. The multidisciplinary aspect of sustainability meets a natural aspect of design, a natural role for designers.

Multidisciplinary levels
of DfS



In conclusion, the sum the of mentioned concepts: –designers as problem identifiers, designers as generalists, design as a process, design as a multidiscipline, supported by a holistic approach to design and sustainability, leads to more meaningful and interconnected concepts. These concepts become a strong platform for a curriculum in which design for sustainability content can be delivered to future designers. The role of design in creating a sustainable world must be present in students’ minds from the time of their higher education and encouraged by design instructors. Tomas Maldonado anticipated these concepts in a brilliant definition:

“It is a choice between destructive pessimism and constructive pessimism. We (designers) in fact prefer the latter. For us, there exists only one possibility: to keep rejecting everything that threatens human survival; to help defuse the “time bomb”, which means to respond to irresponsible growth with responsible control, to respond to congestion with management. In brief, we choose design and planning.” (Maldonado, 1972, p. 39)

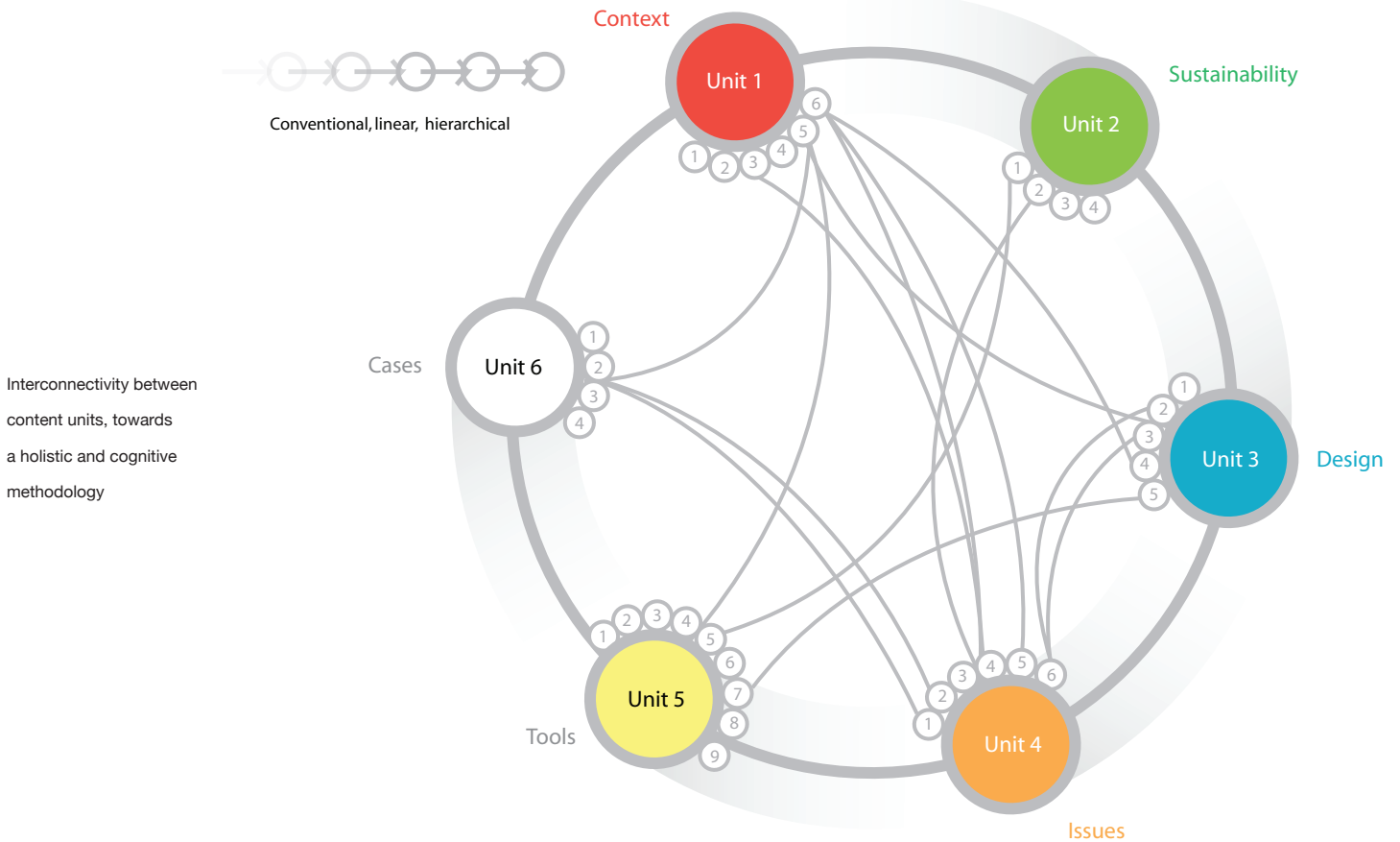
2.5 Teaching and implementation of these concepts: the curriculum, methods and conceptual tools

Creating awareness about sustainability in design students, and providing detailed information about it and its relationship to design decisions, is an important goal of this thesis project. The main goal of the Design for Sustainability course is, by providing a conceptual framework, to modify the mindset of students and allow them to gain different insights and a broader sense of responsible design practice. Students taking Design for Sustainability will have a broader understanding of traditional design issues and of other fields outside design. It means a better understanding of the complexity and interconnectivity that rule ecosystems and the basis of life function. DfS curriculum will stimulates critical thinking and address new paradigms of design, bringing retrospective and prospective analysis.

In a DfS course the medium must be also the message. It should be based on a dynamic curriculum, and current information within which students can find a space for interaction, exploration and experimentation. For this purpose, this thesis project is based on a modular structure of units covering the essentials aspects of DfS, determined by the analysis of other analogies and the outcomes from testing and personal teaching and professional experience. The units included in the DfS curriculum are:

1. Introduction to the Problems
2. Introduction to Sustainability
3. Design for Sustainability I: the will to act
4. Design for Sustainability II: the issues
5. Analysis of Conceptual Tools
6. Analysis of Case Studies

These six units are ordered in sequence, but, interconnected for a more apprehensive and holistic experience. Interconnecting units means developing issues in parallel across more than one unit at the time. In doing so, the delivery of information about the problems can be balanced with information about solutions simultaneously, e.g. introducing context at unit 1 can be supported by a case-study relate to the issue from unit 6.



Each unit contains a core of sequential topics to address the learning process gradually. The idea of a traditional curriculum sequence with a hierarchical order of topics allows: introduction and delivery of context, increasing complexity and finally, arriving at conclusions and encouraging critical thinking. On the other hand, the idea of interconnectivity is inspired by Gestalt theory applied to education. In Gestalt, the idea of apprehension means connecting the experience of learning with understanding and perceiving the importance and effects of what we have learned. This is a holistic approach to learning that adds balance to the process of achieving knowledge while understanding new concepts. The juxtaposition of these two orders, hierarchical and interconnected, works as a conceptual tool for the education process. Gestalt theory itself is a conceptual tool that can be used to give meaning to the concept of education

(Brown, 1975, p. 53). In this sense Bert Pearlman, educational theorist, points out “Gestalt theory holds that the discrete elements of a whole are meaningful only in relation to the whole. This is to say that the whole is not explainable in terms of any possible enumeration and conjunction of its parts, but rather, we can only know what the elements of anything are elements of that thing by having a prior conception of the whole”.

In the proposed DfS curriculum, this methodology is supported by different experiential projects, such as interactive exercises (students participating in instructor’s presentations), project-based sustainable designs and field trips seeking problems. In developing the contents and presentations to deliver in class, as well as from student’s projects in class, some conceptual tools are introduced, like new methods of visualization, interactive “widgets” for building scenarios and new possible sustainable media projects.

The pace of incorporating education on sustainability into design courses needs to be accelerated. The longer this process takes, the more difficult it will be to reach a relevant role of design in the context of coming changes. This process depends on having a vision and the goodwill to achieve it. It demands short-term decisions for the long-term benefit. Tomas Maldonado wrote: “we cannot build models that allow us to simulate structures, actions, and behavior if we do not already possess an unequivocal will to realize such structures, actions, and behavior” (Maldonado, 1972, p. 11). We can work on Design for Sustainability if we already possess the will to re-think structures, actions, and behavior. In order to do so, the first steps begin in education.

3. Research Question

3.1 The question

The role of future designers is an issue discussed in every design school and professional institution of design. In U of A design courses the discussion is ongoing. The challenge is in looking for the right questions rather than having designers seek solutions to solve existing pre-framed or “ill-formulated” problems. Moreover, since designers have started to understand how involvement in the profession is causing some of the problems that need to be solved, the discussion is focused on how not to produce the problems in the first place, and then look for solutions.

The process for this thesis research project began long before the project itself. In looking for a subject connecting design with global issues, a wide range of questions came into play, bringing up more and deeper than the usual questions framed in design practice. In the process it was discovered that in crossing boundaries, design assumptions and design thinking are challenged.

The first research question was formulated:

How can designers play a more meaningful future role in connecting a design with sustainable needs, in other words, connecting design and sustainability?

In part, the answer is implicit in the question: working on connecting two fields leads to seeking a medium to produce the connection. Ideally, this connection should fulfill the expectations of modifying the present in order to improve future outcomes. Future designers can be the agents who will lead the changes and education is the medium to engineer the changes. This suggests that the key-concept is educating future designers about sustainable practices, or in other words, teaching Design for Sustainability. Jorge Frascara refers to this point in his book *Design and the Social Sciences: Making Connections*. In his words: “cultural and physical sustainability must become part of every design process, and schools will have an important role to play in the formation of the new generations of designers” (Frascara, 2002, p. 36)

After this first question is established, more specific questions arise, which relate to the implementation of the premise:

- what knowledge do designers need to address the issues involved in Design for Sustainability? (content)
- can future designers be trained for a responsible design practice with long-term effects? How? (curriculum)
- how early can future designers approach these issues from a design perspective? (level)
- are the actual design programs adding these issues at an appropriate rate and depth? (current education)
- what approaches and tools are successful in learning DfS? (method)

3.2 Process and methods

This thesis project addresses these questions through five main strategies included along the project

1. researching (literature review).
2. establishing the relation between Design, Sustainability and Education, and their interrelations, in order to consolidate the bases of a DfS curriculum (the triad of DfS). Incorporating different approaches from design and sustainability literacy.
3. including a field trip to a DfS pilot course and consulting current experts in the field.
4. designing a curriculum, methods and models for teaching DfS
5. testing the model, methods and tools for teaching DfS

4. Background and context

“The crisis of sustainability, the fit between humanity and its habitat, is manifest in varying ways and degrees everywhere on earth. It is not only a permanent feature on the political agenda; for all practical purposes, it is the agenda. No other issue of politics, economics, and public policy will remain unaffected by the crisis of resources, population, climate change, species extinction, acid rain, deforestation, ozone depletion, and soil loss. Sustainability is about the terms and conditions of human survival”.(Orr, 1992, p. 83)

4.1 Global issues

In order to understand the context in which design has to create frameworks, it is imperative to gain a clear notion of what has happened, what is happening and what the future of humanity looks like at the present. Large species and the planet have interacted for 600 million years, but human civilization has become a factor of change for the planet in the past few centuries, and this process has been accelerated since the Industrial Revolution (Flannery, 2007, pp. 12, 23).

Seeing human population growth projected in a time-line, it is easy enough to understand that we are a growing menace to life systems on the planet. But more anthropogenic factors or man-made changes have been produced for a long time, causing reactions in the natural world that are still not completely understood. For 8000 years, for instance, agriculture has been modifying ecosystems by saturating the soil with monocultures and causing the loss of bio-diversity and increasing the rate of greenhouse gas emissions and their effects on climate (Flannery, 2007, p. 55). This problem has become more obvious over the past few centuries, when agriculture turned into an industrial force leading regional and international food markets, at the time big cities started to shape the actual map of our globalize civilization. At this point, issues such as loss of bio-diversity, deforestation, desertification, and climate change began, however very subtle changes were noticed.

It was in the ninetieth century, with the explosion of the Industrial Revolution and the machinery age, that man crossed a limit in terms of exponential changes. Human civilization not only induced important changes at this point in terms of using natural resources and modification of natural systems, but also important changes in the political, social and economic map of the earth. The roots of fundamental problems we are facing in the twenty-first century, such as extended extreme poverty, consolidation of pandemic diseases, polarization of wealth, loss of human values and morals, man-driven climate change, to mention the more well-known, were begun at that time in human history. The world map was redrawn by human enterprise and the world wars. As a consequence, the rise of corporations and economic interests over social policies, and western cultural domination over less adapted cultures, were the causes of the collateral effects known as global issues –read global issues as global problems, also known as side effects of globalization– and they fuel the global agenda of today. The society in which we live and in which design has grown as a discipline,

was molded from that time on. Understanding this context is key to understanding why designers cannot extrapolate our thinking too far and why it is so difficult to think outside the box, when the box has been our actual global civilization.

Global issues understood as global concerns, have focused on inequality and poverty and their social, political and economical implications, which includes issues such as health and medicine supply, food and water supply, literacy and education, abolition of slave labor, children's and women's rights and overall environmental consequences (induced by the symbiosis of industry and consumerism), among the most important ones.

Governmental and non-governmental organizations have worked on understanding these issues and taking action to reduce and eventually eliminate the problems. But for decades they have been addressing the "tip of the iceberg", fighting the visible consequences of caused problems rather than rethinking the origin of the problems. In other words, given the magnitude of the emergency in many parts of the world, organizations have been working on short-term solutions.

Some independent initiatives, communities and international organizations such as United Nations (UNDP and UNEP programs), World Wildlife Foundation, Greenpeace, World Watch Institute, The Earth Charter, AIGA (Sustainable Design Forum), The Talloires Agreement, Massive Change, Treehugger, Bioneers, among many others are working hard not only to address the urgent problems, but also to plant the seeds for medium and long term effects. It has taken years to understand how deep the changes have to be in order to address global problems, and still, these new ideas of human development, like sustainable development, have been vastly ignored or minimized by the wealthy minority who have the power to solve long-term problems starting immediately.

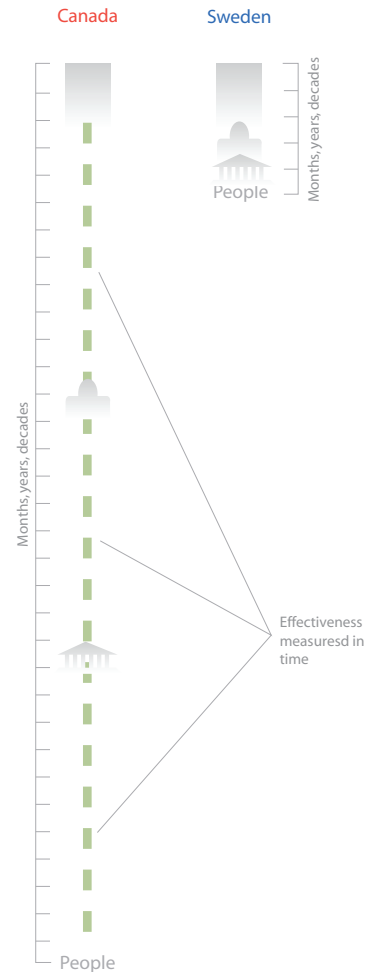
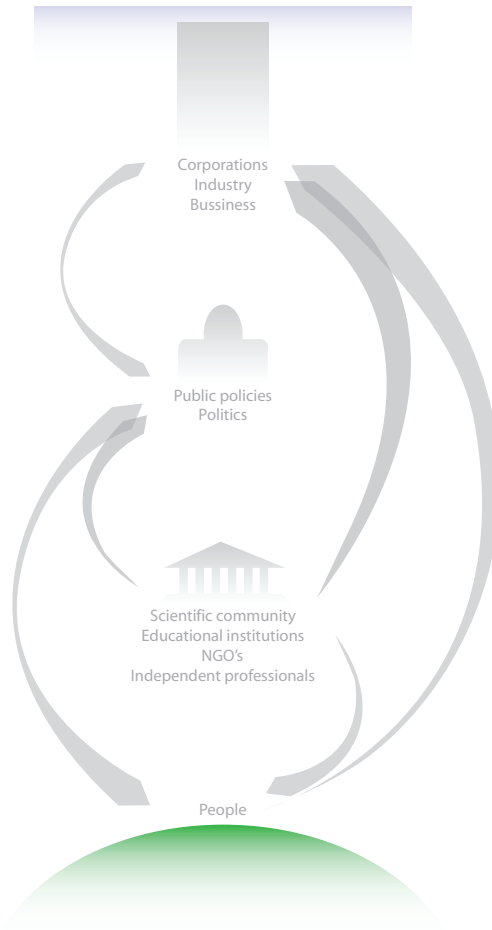
Changes in mindset, speed of actions towards sustainability over society.

Science, education, awareness and advocacy modify people's mindset and behavior with regard to sustainable habits, but also corporations' behaviors towards sustainable practices. People, as educated consumers, modify corporations' behavior too, by buying or not-buying products from industry, and services from business.

Corporations modify policies and vice versa. Politics are influenced by people while people's behavior is modified by policies. The closer these reciprocal forces work the faster results can be achieved and the higher degree of sustainability can be assessed.

These forces respond to levels of effectiveness rather than to the levels of efficiency. Efficient governments and ecologically literate communities can be effective in this process. Strong convictions and agreement between government, institutions and citizens lead them to act decisively and wisely toward a common goal. It can reduce the time gap between actions and results, and lead to sustainability and even accelerate restorative processes.

In terms of time required for forces to influence each other, and how quickly actions are taken, countries like Canada have bigger gaps than some European countries leading the changes toward sustainability like Sweden. Canada is ranked 8th in the list of countries by GDP, while Sweden is 19th, this evidences that the issues are attached to cultural and political rather than economic factors.



10. Concklin, Jeff. Paper retrieved on November 2005 from <http://cognexus.org> and part of a forthcoming book: *Dialogue Mapping: Building Shared Understanding of Wicked Problems*, Wiley, October 2005.

11. Rittel, Horst "Dilemmas in a General Theory of Planning" (1973) and "Issue-Based Information systems of Design" (1989). The Institute of Urban and Regional development, University of California.

The complexity of these problems demand that we operate from "the roots", as a re-design process, going back to the origin of design necessity. Addressing these problems partially or taking them from the visible end of the process instead, can lead to asking the wrong questions and also lead to unexpected and undesired consequences. Horst Rittel in the early seventies, and more recently Jeff Concklin, have referred to these kinds of situations as "wicked problems" based on "ill-formulated questions",^{10,11} the kind of problems in which every time a solution is applied, wrong or partially formulated, it can create new problems eventually becoming an uncontrollable situation. In "wicked problems" there is no "problem" in the traditional sense; similarly no "solution" is ever achieved in the traditional sense. Concklin proposes better alternative terms like "domain of concerns and needs" for "problem", and "domain of resolution and satisfaction" for "solution" "(solution) simply meaning a proposal that might resolve some part or aspect of a wicked problem". Bryan Lawson adds more valuable insights to this matter "In design the solution is not just the logical outcome of the problem, and there is therefore no sequence of operations which will guarantee a result" (Lawson, 1980, p. 89).

Framed in the traditional approaches to problems of design, where the problem is formulated by a client before asking for design intervention, the wicked problems concept can be considered appropriate to provide "solutions" and solving a part of the problem, or the visible end (Margolin and Buchanan, 1995, pp. 3-19).

In the field of Design for Sustainability, the wicked problems theory helps to re-think sustainability problems as a whole, paying special attention to interconnections of factors, and allowing consideration of other theories like lateral thinking (De Bono, 1985, pp. 140-147) or the triad of limitations in design (Papanek, 1985/1971, p. 73). All these theories tend to propose a holistic approach and a "breaking out of the box" in addressing complex problems. But by no means do they solve the problems; rather they hardly help to understand it better. Environmental educator and writer David Orr described how wicked sustainability issues are:

"...after a century of promiscuous chemistry, for example, who can say how the 100,000 chemicals in common use mix in the ecosphere or how they might be implicated in declining sperm counts, rising cancer rates, disappearing amphibians, or behavioral disorders? And having disrupted global biogeochemical cycles, no one can say with assurance what larger climatic and ecological effects will be. Undaunted by our ignorance, we rush ahead to reengineer the fabric of life on earth. Maybe scientists will figure it all out. It is more probable, however, that we are encountering the outer limits of social-ecological complexity in which cause and effect are widely separated in space and time and in a growing number of cases no one can say with certainty what causes what. Like sorcerer's apprentice, every answer generated by sciences gives rise to a dozen more questions, and every technological solution gives rise to even more problems." (Orr, 2002, p. 26)

If the problems of sustainability mean the rise of new paradigms for design, future scenarios can be described as the modern dilemma for human kind, a wicked situation in which “we find ourselves trapped between the growing cleverness of our science and technology and our seeming incapacity to act wisely” (Orr, 2002, p. 29)

4.3 Sustainability: a problem of design

Jorge Frascara addresses the role of designers as problem solvers vs. designers as problem identifiers. The first demands interdisciplinary activity. The second demands the identification of important problems and development of interdisciplinary strategies to deal with them (Frascara, 2002, p. 35). Sustainability is a complex net of important issues and identifying problems within these issues is a core task for designers. Frascara extends the concept, pointing out that “It is not sustainable to continue just reacting to clients’ requests for design inventions” in clear allusion to social and ethical responsibility of designers’ practice. Frascara address the nature of these challenges describing what is needed to approach complex issues with a broader and wider sense: “A set of tools to look at the world will have to be developed by inquisitive, critical, interdisciplinary observation, performed by people in love with humanity” (Frascara, 2002, p. 36).

The role of designers working toward sustainable standards is also noted by Economist and Ecology advocate Paul Hawken as previously mentioned, by suggesting sustainability is a problem of design rather than a problem of management (Hawken, 1994, p. preface xiii). In this way, men can manage things that they create with design and execute with engineering and technology, like machines, cars, buildings, objects, but our knowledge of the earth is in no way comparable. In David Orr words “we did not make it [the world], we have no blueprint of it, and we will never know fully how it works...the target of management is not quiet what is appears to be since a bit of what passes for managing the earth is, in fact, managing human behavior.” (Orr, 2002, p. 17) Also alluding to ethical and moral responsibility of designers toward sustainable practices Orr held that sustainability

“is a design challenge like no other. It is not about making greener widgets but how to make decent communities that fit their places with elegant frugality. The issue is whether the emerging field of ecological design [and design for sustainability] will evolve as a set of design skills applied as patchwork solutions on a larger pattern of disorder or whether design will eventually help to transform the larger culture that is badly in need a reformation... Green consumerism or even greener corporations are band-aids on wounds inflicted by economy grown too indifferent to real human needs and pressing problems of long-term human survival.” (Orr, 2002, p. 12)

It is not possible to sustain something that is ill formulated and misdirected or, what is even worse, out of control because it is too late to re-design it. Sustaining something that works badly only drives to the risk of total and inevitable failure, without mentioning the incalculable human and material costs involved. This paradigm is described by David Orr: “we cannot know what sustainability means

until we have decided what we intend to sustain and how we propose to do so.” (Orr, 2004, p. 141) When designers talk about sustainability or sustainable futures, they talk about redesigning things to sustain and re-design the future of things. Design for sustainability is about detecting the nature of failures and acting towards fixing them in harmony with natural rules. It demands certainty, whether restoring the situation to the point at which things turned wrong or simply start from zero (here the word “simply” meant in simple words). In this context, Orr clearly described the necessary way of thinking of design:

“The twentieth century was the most brutal and destructive era in our short history. In the century ahead we must chart a different course that leads to restoration, healing and wholeness. Ecological design [and design for sustainability] is a kind of navigation aid to help us to find our bearings again.”

As mentioned previously, design has to be understood as a process in order to address the interconnected processes involved in sustainability. These interconnections follow a complex net of interdependent systems, and this basic net is the web in which life runs on our planet under natural rules. It is useless to discuss how the human species can modify these rules, since they are the same rules that govern the universe, and humans are just a small part of the universe. Using a metaphor, an atom cannot work against the laws of physics in which atoms have the sense to be atoms, or in other words, humans cannot choose between the time in which we live or another, the world we live in or another, the universe we are a part of or another. We only have one environment. Alberto Manguel, literate in many languages, said that “any loss is a common loss”.¹² Manguel referred to languages and how the loss affects culture, but this metaphor is as present in nature as in cultural diversity –any single loss, affects the whole and its equilibrium. Changing it or going against the rules that keep us alive, to use a behavioral metaphor, is suicide. Common sense points this out and no reasonable individual would disagree with it. David Orr wrote, “It makes far better sense to reshape ourselves to a finite planet than to attempt to reshape the planet to fit our infinite wants” (Orr, 2004). However, our collective behavior seems to go in the opposite direction. Later in this chapter, some definitions are introduced. The assumption and acceptance of the principles introduced by those definitions must be –not only implicitly but also explicitly– transformed in actions and measurable facts.

12. Alberto Manguel is an anthologist, translator, essayist, novelist and editor. He was born in Argentina, became Canadian citizen in 1982 and currently living in France. Manguel visited U of A in 2007 as a part of CBC Massey Lectures Series.

If design can be approached as a process, not just as the formulation of a problem, and not the final solution to that problem, but everything in the middle, so can sustainability. Therefore, sustainability, understood in terms of sustaining life on earth, can be approached not just as the formulation of how to sustain our civilization as it is, nor the ultimate goal of solutions to adapt everything around us in order to sustain our civilization as it is, but everything possible to make a human civilization a factor for good, by being part of natural cycles and processes.

Natural processes work based on time factors. Ancient civilizations understood this very well, using time not as a constraint, but as a tool of change and adaptation. David Orr has defined sustainability under “the arts of longevity”, based on earlier cultures and other societies which understood natural processes (Orr, 2002, p. 11). Settled cultures, like first nations and aboriginals in every corner of this planet did it very well,

before the word “ecology” was used. They designed with ecology in mind; in David Orr’s words:

“because to do otherwise would bring ruin, famine and social disintegration. Out of necessity they created harmony between intentions and the genius of particular places that preserved diversity both cultural and biological capital; utilized current solar income; created little or no waste, imposed few unaccounted costs; and supported cultural and social patterns.

Cultures capable of doing such things work slowly and from the bottom up.” (Orr, 2002, p. 9) Here the notion of long-term results, guided by slow and controllable changes, is present as a consequence of a culture that had no access to huge amounts of information, but had to work with collective knowledge and build cultural wisdom.

“In contrast to the linear thinking characteristic of Westernized people, Native American cultures, for example, had a more integrated view of the world in which they lived.” (Orr, 2002, p. 10).

In America –understood as a continent, not a country– the *successful* western culture leading by United States, with a short, nervous, puritanical and futuristic history, contrasts with Latin America and its long, multilinguistic, Iberian, Aztec, Quechuan, Amazonian and baroque history. As a result, culturally speaking, we could describe impatience in one side of the history (the north) and patience in the other (Fuentes, 2001, p. 56), a fast culture and a slow culture.

The ancient way to understand the natural world is connected with understanding how time works, how “optimums” should subordinate “maximums”, how things must be *right* and not only well done, and how all this knowledge leads to wisdom, which is a way to say being intelligent and capable of survival. In this context it is worth remembering that ancient cultures – as is the case of America – did not fail, but they were corrupted and destroyed by the irruption of modern western cultures driven by the European conquests.

In conclusion, and connected with concepts held in Chapter 2 (pp. 9-14), sustainability is consider a problem of design. It demands designers as problem identifiers, design as a process, time as a factor, and natural patterns as models for which to strive.

4.4 Definitions of Sustainability

The previous chapters have defined design, described the role of designers and oriented design in terms of sustainable practices. Understanding what design is –a process, a multidisciplinary actor, a medium to help identify problems– is necessary before moving on to address sustainability as a field.

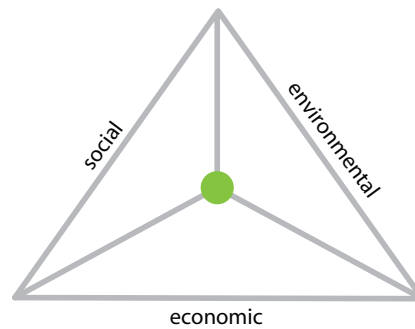
The most accepted definition of sustainability does not exactly address sustainability. Instead, it is a definition about sustainability applied to another concept: development. In fact, the word “sustainability” is not present in traditional dictionaries. Only recently has the term been added to user-based public databases like Wikipedia. Even in these databases, the most accurate definition is still related to “development” or more precisely “economic development”. The Brundtland Commission to the United

13. Bruntland Commission, retrieved in July 2007 from <http://en.wikipedia.org/wiki/Sustainability>

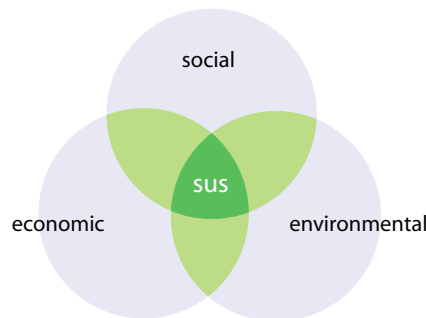
14. These concepts were retrieved from notes taken at Icis-Lund Sustainable Design Futures pilot course, from lectures given by Karen Blincoe (ICIS), Alastair Fuad-Luke, and Dr. Mårten Karlsson, (IIIEE, International Institute for Industrial Environmental Economics), in Lund University, Sweden, November 2006.

Nations introduced the most popular definition of sustainable development for the first time in 1987, but it was present in the minds of economists, thinkers and scholars for some time. In the 1970's. Gro Harlem Brundtland, former Norwegian Prime Minister, defined sustainable development as development that “meets the needs of the present without compromising the ability of future generations to meet their own needs”.¹⁴ This is the most accepted definition of sustainability. A more detailed explanation of the concept refers to the continuity of economic, social, institutional and environmental aspects of human society, as well as the non-human environment. In other words, it is also an attempt to provide the best outcomes for the human and natural environments, both now and into the indefinite future.

Another well known and very accepted definition of sustainability is the triple bottom line, a diagrammatic representation of the issues that sustainability addresses, which add to traditional business thinking of the “bottom line of profit”, with two new dimensions: the social and the environmental. These three bottom lines, in the shape of a triangle, indicate that the more centered in the graphic the approach to business is, the more sustainable a product is meant to be. The point in the middle of the triangle represents a sustainable product, which means socially equitable, environmentally harmless and making economic sense.¹⁵



Sustainable Development
Triple Bottom Line



Sustainability Triple
Bottom Line

The word “sustainable” is defined as the ability to continue a defined behavior indefinitely. In order to define Design for Sustainability –if just one definition could collaborate to better understanding, a first approach might be:

DfS is a process of design that creates the necessary framework to develop products of design or modify human behavior by design, which might meet the aims of sustainable development.

Perhaps the more insightful definition of design for sustainability, is the one written by David Orr while defining ecological design or eco-design, the closest relative to DfS:

“...[eco-design] is an art by which we aim to restore and maintain the wholeness of the entire fabric of life increasingly fragmented by specialization, scientific reductionism, and bureaucratic division.”(Orr, 2002, p. 29).

4.5 Mimicking the best design: mimicking nature.

In the words of Aristotle: “Nature does nothing uselessly.” How far are we from saying “design does nothing uselessly”? Design is not a natural process, but designers are human beings and thus products of nature. In addition to humanities and human sciences, nature can also inspire good design.

In defining the science of Biomimicry (from the Greek bios, life, and mimesis, imitation), Biologist Janine Benyus, inspired by nature’s wisdom, held nature as model, nature as measure, nature as mentor. (Benyus, 2002). Design can be inspired by natural models, design can be measured in terms of its role in natural systems, and design can work under nature’s frameworks.

We have the clues to help us reach the best design products and mediums created and used by design all around us.

“ After 3.8 billion years of research and development, failures are fossils, and what surround us is the secret to survival. The more our world looks and functions like this natural world, the more likely we are to be accepted on this home that is ours, but not ours alone” (Benyus, 2002, p. 3).

This enlightened definition puts in simple words the path we have to seek and follow in order to work “within the limits” try not to break them. Papanek extends this way of thinking while seeking the designer’s role. He wrote that design, if it is to be ecologically responsible and socially responsive, must be revolutionary and radical in the truest sense. It must dedicate itself to nature’s principle of least effort, maximum diversity with minimal inventory or doing the most with the least. That means consuming less, using things longer, and being frugal about recycling materials (Papanek, 1985/1971, pp. 344-346). David Orr agrees with this idea, adding that “sustainability depends on replicating the structure and function of natural systems” (Orr, 1992, p. 33). On this path, it is worth considering certain definitions and differentiations as described later on this chapter.

It is hard to think about mimicking nature without falling into the trap of scientific complexity. We tend to think of nature as something usable, but complex to understand, something to take from but not to give back to. However, everything we do and everything we are is framed in a natural world with natural rules. With the appropriate set of concepts we can be part of and work in harmony with such complexity and perfection.

Benyus introduces helpful descriptions of nature's laws, strategies and principles (Benyus, 2002, p. 7):

1. Nature runs on sunlight
2. Nature uses only the energy it needs
3. Nature fits form to function
4. Nature recycles everything
5. Nature rewards cooperation
6. Nature banks on diversity
7. Nature demands local expertise
8. Nature curbs excesses from within
9. Nature taps the power of limits

In addition, nature can solve more than one problem at the time –indeed multiple interconnected problems at a time– without creating a new one.

These ten points constitute a good model for planning and creating our products of design, conceptually and practically. Accordingly to these principles, nature is a model for a different material world in which:

- farms work like forests and prairies
- buildings accrue natural capital like trees
- waste water systems work like natural wetlands
- materials mimic the ingenuity of plants and animals
- industries work more like ecosystems
- products become part of cycles resembling natural materials flows (Ort, 2002, p. 22)

In industrial design, the analysis of the aerodynamic behavior of seeds in some trees can inspire the design of systems for soil erosion control (Papanek, 1985/1971, pp. 194-200). Still rudimentary, solar energy based on photovoltaic panels was inspired by leaves taking the sun's rays and converting them into energy (photosynthesis). Impressive further developments in solar-based technology are promising exciting outcomes for the future, is the case of scientists working on the production of artificial photosynthesis "Triad project", in the seeking of new sources of alternative energy (Benyus, 2002, p. 76).

In visual communication design complex human-made information is delivered in the form of a natural phenomenon: light. As designers learned in optics from physics class, color perception consists of different ways of decoding light waves over physical mediums (surfaces), black and white being the extreme absence and saturation of these light waves. In short, we use natural laws to transmit information.

In the visual communication profession, problems are related to the media, often and specifically paper. Technology can help us to develop new alternatives to move away from an unsustainable system (paper-based industries like media and packaging) to a sustainable one.

In this sense, futurist and evolutionary economist Hazel Henderson describes a new era of technological development as “Emerging Light Wave Technologies (Photonics)”. Henderson reminds us that sunlight falling on the earth (in form of photons) “supplies enough energy in 10 minutes to put our entire six billion population in orbit” (Henderson, 1999, p. 14), to which William McDonough adds that

“for the majority of our simple energy needs, humans could be accruing a great deal of current solar income, of which there is plenty: [a] thousand times the amount of energy needed to fuel human activities hits the surface of the planet every day in the form of sunlight” (McDonough, 2002, p. 32).

Henderson wrote a detailed list of technologies in progress under the umbrella of “The age of light”. In it is included: fiber optics, lasers, holography, solar, optical computers, bio and genetic technologies, nano technologies among others. We can easily add to this list new technologies or new combinations of technologies, like electronic paper, a device which is a screen and a paper all in one, re-usable, uploadable low-energy consuming, long lasting and finally recyclable. More new media such as those using only projected light and intelligent screens are being developed and they will be coming soon into the market. Helped by these new technologies, we must find out how nature works to produce the effects that we are looking for, and borrow the concept, to mimic nature’s effectiveness.

4.6 Other relevant definitions and important differences

The more our world looks and functions like the natural world, the more successful our design practices will be. Understanding this demands looking for correct definitions and clear differences.

As a result of this research, a collection of concepts and definitions were listed with the intent of bringing to design students the basic notions that support the theoretical background of Design for Sustainability, as well as introducing the basic terminology and etymology implicit in it.

There are two important leading concepts: Holism and Long-term Thinking. Although there is no possible linear sequence to organize a complete list of concepts ordered by hierarchy –and holism and long term thinking can be placed anywhere in the process of describing –these two terms have a deeper meaning. A neurological web rather than a linear path more likely represents the interconnections between DfS concepts.

As mentioned in chapter 2, holism can be defined as “the whole, greater than the sum of the parts”. In terms of a sustainable practice of design, a holistic view means

looking at our design process from a broader perspective, which leads (ideally) to unasked questions and the detection of hidden problems.

Long-term thinking is the capacity to apply a holistic view by adding the time as a factor in the solutions.

Also related to long-term thinking, is the capacity to work possible future scenarios into the process (Schwartz, 1991). In terms of a sustainable practice of design, sustainability itself demands ethical and moral responsibility applied to decisions taken in the present and how those decisions will affect the future. Again, time is a key factor; however, rather than merely a constraint, design for sustainability makes it into a tool for change.

In understanding how nature works in such an effective way, and in trying a holistic approach and long-term thinking, other relevant key terms worthy of definition, come into play:

Resilience: the mental ability to recover quickly from depression, illness or misfortune is an important word in terms of design, it implies the capacity that designers must have to recover our social role in finding and fixing problems. It demands a subordinate keyword no less important though: humility..

Restorative: the ability to recuperate degraded, damaged or destroyed systems through active human intervention is a term used by Hawken, McDonough and other authors to describe the stages before turning into sustainable systems. In terms of a sustainable practice of design, it means design that has the capacity to recover its initial role and help to restore things to the point at which they become sustainable. Also the word regenerative: the ability to replace the present linear systems of throughput flows with cyclical flows is related to this concept and its definition is clearly oriented to the seeking of sustainable development. Arthur Koestler held that regenerative in a broad sense is a possibility of reacting to a critical challenge as an alternative to a degenerative detour in evolution. It involves, in his words, “major reorganizations of structure and behavior, which result in biological or mental progress.” (Koestler, 1967, p. 173)

Enlighten: to make clear to the intellect or conscience, making up the mind or understanding is a verb but also the description of an emotional state, a feeling of excitement when we realize the truth or a new path in seeking the truth is revealed. For designers, sustainability can be a new path that drives to enlighten.

Ecology: the scientific study of the distribution and abundance of living organisms and how the distribution and abundance are affected by interactions between the organisms and their environment. We all have an idea of what this is about, but it is important to have clear understanding of its origin and etymology. The term oekologie was coined in 1866 by the German biologist Ernst Haeckel. The word is derived from the Greek oikos, “household” and logos, “study”; therefore “ecology” means the “study of the household [of nature]”. Ecological practices have become synonymous with

environmentally friendly practices, but their implications are much further connected with social and economic factors, in other words, with sustainable development. From design perspective, environmental problems are mainly the result of a “miscalibration between human intention and ecological results, which is to say that they are a kind of design failure.”(Orr, 2002, p. 14)

Anthropogenic: the influence of human beings on natural objects. This definition is actually a good question for designers: how influential [on natural objects] are our products of design or design-driven actions?. Design, by definition is an anthropogenic factor for nature. How good that influence can be by design, lies in our sense of resilience and humility.

Entropy: (commonly) the tendency of a system that is left to itself to descend into chaos. The second law of thermodynamics: transference of energy. Entropy effects are commonly misunderstood, using the term to justify a pessimistic vision of human endurance and a pessimistic version of the future. In simple terms, it is held, there is nothing we can do in order to avoid the descent into chaos. It holds that everything starts and ends, like an inevitable linear process, which resembles mortality. Along the same lines of thinking, there is nothing we can do for our future because all of us will die sooner or later. But the point here is when and for how long the things we make will affect us, and the others to come before we die. In other words, how does the time factor, and our finite human nature, affect our way of thinking. A day is a lifetime for a mosquito. A human life is a moment on a planetary scale and a planetary scale history for a mosquito, but both species, mosquitoes and humans belong to a system that works beyond our scale of comprehension.

A more fruitful interpretation of entropy is one that which suggests we are always moving from one state into another, changing to maintain the same core. Nature is the model, measure and mentor in this. In this context the problem with human as an anthropogenic factor is in modifying the tendency and pace at which entropy works, going from a natural level of changes to a high level of changes and unimaginable consequences.

Designers should be more interested in the second definition of entropy, which introduces us to the science of thermodynamics, or how the energy is transferred from one state to another, and what the cost of this transference was. The economic factor in the sustainable development’s triple bottom line is directly affected by the understanding of this theory.

Ecological footprint: the resources (in terms of land and water) that a population would need to sustain and support itself and to absorb its wastes. It is understood that there is no such thing as waste in nature. This is a conceptual assumption but, since nature re-uses everything that it produces, it is also a verifiable fact. The footprint in this case is related to any alteration produced to natural processes; this means artificial, anthropogenic or man-made alterations.

Carrying capacity: the number of individuals an environment can support without significant negative impact. Beside the depth of alterations made to natural processes, a growing population on the planet implies multiplying anthropogenic factors. The effects of uncontrollable growth are challenging the carrying capacity of the planet and can lead to unthinkable consequences in a relatively short time.

Greenhouse gases (GHG): gases emitted as a result of human activities, which produce a “green-house effect” (infrared radiation in the atmosphere, which warms the planet’s surface).

It is not the purpose of this basic list of terms to reproduce an encyclopedic revision. However it is worth paying attention to the origin of the problems that design for sustainability has to address, revealed by widely used terminology. Climate change has become an issue that turned on the alarms of our civilization, because of the simple fact that it has become tangible and calculable. It is proof of anthropogenic factors and subtle, but definitive alterations to natural processes made by humans. But it is also a problem to be fixed, as long as we understand causes, consequences and the natural way to solve it.

A revealing exercise for challenging our assumptions is the analysis of similar keywords (sometimes easy to mix up) with different or opposite meanings, and the use we make of them, the concepts supported by them, and most importantly, the misinterpretations derived from them.

Pessimism, optimism and hope

The first differentiation worthy mentioning is probably the best description of what is happening in the world today when “green” initiatives and ecological speeches gain the attention of the public and, as a result, two reactions can be seen: one related to optimism and the other to pessimism. Both extremes can fail in addressing sustainability issues. Optimism is based on predictions and tendencies about the future, but optimism can easily mislead. On the other hand pessimism paralyzes people. The right focus is in understanding the difference between optimism and hope. Hope is a sober quality that requires courage and will and can change even the optimistic forecasts. It is about doing our best. Optimistic speeches are what the audience wants to hear, but are often rather phony and not terribly sober.¹⁵

15. Words taken from David Orr’s interview by Treehugger Radio, retrieved from http://ads.treehugger.com/thtv_files/audio/TH%20Radio/Podcasts/TH%20Radio%2052.mp3 on October 23rd, 2007

Intelligence vs. cleverness

Intelligence, defined by the dictionary, reflects a broader and deeper capability for comprehending our surroundings ”catching on”, “making sense” of things, or “figuring out” what to do. Cleverness, on the other hand, means possession of quick or able intelligence. It reflects ingenuity and talent.

The difference between them is in the range, and this is connected with the time factor that affects both. While being intelligent means having a broader comprehension of a situation and acting according to critical skills in order to achieve a goal, being clever relies on talent to react quickly, but not necessarily correctly enough to achieve the ultimate goal. In terms of design for sustainability, intelligence and cleverness describe two different stages in a timeline. Design for sustainability demands acting for long-

term results, and it means acting intelligently rather than only cleverly.

Beyond efficiency: effectiveness

Efficiency can be defined as the extent to which time is used for the intended task. Effectiveness, as the power to produce a decided or decisive effect. Both concepts are meaningful for developing good sustainable design, however there is a subtle but critical difference. Something efficient is not necessarily good. Take for example, war machinery or Nazi propaganda. They were very efficient indeed, also nuclear technology that resulted in atomic bombs, and new technological advances like genetic design all involve potential and irreversible side effects. The advantage of thinking in terms of effectiveness is based, as the root of the word indicates, on the effect that we expect and the effect that we finally produce at the end of a process.

Optimum vs. maximum

This is another critical confrontation, relevant for designers. While we understand maximum as the highest limit, optimum represents the best or most favorable condition, or the greatest amount or degree possible under specific circumstances. The bottom lines lost by policies and economic rules in modern capitalist civilization are the “specific circumstances”. Under this umbrella, we have to consider social, cultural, environmental, and health costs projected into future generations. Maximum profit in the shortest time possible is not an optimum goal at all. It is not even a real maximization of profit, but just a maximum framed within a specific period of time. So, when business plans and economic policies are applied, do they follow maximum or optimum benefits? For both approaches, design and sustainability, optimization is the goal to achieve.

Information, knowledge and wisdom

In particular, visual communication designers have to understand the differences between information, knowledge and wisdom. The relationship between these three concepts is the key to introducing, again, the time factor and the role of designers in a design timeline, and thus, the core to comprehend long-term thinking in a design-thinking context.

Information is defined as “data that have been processed into a format that is understandable by its intended audience”. In the best of cases, information is a trial for letting us know facts (not necessarily the whole truth). With sustainability issues, the problem with the delivery of data is just that: data is distributed but hardly well understood and by no means deeply analyzed. There is no guarantee, for instance, that by delivering as much information as possible, your audience will be more informed. Edward De Bono pointed to this,

“Consider a rough relationship between value (new ideas) and information: an increase in information causes a greater increase in new ideas. But there comes a point where a person is so overloaded with information and experience that he is unable to generate anything new.”¹⁶

16. Retrieved from <http://www.edwarddebono.com>

When designers intend to produce awareness and change behavior through their work, a strategy based only on delivering more information can be ill formulated or at least only partially focused. By selecting the most pertinent information and the

presentation mode in order to challenge assumptions, design has more chances to be effective.

Knowledge is different from information. Defined as “relevant information that one is able to recall from memory, recognition of cause and effect” (Orr, 2002, p. 37), knowledge implies a previous process of collecting and selecting worthy information prior to recalling it, coming to conclusions, taking a position and acting. However the accumulation of “fast knowledge”(Orr, 2002, p. 37) or the achievement of knowledge in ever shorter periods (by gathering information faster), doesn’t lead to wisdom. Again, the time factor, and its opposite effect over the speed factor, is a key to evolve from gathering information to gaining knowledge and finally building wisdom. Orr described this phenomenon wisely:

“The increasing velocity of knowledge is widely accepted as sure evidence of human mastery and progress, but many, if not most, of ecological, economic, social and psychological ailments that beset contemporary society can be attributed directly or indirectly to knowledge acquired and applied before we had time to think it through carefully. We rushed into the fossil fuel age only to discover problems of acid rain and climate change...Chlorinated fluocarbons, along with a host of carcinogenic, mutagenic, and hormone-disrupting chemicals, too, are products of fast knowledge.”(Orr, 2002, p. 37)

Within the boundaries of knowledge it is worth remarking on the differences between fast knowledge and slow knowledge. While fast knowledge is focused on solving problems, usually through technology and large quantities of human resources and money, slow knowledge has to do with avoiding problems in the first place, by understanding the complexity of the situation, and working with time as a factor and not as a limitation to be defeated. There is a logical connection with the comparison between designers as problem solvers and designers as problem identifiers implicit in this observation; most of the time, by identifying and anticipating future problems, designers are avoiding them. David Orr adds even more fruitful comparisons related to the speed of knowledge (Orr, 2002, pp. 40-41):

fast knowledge	slow knowledge
• fast knowledge deals with discrete problems	> • slow knowledge deals with context, patterns and connections
• fast knowledge arises from hierarchy and competition	> • slow knowledge is freely shared within a community
• fast knowledge is about know-how	> • slow knowledge is about know-how and know-why
• fast knowledge is about competitive edges and individual and organizational profit	> • slow knowledge is about community prosperity
• fast knowledge is mostly linear	> • slow knowledge is complex and ecological [interconnected and cycling]
• fast knowledge is characterized by power and instability	> • slow knowledge is known by its elegance, complexity and resilience
• fast knowledge is often regarded as private property	> • slow knowledge is owned by no one
• in the culture of fast knowledge, man is the measure of all things	> • slow knowledge, in contrast, occurs as a co-evolutionary process among humans, other species, and shared habitat
• fast knowledge is always new	> • slow knowledge often is very old

The word wisdom, by definition, is the combination of knowledge (insightful), experience, and intuitive understanding. In other words, wisdom is a goal, something to pursue unlike fast concepts like cleverness or accumulation of information. Wisdom is the proper aim of all true learning. The best way to achieve this goal is through slow knowledge and the aim of slow knowledge is resilience, harmony, and the preservation of patterns that connect... Deep roots in old civilizations, adaptation of species over millions of years, and genetic heritage, are all proof of wisdom: a blend of knowledge, time and abilities. Design has to learn from models of wisdom, and follow these patterns. Knowledge must be applied carefully in order to gain true learning, in order to acquire wisdom. According to Orr, the velocity of knowledge can be inversely related to the acquisition of wisdom. (Orr, 2002, p. 39)

Growth, development and evolution

Growth is defined as an increase in size, number, value, or strength.

In medicine, growth is seen as pathology, it means an abnormal mass such as a tumor. This different –negative– meaning is useful to demonstrate that growing is not always a good thing or can be bad, especially in excess. The relativity of the word growth is also demonstrated by the international indicators for wealth. It seems to be that governments, corporations, and international organizations are obsessed in measuring growth –in a country, a region or the whole world– in terms of economic indicators. A popular indicator (and influencing political decisions) is the GDP –gross domestic product or the total value of goods produced in a country during one year. GDP is an indicator of wealth and sustained economic growth in developing countries just as it is in developed countries. However, in countries with higher GDP, poverty, criminality and marginality are present, and indicators show that these factors are growing.

Development is defined as progress through a sequence of stages. It is commonly assumed that growth, wealth and progress are very close concepts in terms of economics. The path to achieve a sustained economic growth, become a wealthy country and be integrated to progress, is seen as development. In these terms the world is divided in three kinds of countries: developed, developing and under-developed.

The questions that arise are those related to the kind of growth, progress and development that are being considered. Should the economic factor be the most important, if not the only factor, in defining these indicators? Why are social and environmental costs (added to economic factors in the triple bottom line of sustainable development) not considered as a part of that path to development? And finally, if no significant modifications are made in the way human factors are measured, can sustainable development be considered a true sustainable goal?

Redefining Progress, a non-profit organization dedicated to shift public policy to achieve sustainability, created the Genuine Progress Indicator (GPI) as an alternative to the gross domestic product (GDP). The GPI enables policymakers at the national, state, regional, or local level to measure how well their citizens are doing both economically and socially.¹⁷ The DfS curriculum includes this and other sustainability indicators as an alternative to measure real wealth (See unit 1.4: *Globalization, Inequality and the misconception of Darwinism*).

17. Retrieved from www.rprogress.org/sustainability_indicators/genuine_progress_indicator.htm on November 2007.

Evolution is understood as a gradual process of development leading to a more advanced or complex form. Charles Darwin introduced the theory of evolution by natural selection, based on the study of survival species, and their ability to adapt to life after long periods of slow changes. Evolution is the archetypal example of slow knowledge. Evolution seems to work through the slow trial-and-error testing of small changes. (Orr, 2002, p. 39). Evolution seems nothing to do with unlimited growth, progress or development, in the same way that the amount of information does not lead to wisdom.

Consumption, consumerism and waste

It is imperative to understand what consumption, consumerism and producing waste mean. While consumption is the act of consuming or using something, consumerism is a materialistic attachment to possessions. Waste is commonly understood as an excess of material, useless by-products or damaged, unsaleable products; garbage; rubbish, none of this is actually present in natural processes. So, do we consume objects or do we just take something from them (a meaning, an experience, a service) and then discard them? In nature there is no such thing as waste. Consumerism is a human behavior. On the other hand, consumption is not what human “consumers” do; a tree is a real consumer.

The morality of function and the function of morality

Finally, these two words: functionality meaning useful; serving a purpose, and morality relating to principles of right and wrong in behavior, have a relevant relationship, and affect each other. However, the difference is in that functionality does not have to pursue moral values necessarily, but moral behavior seems to be functional in the long term. This is an important difference to take in consideration when designers work on fitting form to function. Our human values play a meaningful role then.

5. Research on context and content for the implementation of a DfS curriculum

The first part of this thesis project was dedicated to understand the nature of design and the paradigms of the practice of design, facing a complex situation in the present and the near future. It also introduces research questions and describes the background and context in which these questions arise, and most important, suggests theories and methods applicable in addressing these issues.

The second part of this thesis project is dedicated to describe what can be done in terms of applying DfS in design education, to describe who is the targeted audience, the analysis of different methods and case-studies, and finally the proposal of new DfS methods and tools, testing, evaluation and further conclusions.

5.1 Target audience: designers of the future

As mentioned in chapters one and two, [design] education is the ideal vehicle to address Design for Sustainability, since it can prepare and equip students for sustainable thinking and a sustainable practice of design. Today's students of design are the designers who will design the future.

A design for sustainability class would be focused primarily on students, not on the general public, nor focused on current sustainability campaigns, nor the marketing of sustainability or even organizations involving sustainability. However, all these factors are included in the analysis of the context, the target of this research is students' mindset. Results in terms of work in class, discussions and new ideas, showing students' insights, challenging questions, and innovative and unusual proposals would be successful outcomes. In traditional classroom methods, addressing given problems with a set of principles and tools is the starting point. But the traditional design "toolbox" and design theories do not ignite the thinking process by themselves. A Design for Sustainability class will produce engagement and motivation, necessary for leading students to design thinking. A DfS class must reinforce the designers' role of being challenged, by pushing the nature and the limits of the challenges even further, and emphasizing the necessity of interdisciplinary practice.

5.2 Understanding the teaching environment

This thesis project has been motivated and informed by 15 years of personal experience as designer, and by studying and teaching design over the last two years in the Visual Communication Design (VCD) program at the University of Alberta.

It is arguable that an inclusive, overview-oriented or survey style DfS course is less accessible for students, since introducing the "big picture" of DfS, in just one course, can be overwhelming to them. (Thorpe, 2007a, p. 7). It partially explains why the proliferation of graduate or professional-oriented courses about DfS in the first years of introducing this matter to design education, like for instance the ICIS-Lund project. However, this thesis project demonstrates that, DfS can be taught to undergraduates in advanced levels of a program. The experience of having been part of VCD undergraduate and graduate courses as student, and having taught undergraduate design courses, by delivering lectures and provoking debates about sustainability, has suggested that it is possible to include sustainability issues at undergraduate level. As described later in this chapter, these preliminary experiences in the field of design education supports this hypothesis.

Two kinds of courses related to sustainability and design have been identified at both undergraduate and graduate levels in higher education: the overview course and the single topic course. The first kind attempts to cover the whole aspect of sustainability –environmental, social, and economic, included in the "triple bottom line" described in Chapter 4. The second kind focuses on just one of the aspects, like ecology (environmental) or culture (social) (Thorpe, 2007a, p. 7).

18. The UofA ERSC –Environmental Research and Studies Centre– is working on a joint project with EPSB –Edmonton Public Schools Board– for preparing class material about sustainability issues for Grade 4 and 5. The Alberta Government offers supporting resources for environmental education at <http://environment.gov.ab.ca/edu/homeEd.asp> , while some other online resources like www.resources4rethinking.ca and www.insideeducation.ca are available from kindergarten to grade 12. Unfortunately the core of the Canadian oil industry and Canadian companies in the exploitation of forest are the main sponsors of the last project, which involves a conflict of interests.

Ann Thorpe reflects on DfS overview courses sustaining that their success is connected to the age and maturity of students (Thorpe, 2007a, p. 7). This argument, despite of the lack of consistent evidence, can reinforce the idea of focusing DfS in the last years of undergraduate education. Undergraduate students are particularly open to new concepts like eco-design ideas (Thorpe, 2007a, p. 8) and, although they are still in the process of learning design, approaching DfS concepts at this stage can be an important step for their future professional development. Following this principle, it is broadly accepted that, at an appropriate level, a general idea of ecosystems and natural interconnections –very complex concepts indeed– can be introduced even to children at early elementary age, without overwhelming them, rather, taking advantage of their capacity of incorporate new ideas easily. In fact, ecology content and its links to sustainability have been introduced to early education and it is in the process to evolve even more.¹⁸

This personal experience, allowed the analysis of issues connected with design thinking and DfS included directly or indirectly in the content of the courses. This experience has included all the levels in VCD, from foundation and undergraduate to graduate courses. DfS connections are present particularly in the following taken or given courses:

- Design Issues, Theory, History and Criticism,
- Concepts and Systems,
- Practice of Graphic Design
- Conceptual Analysis and Practical Applications

Although these courses have specific assignments and projects related to sustainability issues, it is possible to find connections also in other courses that include discussions and approaches to sustainability. This has become an increasing tendency, since instructors and students can connect the true nature of design field and its relation to sustainability.

Complementary to the courses content, some DfS presentations and debates were introduced in some of the mentioned courses as guest lectures. In the Concepts and Systems course –dedicated to third year VCD students– a series of lectures were introduced as “Open Talks”: 20 minute-long debates ignited by a DfS related topic, and the delivery of examples and slide-shows. The “Open Talks” series were organized as a sequential list of topics, introduced one per scheduled class. The topics included issues related to design and sustainability, such as, “How a good design can be a bad”, “Connections between VCD and sustainability”, “Materials and Recycling”, and “Energy issues, towards re-establishing our connection with the sun”. Debates were provoked by including questions such as *what can design do about sustainable practices? Are we aware of environmental issues? Are we real consumers? Or are we well informed about the consequences of our life-styles?*

More initiatives were developed before and while this thesis project was in progress. The first sustainability media resources database from Art & Design perspective was initiated and published on line as a weblog. The project called *EarthAirWaterFire* is an un-precedent work created by Art and Design instructors and students at the University of Alberta, as a collaborative research project between VCD Practice of Graphic Design course and HADVC courses. It includes access to relevant bibliography, video collection, articles, papers and electronic resources connected to sustainability. This applied model can be used as a locally generated database for interaction with DfS class components or courses.

Also within the University of Alberta's design environment, specifically in industrial design, instructors and students have dedicated energy and time to produce sustainable industrial design projects and the promotion of sustainability concepts, focusing on materials and production systems in particular, but also in user-centered and user behavior issues.

5.3 The process of including sustainability at design education

From the first steps of eco-design to DfS as it is today, a period of 3 decades, sustainability issues connected to design programs are moving to the next stage in different parts of the world. This process had already started to show noticeable results. This chapter describes some examples of this evolution and introduces a brief description of pioneer programs and institutions working with DfS issues.

DfS in design programs

Is worth mentioning that three different approaches to DfS in higher education can be identified:

1. product and production systems oriented DfS
2. marketing and business oriented DfS
3. art and visual communication design oriented to DfS

This classification is also noticeable in recently published books, articles and papers related to sustainability. For example, in the University of Alberta Libraries, only in the first 8 months in 2007, 55 titles have been released, in which the 3 categories involving DfS can be identified among others sciences.¹⁹ More recently, the U of A Bookstore showed that the count has been increasing to more than 70.²⁰

In the first category, product and production systems oriented, Technische Universiteit Delft in Netherlands is one pioneer in introducing DfS to their programs. This University is clearly oriented toward technology and industry, and design is included as a part of industrial design and engineering content.²¹ The TU Delft Design for Sustainability programs are a valuable resource to help explain in complexity, for instance, the implementation of methods and tools of sustainability assessments. Some of these methods, like Impact Matrix, 8-point wheel and Life Cycle Assessment (LCA) were approached and analyzed in the ICIS-Lund workshop described later on this chapter.

19. Retrieved from University of Alberta Libraries. NEOS Consortium Libraries Catalogue, http://ualweb.library.ualberta.ca/uhtbin/cgiisirsi/x/0/0/57/123/X?user_id=WUAARCHIVE&_search_ui=ilink

20. This number of titles was exhibited in a Bookstore booth at the Parkland Institute 11th Annual Fall Conference, in November 2007.

21. UNEP - TU Delft (2005). *Design for Sustainability: A Practical Approach for Developing Economies*

22. Retrieved from <http://www.design.polimi.it> on
September 2007

23. Manzini, Ezio - Jegou, Francois (2003). *Sustainable
Everyday: Scenarios of urban life. Milan: Edizioni
ambiente.*

24. P. White, L. St.Pierre and S. Belletire, (2004). *Okala
Ecological Design Curriculum, Course Guide*, IDSA

25. Okala was originally thought to be applied as a full
focused course, and oriented to product design. However
it has not been implemented in that way, but partially
included in other design courses or inspiring other
curriculums.

26. This information was taken from research notes for
this thesis project, the opinions collected from design
educators' experienced with sustainability assessment,
life cycle analysis and sustainable systems and
supervised design studies in North America
and Europe.

Another example of product-oriented DfS programs is the Facolta del Design at the Politecnico di Milano in Italy. This institution has a tradition in approaching industrial design issues and sustainability.²² Like TU Delft, Politecnico di Milano has also worked with the support of United Nations Environment Program (UNEP) and local governmental and non-governmental organizations, as well as corporate sponsors. The book and catalogue *Sustainable Everyday: Scenarios of Urban Life*, edited by Ezio Manzini and Francois Jegou is an example of how much involved is this institution in design and sustainability issues. The book shows work exhibited in the Triennale di Milano, most of them deliver case-studies and ecological literacy for designers. In this book an International Network on Design for Sustainability is mentioned, where design schools from all over the world have participate in workshop series. U of A is among the institutions involved in this partnership.²³ This thesis project has taken examples as well as valuable concepts in defining unsustainable situations and sustainable solutions for everyday life, applicable to design exercises in DfS classes.

In March 2004 the Ecodesign Section of the Industrial Designers Society of America (IDSA) introduced Okala Ecological Design, a curriculum oriented to product design at undergraduate level, for industrial design schools in North America.²⁴ Pilot classes were tested in important design schools like Emily Carr Design Institute of Vancouver and the University of Illinois, Urbana-Champaign. Okala has been applied, if not as originally intended,²⁵ introducing concepts indirectly in industrial design courses. After many revisions, a 2007 Okala Design guide is available on line for consultations, as a valuable tool for design and sustainability classrooms. Okala is consistent and well presented in terms of organization of content. The strength of Okala content is in its focus on life cycle impact assessment over products. However, it can be argued that the general approach tends to be too simple for a course at a university level, which implying the acquisition of tools and concepts that lead to crucial decisions in materials and processes.

Life Cycle Assessment and other impact assessment methods are being questioning as well. It is accepted among design educators that, while lifecycle thinking and lifecycle assessment tools are a central aspect of sustainability, it is also arguable that they do not contribute in any direct or meaningful way, to applied sustainability. In fact, courses like Okala teach methods concerned with doing less damage vs. doing good."²⁶

Arguable too, is financial support from private corporations, such as chemical industry and appliances industry sponsoring projects like Okala producing a contradictory effect with regard to public opinion. This controversial situation is common to many important initiatives working towards sustainability like Okala, Milano or TU Delft. Sometimes the same corporations that have operated with irresponsible practices for decades sponsor activities that represent the opposite philosophy. This evidently affects the credibility over the ultimate goal of these projects. Are some of these corporations selling as much as possible to us and, at the same time, telling us stop buying their products? Or, in more obvious examples, can the most important oil companies be the most important investors in alternative energy resources? People have started to read beyond slogans and understand that "beyond petrol" same philosophy is waiting to make more profit.

In chapter 1 a first design questions was formulated: *How does design relate to this context: resisting change, supporting change or waiting indifferently, being driven by others' decisions?* Again, this question applies to cases in which corporations, intentionally or not, manipulate the spirit of projects based on change.

This reflection is not trying to evaluate the quality of the work done by cases like Okala, which are very good examples of content, excellent compilations of data, and consistent and very professional projects overall. But ignoring these ethical facts is working against the social responsibility implicit in the triple bottom line of sustainability.

Despite of strengths and weaknesses, Okala is a valuable case study. It helps us to understand a focused DfS experience, tested in the context of different North American design programs.

In November 2006, ICIS –International Center for Innovation and Sustainability– and the University of Lund, Sweden, under the umbrella of the ICIS/Lund Sustainable Futures project developed a two-week pilot educational course, Sustainable Design Futures, to test out the particular configuration of sustainability and design topics that was to be incorporated into a future Design for Sustainability Masters program in Scandinavia. This pilot module was designed to give students at Masters level an introduction to the challenges and values of sustainability in the context of design, spanning issues ranging from business ethics; ecodesign and eco-innovation; biomimicry and slow design; product development and waste. The module was also focused on sustainable city issues related to transport, waste and energy. This course introduced definitions, methods and applications and expanded on the latest theories as well as tools in the field of sustainable design. There were showcases as well as practical examples of implementation to encourage creative new thinking in meeting the challenges of sustainability.

Their approach to issues like LCA (Life Cycle Assessment) provided an example of ecodesign implementation and other ways to address the ecological footprint. It brought to this research the basic concepts of long-term thinking, a holistic design approach, a better understanding of design and sustainability as processes, and many other crucial ideas. This workshop also introduced new concepts such as slow-design –described later under Slow-Lab– and introduced new authors to the bibliography. Most important, it suggested that a focused Design for Sustainability course was possible, not only in Europe and not only for the Master's level.

Although ICIS/Lund workshop explored the three categories on which DfS can be approached in higher education: product and production systems oriented, marketing and business oriented, and art and visual communication design oriented, this pilot course focused professionals and students on the topic marketing and business in particular.

The ICIS/Lund Sustainable Futures project is a joint endeavor intended to create the foundation for an innovative new Scandinavian Masters program in sustainable design.

ICIS and the Department of Environmental Strategy of Campus Helsingborg (Lund University) are the principal founders of this educational program. The Municipality of Helsingør, City of Helsingborg and Frederiksborg County had contributed as financial partners to the project: "...designed to elevate the level of sustainable design competence in the Øresund region, Scandinavia and Europe."

In the last category – Art and Design oriented institutions, and nominally closer to Visual Communication Design program at U of A– some design schools in North America have been included as references in this thesis research: the Emily Carr Design Institute of Vancouver, the Academy of Art University of San Francisco, and more recently the Parsons School of Design of New York. These cases are good examples of the increasing interest and activity in issues attached to sustainable design practice. The discussion, debate and implementation of new ways to approach design in sustainable terms is present along different courses in such institutions.

Design programs from two important institutions, which seem to be comparable in size with U of A design programs, are being taken by U of A as analog cases for benchmarking assessment purposes.²⁷ The outcome of this benchmarking study is supporting the decisions for the next 5-year plan in design at U of A. Both analog institutions are in North America: the University of Michigan and the York University / Sheridan Institute Joint Program in Design in Ontario. Unfortunately, none of them has included design for sustainability consistently, either as a focused course or as a component of any course, in their visual communication design curriculum. The inclusion of sustainability, and its connections with design, have been addressed by papers and complementary material, in Industrial Design and Architecture courses at the U of Michigan and in courses like "Design for Public Awareness" at York (Bachelor of Design program).²⁸

At the beginning of this thesis research the Emily Carr Design Institute of Vancouver was the only institution in Canada that had signed the Talloires Declaration described in chapter 2, at the moment this thesis is written York University has signed as well (as in September 2007). The University of Michigan has not signed.

DfS environment at design schools

The commitment to bringing sustainability to higher education can be extended to institutional roots. That is the case of many campuses worldwide, looking for agreement in meeting sustainable goals, not only by teaching but also applying the concepts outside the classroom. For both goals, teaching and applying sustainable practices, the Talloires Declaration is a step forward; many campuses in United States for instance, are being measured in terms of how sustainable they are, or how consistent official speeches are with official actions.²⁹ This information is extremely valuable at the moment parents and students decide in which institution spend the next four to ten years.

27. University of Alberta, 2007-2011 *University Plan for Submission to the Government of Alberta*, 23 March 2007, retrieved from http://www.uofaweb.ualberta.ca/strategic//pdfs/Final_2007-11_UnivPlan.pdf

28. Retrieved from <http://www.yorku.ca/web/> and <http://www.umich.edu/>

29. <http://www.sustainablecampus.org/universities.html>

30. Michael P. Shriberg (2002). Sustainability in U.S. Higher Education: Organizational Factors Influencing Campus Environmental Performance and Leadership. A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy (Natural Resources and Environment) in The University of Michigan. (p.305)

31. These conclusions are based on checking different sources. The UofA has not signed the Tailores Agreement, or any other similar initiatives. Official organizations within UofA, such as Parkland Institute – a research centre from the Faculty of Arts– and ERSC –Environmental Research and Studies Centre– are doing efforts in introducing sustainable goals in the U of A agenda. Some of them like meeting the Kyoto Protocol on Campus are going to be introduced, but these goals are still not advertised.

32. Amory B. Lovins is Chairman and Chief Scientist of the Rocky Mountain Institute, a MacArthur Fellowship recipient (1993), and author and co-author of many books on renewable energy and energy efficiency. Lovins has worked professionally as an environmentalist and been an influential American voice for a “soft energy path” for the United States and other nations. He has advocated energy-use and energy-production concepts based on conservation, efficiency, the use of renewable sources of energy, and on generation of energy at or near the site where the energy is actually used. Lovins has provided expert testimony in eight countries and more than 20 US states, briefed 19 heads of state, and published 29 books and several hundred papers.

33. Retrieved from http://www.oberlin.edu/ajlc/design_1.html on September 2007.

34. Karen Blincoe is designer, educationalist and environmentalist. She has been board member in Icoagrada (The International Council of Graphic Design Associations) and design educator at University of Brighton, and Danmarks Designskole. Blincoe is currently the Director of the Schumacher College, UK. and founder of ICIS, The International Centre for Creativity, Innovation and Sustainability based on Denmark.

PHD Michael P. Shriberg from the University of Michigan introduced in 2002 a valuable document as a part of his doctoral dissertation, evaluating the context in which U.S. Universities can work towards sustainable practices, and comparing at the same time the activity of those institutions which signed the Talloires Declaration and those which have not yet. Shriberg sustain that the findings from this kind of studies “begin to bridge the gap between activist calls for campus leadership on sustainability and the inherent institutional conservatism of academia”.³⁰

Like many other campuses along Canada, the University of Alberta has been increasingly concerned about the implementation of sustainable principles into practice, but still there is not a successful policy applied and the gap described by Shriberg is applicable to U of A campus today.³¹

Good examples of sustainability coherence between what is manifested in words and what is manifested in facts can be found in different parts of the world. For the purpose of this thesis project is worth mentioning three other research and education institutions:

The Rocky Mountain Institute in Colorado, is a nonprofit organization focused on design and sustainability. Initiated by Amory Lovins³² in 1982, the RMI campus counts with sustainable state-of-the-art locations in which designers, engineers, architects and scientists bring research and consulting services for the industry.

Oberlin College in Ohio, inaugurated its Center for Environmental Studies in 1999, as a part of its Environmental Studies Program. The building was conceived as an integrated building-landscape system based on life-cycling practices and supported by a design philosophy inspired in sustainability goals. David W. Orr, a permanent reference for this thesis project, is Professor and Director of Oberlin’s Environmental Studies Program. At the groundbreaking ceremony he said:

“Is it possible to design buildings so well and so carefully that they do not cast a long ecological shadow over the future that our students will inherit? We now know that such things are possible, that buildings can be designed to give more than they take.”³³

Schumacher College, is based in the countryside of southwest England. The landscape and buildings, as well as the concept of community living, are parts of the background philosophy. The College brings short-courses including: sustainability, ecology, environmental economics, sustainable development, spirituality, science and art. It is also home to the MSC in Holistic Science, a unique masters program. Schumacher College receives international lecturers and offers courses given by recognized intellectuals and design practitioners (some of them mentioned authors in this thesis project). Again, philosophy and action meet in a consistent way. Karen Blincoe³⁴ became the Director of the Schumacher College in September 2006, at the same time she introduced the ICIS-Lund pilot course in Denmark and Sweden.

5.4 Practitioners inspiring DfS practices

In order to complete a broad picture of analogies following the pattern of *design for sustainability*, it is worth mentioning some other initiatives –organizations, businesses or entrepreneurs– that relate to the practice of both fields, design and sustainability (see complete list on Appendix 10.9). Among the most influential examples for this thesis project:

Carbon Busters is a small business based in Edmonton, but working internationally. Carbon Busters assists school boards, governments and industries in maximizing energy efficiency and reducing greenhouse gas emissions while educating building users and maintenance staff as to its benefits.

Parkland Institute is a research centre situated within the Faculty of Arts at the University of Alberta. This institute is oriented to study economic, social, cultural and political issues facing Albertans and Canadians, using the perspective of political economy.

Design can Change is a website for designers, intended to create awareness and promoting sustainable design practices.

Visiblestrategies.com is a small company based in Vancouver. It provides next generation strategy mapping and decision support visualizations.

iD2 a design firm based in Victoria, and specializes in sustainable solutions designed to help small businesses and organizations reach their marketing and communications objectives.

Re-nourish.com is a resource for the graphic design industry based on a website, which includes information about papers, inks, printers, packaging, green design firms, sustainable living, related articles and case-studies.

DfS –Design for Sustainability– is a joined initiative created by UNEP, TU Delft, Inwent Germany, and SusDesign Portugal, which intends to promote product innovation based on sustainable development for developing economies.

Slow Lab

SlowLab.org is a design community initiated by Alastair Fuad-Luke³⁵ in New York City. The mission of the organization is to promote ‘slowness’ as a positive catalyst of individual, socio-cultural and environmental well-being.³⁶

Massive Change was originally conceived as an exhibition and later spawned a book by the designer Bruce Mau and the Institute without Boundaries. Massive Change explores paradigm-shifting events, ideas, and people, investigating the capacities and ethical dilemmas of design in manufacturing, transportation, urbanism, warfare, health, living, energy, markets, materials, the image and information.³⁷

35. Alastair Fuad-Luke is chairman of Tempo, the sustainable design network based in UK. He is a sustainable design facilitator, writer, lecturer and maker. He was one of the lecturers at ICIS-Lund Sustainable Futures workshop in Denmark-Sweden, from which this DfS thesis project drew inspiration.

36. Retrieved from slowlab.org on November 2007

37. Retrieved from Massivechange.org on November 2007

AIGA Sustainable Design

The AIGA Center for Sustainable Design is a branch within AIGA's website, dedicated to providing designers with a wide range of information regarding sustainable business practice.

Treehugger is a media outlet dedicated to driving sustainability mainstream.

Treehugger's website includes weekly and daily newsletters, related video segments, radio shows and a user-generated blog.

Earthship Biotecture is a global company offering proven, totally sustainable designs, construction drawings & details, products, educational materials, lectures / presentations, consultation & guidance toward getting people in sustainable housing.

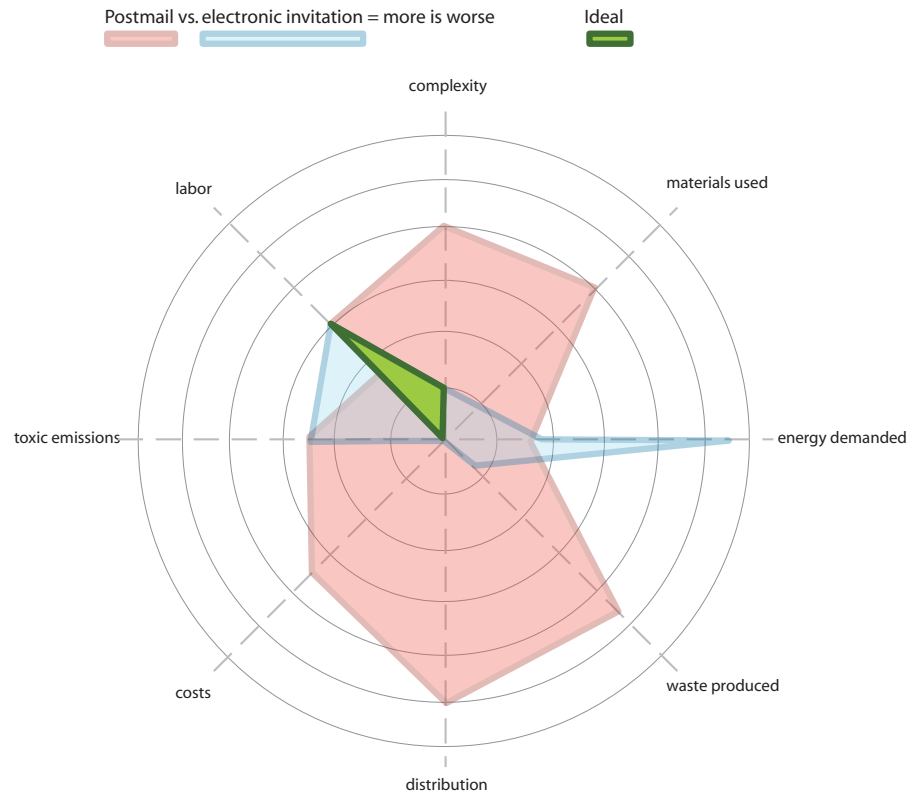
5.5 The visual interpretations and information design experience present in DfS: graphs, charts, diagrams and widgets.

The next is a collection of visual interpretations generated to support the concepts included in DfS curriculum. Some of this material was part in testing classes and presentations and is based on the design research.

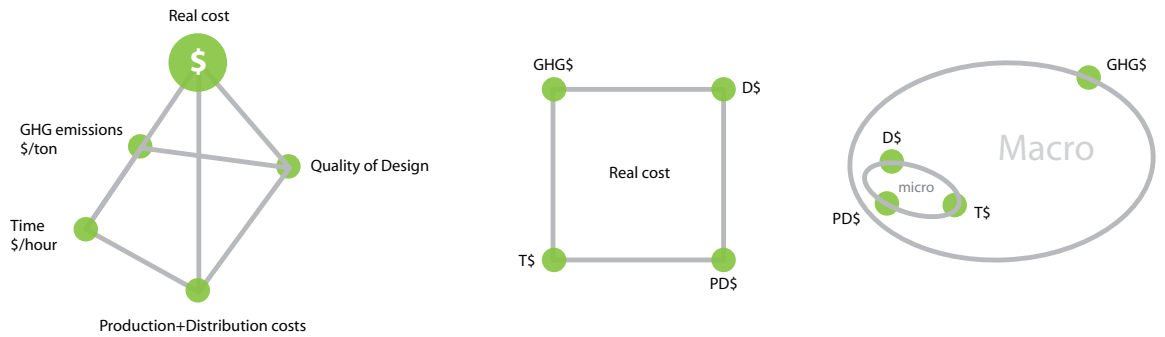
Examples of Visual Representation of ecological impact from design decisions.

Case: conference package. Comparison between poster + booklet vs. broadsheet, based on Impact Matrix and 8-point Wheel tools.





Sustainable design products / implementation costs



GHG\$: cost of unsustainable effects on environment, result of green house gases emissions, energy used in the design stage, production and implementation. Considering also materials used and their life cycle., disposal and waste management costs. Calculated in carbon tons and carbon credits.

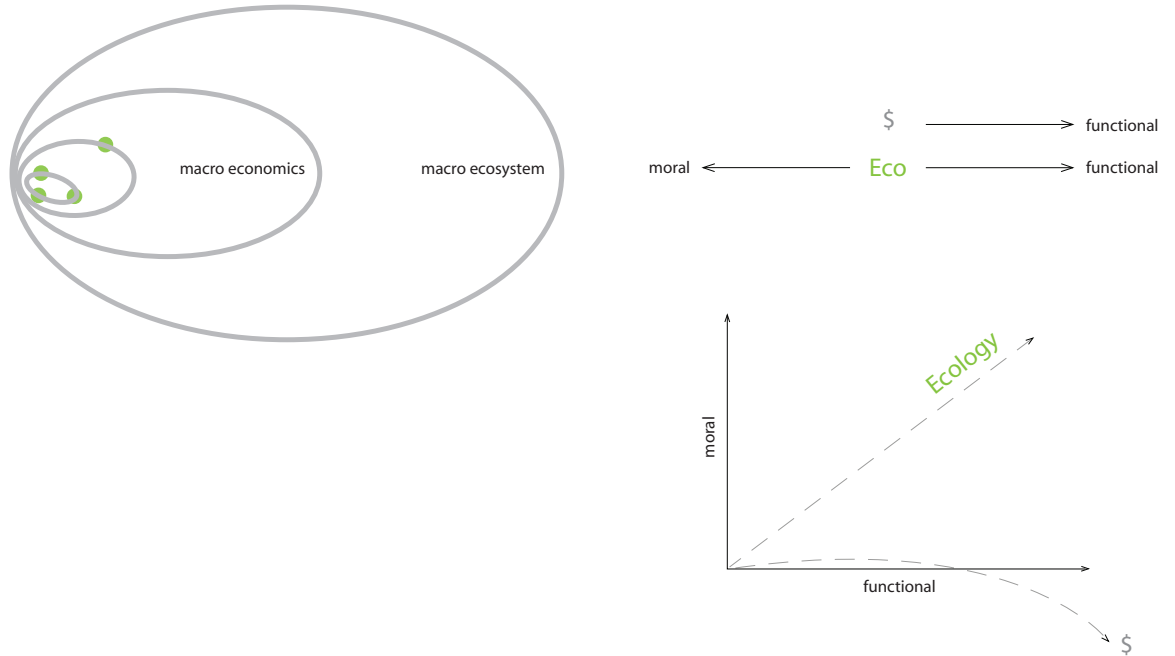
D\$: Cost of design measurable in \$ per hour, assuming that high fees respond to better ranked professionals, and better ranked means a better design quality.

T\$: Waiting time required to implement the project and its cost translated to profits and revenues.

PDS: Production + distribution and implementation costs, price of materials and labor, result of market prices.

Economy and ecology systems

Economy and ecology can be seen as retrofeeding systems, depending on both micro and macro levels of interdependency. Individual earnings is a micro factor that collectively affects the whole macro system of an economy. Individual actions toward sustainable habits can support a sustainable system in the same way. If collectively (and globally) money is accepted as a micro component of a macro system, collectively our ecological behavior can be seen as a part of our ecosystem. While money is functional to men, ecology is functional and moral. This shift demands ethical responsibility.



5.6 Conclusions towards a VCD DfS curriculum and methods

The research on context-based on case studies, developed in this thesis project, supports the content and the implementation of methods in a DfS curriculum. The moment in time for implementing DfS in design education is not only favorable but also crucial and urgent; issues connecting design and sustainability not only require immediate attention but also immediate action, starting in design classrooms.

In design programs like the one at U of A, the tools and physical resources for change are already set up, and this change is demanded in the minds of the community and students. It is in the good will of policy makers, and a broader understanding from educators and administrators, where the next steps to successful sustainable practices on campuses are lie. As well as in design practices, a higher education institution can reach excellence and more quality results from a pro-active profile, in other words, better long-term results can be achieved *being active rather than reactive*.

6. Design response, designing situations: a DfS curriculum

Designing a design curriculum about sustainability is designing the context in which a set of resources and tools must be applied, in order to understand scenarios and in order to move from re-formulated design theories to sustainable design practices. The un-precedent challenges that this educational experience involves so far make this particular design process extremely dynamic and changing. The same situation is faced by many institutions of higher education worldwide, and ultimately will be faced by every design school.

Any design response is a temporary response –it depends on context, time, places and cultural aspects, liable to change. In DfS context this is even more dynamic, and it is happening on many frontlines at the same time. Understanding the connections between design past and present with sustainable futures demands an introspective vision of historical, social and cultural factors that have built design as a discipline. It is a constant back and forward thinking process, and it challenges the conventional linear ways of thinking, demanding multiple web-like connections and layers of connections. A curriculum that has to deal with this changing context has to be a dynamic and adaptable model and not a collection of mechanized methods.

In his book *The Ghost in the Machine*, Arthur Koestler refers to mechanizing routines as a human condition and the challenge of breaking down this tendency through critical thinking:

“All skills, whether derived from instinct or learning, tend with increasing practice to become mechanized routines. Monotonous environments facilitate enslavement to habit; while unexpected contingencies reverse the trend, and may result in ingenious improvisations. Critical challenges may lead to a break-down of behavior or to the creation of new forms of behavior.”(Koestler, 1967, p. 112)

Students taking Design for Sustainability may reach a new viewpoint that in other traditional design issues and even in other fields than design. It means a better understanding of the complexity and interconnectivity that rule ecosystems and the basis of life functionality. This understanding stimulates critical thinking and address new paradigms of design, bringing retrospective and prospective analysis. It is about breaking down some rules and motivating for change.

In order to address the teaching DfS as a subject of study, this thesis project introduces a pilot course including an outline followed by project-based exercises and recommended reading and research material. (see Appendices 10.5, 10.6, 10.7) The course is a combination of two types of design course: studio (project or practice based) and theory (lecture, seminar based). It can be conceived as a one-time experience or as a series of classes, applied as a focused DfS course or developing the units as a part of other courses. For this thesis proposal, the more accessible option for study reasons is a curriculum focused in one course.

The focused DfS course model consist of a general introduction and a modular structure of six units summarized in this point list (extended definitions and details can be found in the draft curriculum Appendix 10.7):

Preface to the introduction

Prior to introduce the topics is worth a call for students to be critic and optimistic at the same level. In Maldonado's words "we cannot build models [...] if we don't already posses an unequivocal will to realize [those models]". We cannot work on Design for Sustainability if we don't already posses the will to act. It demands an inner view of our own assumptions and values. Skepticism, apathy, individual, collective and corporate behavior, political will, inconvenience, and common misconceptions, among other human constraints, will be found all along the process in addressing DfS issues. An overview of scientific evidence, social sciences' philosophical and empirical argumentation and analysis of facts, is also necessary to approach the teaching of DfS. Once this first analysis is done and students find agreement about the basis of DfS, the class can move to work on the issues.

Unit 1. Introduction to the problems

We have turned our world unsustainable, how did we get here?

The first class' assumption is inherited to this question. For arguing this assumption, the unit goes through 6 analytical points.

- 1.1 History and socio-political context
- 1.2 The ancient sustainable world
- 1.3 The path from the Industrial Revolution to the Global Warming
(connected to descriptions in Unit 4)
- 1.4 Globalization, inequality and the misconception of Darwinism
- 1.5 Design as a part of the problem. Design as a tool of consumption.
(Introducing tools from Unit 5 and cases from Unit 6)
- 1.6 Designers as interpreters

Tentative components for this unit: Introductory lecture, an overview handout, reading material, programmed debates, group work assignment: summarize articles and book chapters and present it to the class, behavior change exercise.

Unit 2. Introduction to Sustainability

- 2.1 Sustainability: brief and extended definitions
- 2.2 Framing the issues involved in Sustainability (introduction)
- 2.3 A slow revolution: Evolution from Ecology, Eco-Design and Green Design to Sustainability and Design for Sustainability
- 2.4 Multidisciplinary aspects of Sustainability

Tentative components for this unit: Introductory lecture, an overview handout, reading material, weekly in-class tour to websites about sustainability, group work assignment: summarize articles and book chapters and present it to the class.

Unit 3. Design for Sustainability I: the will to act

- 3.1 Holistic approach.
- 3.2 The Design process and DfS process
- 3.3 Responsible Design, concepts and practice.
- 3.4 Designers as problem identifiers, designers as generalists.
- 3.5 Design within limitations
- 3.6 Research for DfS

Tentative components for this unit: Introductory lecture, an overview handout, reading material. Supervised project: field trip, searching for un-sustainability on Campus. Presentation field-trip report.

Unit 4. Design for Sustainability II: the issues

- 4.1 Energy
- 4.2 Waste treatment
- 4.3 Environmental harm
- 4.4 Human health
- 4.5 Social (side)-effects
- 4.6 Products of Design

Tentative components for this unit: 2 lectures about Energy and Products of Design, an overview handout, reading material. Guest speaker and/or movie projection. Exercise #1 in class: transportation, industry, consumption and its connections with Global Warming. Exercise #2 in class: working for zero-waste product of design (anticipating final project). Crits in class.

Unit 5. Analysis of Conceptual Tools

- 5.1 Triple bottom line sustainability strategy
- 5.2 Biomimicry: inspiration in the best possible design (nature)
- 5.3 Slowdesign: a contra-cultural vision
- 5.4 Communicating Sustainability
- 5.5 Restorative design
- 5.6 Inclusive design and user-centered design principles applied to DfS
- 5.7 For good is for best vs. the harmless the better: overview of assessment tools for products of design.
- 5.8 Benchmarking Sustainability
- 5.9 Macro solutions: tools from Politics, Economy and Advocacy

Tentative components for this unit: Introductory lecture, an overview handout, reading material. Exercise: understanding LCA (guest speaker) and other impact assessment methods. Project: Communicating Sustainability. Crit in class.

Unit 6. Analysis of case studies

- 6.1 No waste products, no waste packaging, no waste promotional material
- 6.2 More communication devices and more trees.
- 6.3 Alternative Energy

- 6.4 Sufficient nodes (homes) and efficient systems (cities)
- 6.5 Sustainable food
- 6.6 Carbon calculators, mapping and other sustainability widgets

Tentative components for this unit: Introductory lecture, an overview handout, reading material. Project in groups: research on detecting more sustainable designs locally, regionally and globally. Presentation of the results to the class.

These six units are ordered in sequence but given interconnected for a more apprehensive experience (see inspired in Gestalt's apprehensiveness in chapter 2).

The course requires a Final Project that consists of the development of an innovative no-waste design in any field: an object, a system, a visual communication piece, packaging, etc. The process involved in this final project includes analyzing situations, detecting problems, proposing design solutions, justifying a proposal, describing the implementation, and presenting the results in a final exhibition.

6.1 Prototypes and methods: ideas, aims and descriptions

One of the paradigms of DfS is to materialize theory into practice, since design is an applied field, and design education is a studio-based experience. The traditional and current client-based demand of design lies on the systems of consumption and production that this thesis project has intended in criticize and challenge, following conceptual approaches from sustainable development, eco-design and sustainable design principles. Rather, it is hard to find design demand for solving real sustainability projects, particularly at small scale or accommodating the projects in the short term.

In teaching DfS, instructors and students have to work within the paradigm of intangible design results. For instance, this is present in the lack of materially measurable projects or the lack of applied aspects of a design product versus more traditional projects resulting in tangible products, e.g. designing a book without using paper or developing new methods of design thinking. This chapter intends to address the paradigm by introducing some ideas to link the teaching of DfS with tangible results, in which students are actively involved as a part of innovative DfS teaching methods.

Expanding the teaching space

One of the richest experiences that a design student can have is contact with “real life”, as a designer, outside the classroom. There are at least three ways to involve a class with outside issues:

The first and probably most common way is by bringing real projects to the class, this is by including a real issue taken as a class project, with the possibility to implement the results and materialize the project. It can be involving clients such as organizations inside the university, the community, non profit organizations or any other external project that demands a design approach. This kind of project rewards students in

many ways, including experience, income, awards, grants or future employment. Most importantly, it drives them to deal with real problems, real responsibilities, and it put students in contact with agents as well as with instructors, agents that don't necessarily know about design, but just need it.

The second way to involve a class with external issues is by extending the boundaries of the classroom to the virtual space of www networking. A class can be in permanent contact with other DfS classes, with DfS events and DfS practitioners in real time. The technology is there. Sharing information, news, databases, etc., is a routine that a design studio class can incorporate easily. A DfS class should build, feed and administrate its own virtual framework; a website is the most usual format, but nowadays even using templates or weblogs would be enough for the same purpose. The DfS class suggested by this thesis project is a class that shares all the projects, outcomes and results through an open space on the internet. It is also a class that works as a network, where the students can have and share information in real time, where the traffic of information is basically digitalized and the use of paper can be reduced to almost zero.

In unit 2 of the proposed curriculum (Appendix 10.7) a virtual in-class tour to websites about sustainability is included as a part of the class routine. It is aimed at introducing the most relevant DfS websites and frequent updates, but also to encourage students to find new material on the internet. This regular contact keeps the class well informed and also helps to analyze how visual communication design is manifested in these spaces.

The third way is connected with the idea of "slow knowledge" introduced in Chapter 4. It is about going outside the physical space of the classroom, conducting outdoor sessions or field trips. It can be, for instance, a simple walk around campus to detect unsustainable behavior (manifested visually), or seek design models in nature in nearby park areas (inspired by biomimicry), or sit on the grass to study the potential combination of solar income and new devices that need to be designed. More ambitious plans like traveling to the places in which climate change can be understood through seeing and experiencing the effects directly or visiting classes in different institutions working with DfS would be worth while.

In unit 3 of the proposed curriculum (Appendix 10.7) a field trip around campus is introduced as a part of a project. The project is about searching for "un-sustainability" around your DfS work place. This search is focused on detecting current visual communication design situations that show a misconception or an unsustainable human behavior, or the absence of VCD and DfS where is needed. It also includes a general reading about the environment and physical context in which the situations are found. Architecture, systems and cultural aspects are taken in count. Students in groups have to make a presentation and a written field-trip final report.

Ideally, a DfS working class looking for inspiration and deeper DfS thinking exercise, cannot be shut in a closed environment with windows closed, auto artificial climate and fluorescent lights on during the day. When weather and project allow it, without previous scheduling, classes will be encouraged to work outdoors, in green areas of the campus. Looking for these locations and even asking for authorization to use them can be also an interesting initiative.

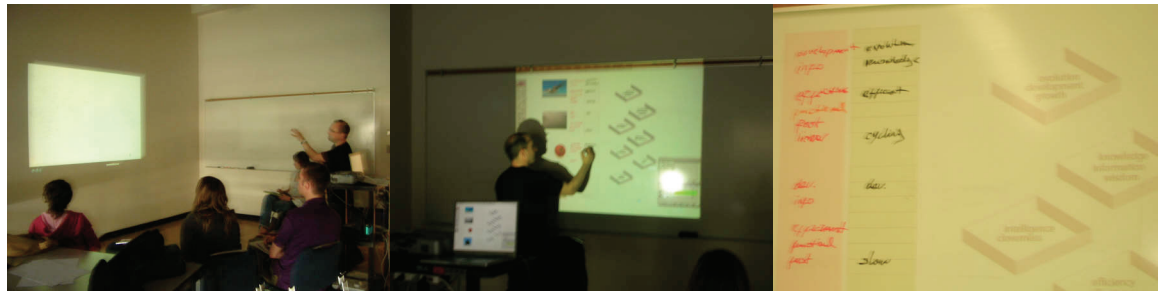
Interactive presentations

As described at the beginning of this document, thinking is a skill that can be improved, it demands however some training and an exploratory attitude. Many innovative methods have been shown by Edward De Bono's techniques in teaching critical thinking. One of these techniques is appealing to the dynamic of changing roles to produce a mobilizing effect on audiences. In this case for mobilizing students minds, the following procedure was practiced as a part of an introductory DfS class (exercise A):

1. The class is set up facing a white board from relatively short distance (it can be also a white paper sheet), and a projector is projecting a slide show presentation on it.
2. The projection consists in a prepared exercise that includes a series of screens. First screen consists of a series of images on the left column, related to branding, consuming, advertising and other examples connected to design, and a series of grouped words on the right column (in the form of "boxes"). Every box of words contents words related in meaning, but substantially different from a DfS approach, as is explained in "relevant definitions and important differences" in chapter 4. In-between images and word boxes, there is a blank column to fill with handwritten words.
3. Students are asked to match the elements by free association, selecting a word from the right column and writing down on the whiteboard in the central column with a marker, close to the image associated with this word. They have to pick just one word from every box, the word that fits conceptually with the image.
4. All the class participates by suggesting, agreeing or arguing, and the instructor guides this process adding comments or remarking on the findings. The challenging nature of this exercise, makes it hard to do it quickly. By using the whiteboard and markers, is easy to erase and re-write as many times as needed. This process can be described as "sketched brainstorming".
5. After this first round, a second screen with a different series of images is projected, this time images related to nature or inspiring designs found in nature. The right column with the word boxes remains the same, and also the words handwritten in the previous round on the central column, but a second central column is added to write some more connections.
6. Now students have to repeat the process, this time connecting words from the boxes with the new images from nature.

The final result of this exercise reveals a clear division of meanings, the same thinking process as described in Chapter 4, but this time the conclusions are visually and interactively built. Students can see, listen, think, talk, write and discuss openly with other students and the instructor. This exercise helps to consolidate basic agreement for a DfS class before moving to more complex assignments, and it motivates a better understanding on *design for sustainability* concepts. It is intended to stimulate creative and analytical skills, by challenging and testing students' assumptions, and finally engaging them with the spirit that DfS has to match.

Pictures from DfS testing classes



New methods of visualization, design of persuasion and delivering dynamic information: examples to take and to give

Interactive “widgets” for building scenarios

A relevant task for designers in the present and the near future is building scenarios that help us to understand current situations and possible situations in the future. Information design principles can be applied, depicting existing data and translating it into visual representations. In this sense, is suggested to support this kind of exercise with related readings like Edward Tufte’s *Envisioning Information* and material from the International Institute of Information Design (IIID). Information design relates to this kind of project however, new technologies and computer-based tools also allow to develop more interactive and ambitious ways of visualization. Is the case for the three examples selected for this DfS applied project, the gapminder, the ecological footprint calculators and the sustainable cities emulator.

38. Gapminder is a non-profit venture for development and provision of free software that visualize human development. This is done in collaboration with universities, UN organizations, public agencies and non-governmental organizations. It was founded in 2005 by Ola Rosling, Anna Rosling Rönnlund and Hans Rosling in Stockholm.

Gapminder

The first steps to this project started in Sweden in 1998, by a group of programmers developing visualizations that enhanced the understanding of complex information. Later prototypes incorporated moving graphics and trend simulations. In 2003 this group in collaboration with United Nations Division of Statistic and UNDP, initiated a project with the aim to visualize the fulfillment of millennium development goals with a World Development Chart 2005.³⁸ This interface shows the full UNDP numbers report classified in nine different charts, addressing topics like poverty, health, world income distribution, trends, etc. The information can be seen globally and locally. The user can see animated trends and manipulate some items to isolate part

39. <http://www.gapminder.org/downloads/presentations/human-development-trends-2005.html>

40. These are just some examples analyzed by this study:

<http://www.ecofoot.org>

<http://footprint.wwf.org.uk>

<http://safecclimate.net/calculator>

<http://usctcgateway.net/tool/>

http://www.thegreenguide.com/green_home

<http://www.ecologicalfootprint.org/Global%20Footprint%20Calculator/GFPCalc.html>

41. http://www.abc.net.au/science/planetslayer/greenhouse_calc.htm

42. The SustainLane 2006 US city rankings take the 50 largest cities in US and test them with the most complete report card on urban sustainability. The rankings take indicators about quality of life and city economic and management. These indicators gauge, for instance, which cities' public transit, renewable energy, local food, and development approaches are more likely to either limit or intensify the negative economic and environmental impacts of fossil fuel dependence. <http://www.sustainlane.com/us-city-rankings/overview.jsp>

43. This visualization project is conducted by Stan Ruecker, Professor from Humanities Computing / English and Film Studies / Faculty of Arts. The VCD collaboration is about the design of an interface for Decision Support Visualization, originally requested by the Faculty of Chemical & Materials Engineering and sponsored by local industry. The project included a study the goal of which is to examine how interface design affects the usability of the Decision-Support Visualization (DSV) by studying the user's perception of an interface prototype that displays data.

of the information. *Gapminder* is a powerful tool for reading complex and extended information in a holistic manner, and it is also a map to help recognize and understand the proportions of main global problems. A global report such as UNDP is hard to picture, and their trends hard to simulate. *Gapminder* is a good example about how design can help to depict complexity.³⁹

Ecological footprint calculator

Ecological footprint calculators –websites dedicated to provide mechanisms for calculating our ecological footprint– have become more and more popular nowadays. These websites can provide an estimate of how much green house gas –like carbon dioxide– we emit, individually, at home or business, consuming or producing goods; but also how many toxic emissions, waste and energy we unnecessarily spend. After giving us the diagnosis, these websites use to include some tips, suggestions and solutions to control, reduce, minimize and eventually eliminate our ecological footprint.

Some of these websites like *ecofoot.org*, *safecclimate.org* or *Wildlife World Foundation* give us a simplified, although realistic, idea of how damaging our habits and social behavior are in our everyday life.⁴⁰ Some other websites are more oriented to children and young visitors, like the Australian *ABC's planetslayer*.⁴¹

Creating these kinds of interfaces is an excellent opportunity for DfS students, who can also associate webdesign and interface design knowledge from other courses currently included in VCD programs. It is not only possible but also very appropriate to integrate these combined issues across the courses.

Sustainable Cities Simulator

This idea was developed for this thesis project, and inspired by SustainLane 2006 US City Rankings.⁴² Although the principle is similar to this or any other ranking for sustainability in terms of the factors considered to assess the level of achievement –of a city, region, country, etc–, the Sustainable Cities Simulator is also inspired by decision support models developed for collaborative interface design projects at UofA,⁴³ which imply the generation of possible scenarios based on current data, by manipulating the data and speculating with future results, which can lead to support long term decisions. The combination of both ideas, the ranking and the decision support model, brings an interface-based solution also known as “widget”.

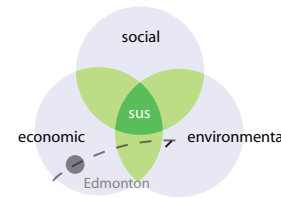
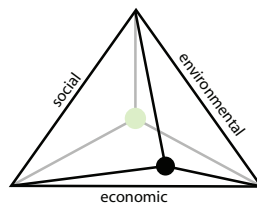
By default, the simulator will show a city currently ranked, visualized as *Gapminder's* bubbles alike. Then the user can set up the parameters and modify factors by sliding controls and observing what happened visually as a result. Factors are able to be modified (speculation) and go from CO₂ and dioxins emissions, to healthcare access and use of public transportation, among many others. The evaluation can consider hundreds of factors and sub-factors and variables, from macro to micro issues, and the user can add more factors and manage their parameters on how these factors affect the others.

44. There are more interesting projects about visualizations, like treemaps, matrix charts, timelines and visualization streams, inspiring for DfS projects. Some of them can be found at <http://blog.many-eyes.com> , <http://www.number27.org> , www.visiblestrategies.com, or also some specific tools like United Nation's MDG Monitor for tracking the Millenium Development goals at www.mdgmonitor.org , and the list is increasing.

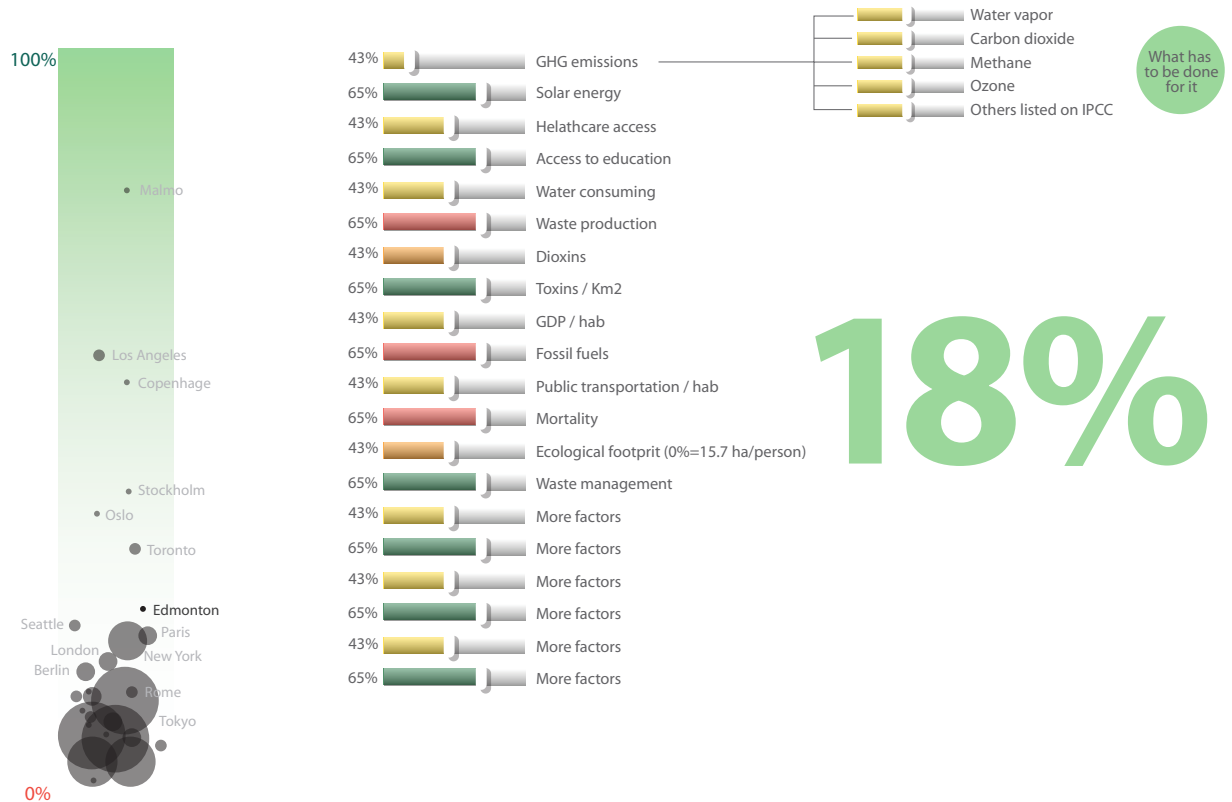
The results of these speculations can help to support or suggest the issues that should change in your community for achieving sustainability. It is a simple design concept that demands a complex data and system support, as cases like *Gapminder* use to be. In any case, it is a DfS project that can be developed as a parallel project in which all DfS courses can participate at different levels, and, once built, it is also a tool for analysis like the other two visualizations described before.

Like *Gapminder*, other visualization projects exist that can be explored for DfS purposes, to generate new tools for visualizing complex sustainability information.⁴⁴

Edmonton
currently#234
speculation#115

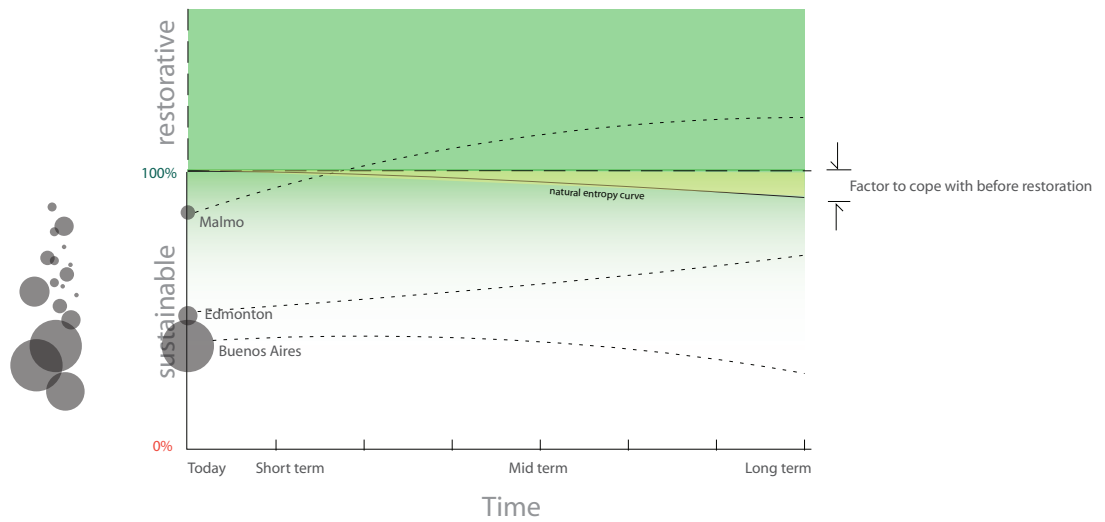


In this triple bottom line diagrams, Edmonton is improving environmental aspects, however social inequality tendencies prevent to achieve sustainability goals



SCVS Sustainable Cities Visualization System
(Imaginary example)

Sustainability and restorative tendencies, from
SCVS Sustainable Cities Visualization System
(Imaginary example)



New sustainable media

Innovation is a key factor in DfS. It is not related to only the development and implementation of new technologies, rather, technology should create more meaningful goals than extending the limits of human scientific conquests. In other words, innovation in DfS is more than a race for technology; it is about re-thinking the use of current and possible coming technologies. It is innovating by renovating.

The roots of DfS innovation are in the critical thinking process of design. By asking the right questions and following thinking exercises, like interactive presentations described early in this chapter, discussions can lead to good ideas about how to implement current technologies in tune with human needs and sustainability goals. Comparisons between natural and man-made systems can lead to a better use of technology.

The field of biomimicry is full of innovative solutions observing and following natural patterns. For instance, the most common examples are those related to mimicking processes like photosynthesis –e.g. photovoltaic cells and sunlight uses– or those related to animal and vegetal behavior –e.g. Velcro inspired by animal furs and movement without muscles by some vegetables micro-reacting to water pressure, somehow connected with nanotechnology principles.

In terms of visual communication design, the profession and its related industry, is dealing with major changes ahead. Paper-based media use is one of the issues that is demanding big changes in the short run, but the solutions to come have to be conceived for the long term. It is an immediate DfS problem. The paper industry is the third largest user of fossil fuels, behind power generation and transportation, and the largest single user of water worldwide, aside from being a giant agent in polluting, emitting –green house gases (GHG)– and generating unnecessary waste,⁴⁵ not to mention that it is the main factor in the destruction of rainforests by an increasing logging demand.

In the DfS course, replacing paper use with alternative media is an issue of importance. Projects in this field should be permanently added. One of the projects inspired by this thesis project is the seeking of a new generation of newspapers and magazines, detached from printing and paper production, and also from desktop and laptop computers, although dependent on internet and advanced communication technologies and materials.

DfS project: Introducing the future of the newspaper

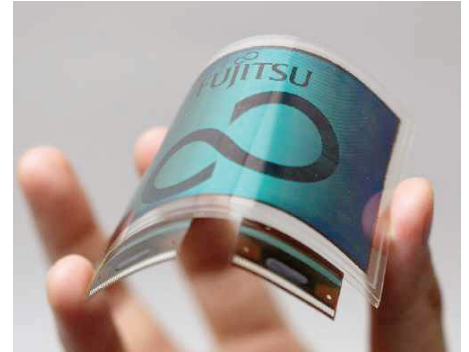
This project involves an important research from industrial design, related to new interfaces, media, screen technologies and materials. From the visual communication aspect, all the traditional issues involving interface design, publishing, layout, typography, imagery, etc, apply to the project.

But also changes in human behavior and coping with cultural factors are goals to achieve from a design perspective. Students have to develop a project that involves a revolutionary change in the way of seeing the delivery of information. Such project involves:

- Analyzing the current systems of delivering information, detecting pros and cons, taking account of practical factors (efficiency vs. effectiveness) and human and cultural factors (sociological, psychological aspects).
- Researching about new and coming technologies, able to be included as a part of a sustainable solution
- Introducing a new design proposal including: re-designing the system, re-designing the medium, pre-testing the results
- Building possible scenarios and analyzing possible implications driven by such changes from industry to end-users
- Evaluating social, environmental and economical effects of such new system
- Introducing a proposal for the production of the new system

Part of this work has been developed in different parts of the world, known as electronic ink devices and electronic paper projects. For example, *Plastic Logic*, a company initiated in Cambridge University's Cavendish Laboratory in 2000's now extending its production to Germany in 2007, as well as some developments from MIT Media Laboratory, or the Japanese *Fujitsu*.⁴⁶ These prototypes still need to be improved, technologically and in terms of design aspects, in order to replace books and newspapers.

46. For more details see www.plasticlogic.com/hi-res.php
<http://www.fujitsu.com/global/news/pr/archives/month/2005/20050713-01.html>
<http://www.media.mit.edu/micromedia/elecpaper.html>



Exercises: Sketching from statements and facts

This exercise was introduced and tested in DfS class studies, as two different parts: B and C. The aim of these exercises is to encourage students to apply critical thinking –introduced in the first part of DfS classes as exercise A– from theoretical scenarios to practical cases. In other words, transforming DfS thinking into a new design concept first, and then into a practical design proposal. By doing this, the class keeps the original spirit of a project-based class, traditionally part of studio courses, connecting theory with practice.

This exercise consists of the following steps:

Part A: Associations

This part can be oriented to connect DfS critical thinking with working on visual communication design implementation, following the steps described early in this chapter under “interactive presentations”

Part B: Picking a message

Students –previously divided in groups– are provided with some statements on paper that describe meaningful facts about the issues related to sustainability, here is a possible selection included on the study:

- 01** | By 2050 Earth population will reach 8 to 10 billion people
- 02** | We belong to the first generation ever that experience human-driven climate change
- 03** | Nature runs on sunlight
- 04** | Only 10% of paper production uses forest sustainable managed
- 05** | The energy of the most powerful nuclear plant hits the surface of the Earth everyday, however we use a very little part of it
- 06** | In nature waste equals food
- 07** | After 3.8 billion years of research and development, failures are fossils, and what surround us is the secret to survival
- 08** | We have never gone beyond fire: our cars, computers, buildings... all feed on photosynthesis, because the fossil fuels they use are merely the remains of 600 million years worth of plants and animals
- 09** | Business is destroying the world, there's not polite way to say it
- 10** | Act locally is not about individuals
- 11** | Global economy based on gas, heating and food as actual, creates inequality
- 12** | If industry in all countries were to produce only what is needed, the future would look bright indeed
- 13** | Our children can identify over a thousand corporate logos but only a dozen or so plants and animals native to their region
- 14** | It makes far better sense to reshape ourselves to a finite planet than to attempt to reshape the planet to fit our infinite wants

Every team group has to choose one statement, understand it, analyze it, and try to connect it with the information gathered in previous lectures and the interactive presentation –part A "associations". Through this exercise students are asked to think and reflect on the ways in which the statement could be translated into or supported by visual communication.

Part C: Sketching

After arriving at a concept and a strong connection with design for sustainability background issues, students are asked to communicate sustainability in visual

terms. Every group creates a design proposal by rough sketching first, then drawing, mapping, and/or adding notes on paper. Some preliminary steps are suggested before moving to paper, like brainstorming and writing down thoughts on paper first. This design assignment is totally free of physical and technological constraints. The results can be represented by traditional media like a poster, a TV spot, etc. or by innovative media, using existing technologies or taking advantage of natural systems. The most important goal for this exercise is to arrive at a strong design concept. Students do not need to use the exact statement, it can be modified, replaced or not mentioned at all, as long as still inspires the ideas. The design proposal can include resources such as metaphor, humor, sarcasm and visual rhetoric. It is expected that students will apply their design-thinking skills to the solutions, but new questions may arise and, eventually, modify their mind-sets in the process. The proposals will show students' ideas to the rest of the class, as well as increase their understanding of *design for sustainability* issues.

Students are asked to consider, if it is possible to apply, the following factors to idea generation:

- bring an alternative solution or possible solutions to an existing unsustainable situation / information
- include the factors that define their design solutions as “sustainable” (media used, materials, long term effects)
- drive the audience to associate examples in nature
- ask and answer questions like: should this exist? will end-users really be consumers of this design?
- meet natural concepts like cycling and long-term thinking
- change the behavior of end-users towards a sustainable attitude

After finishing the sketching work, students are invited to share proposals with the rest of the class, by posting them on the classroom wall. Every group then synthesizes, in a few words, what the proposal is about, and other groups will participate asking and criticizing.

This series of exercises leads to the first steps in designing visual communication solutions for sustainability projects.

Imagery project: “collage of differences”

One of the topics approached in many design fundamental classes is imagery, or the capacity of building a message through managing images and information without words. In this kind of project, students are asked to create a “collage of opposites”. For this task they have to collect images, looking for natural and human-made elements or situations, by using magazines as their image source. Once they have a large selection of material to work with, they begin to group the images in an organized manner. In creating a series of opposites, they can look for conceptual asymmetries like: organic-geometric, complex-simple, dynamic-static, artificial-natural, etc. But this exercise can

be applied using any other pair of concepts that a collection of images can suggest. DfS class introduces a project called *collage of differences*. The principle is the same, but this time students have to work with the terms introduced in Chapter 4, such as Optimum vs. Maximum or Effectiveness vs. Efficiency. By grouping and connecting images, students will gain a deeper understanding of the meaning, the differences and connotations, and gain experience from observation, categorization and selection of imagery for communication of the messages. They can explore how the visual characteristics of an image affect its meaning and how this meaning can be oriented to understand the basic issues of DfS.

Becoming familiar with key authors

Including bibliography, references, suggested authors and required readings, are assumed to be common resources in every design course, but DfS demands a deep knowledge and understanding of the ideas offered by key authors and pioneers who have linked design with sustainability issues.

The examples taken as analogies to the DfS course introduced by this thesis project, like *Okala* and *Teaching Guide for the Designers' Atlas of Sustainability*, include the key authors extensively and actively along their contents.

The DfS course should have a systematic approach to the books and reading material that makes the DfS content strong. The basic approach would ideally mean reading these three books, before taking the DfS course:

- *The Nature of Design* by David Orr
- *Design for the Real World* by Victor Papanek
- *Cradle to Cradle* by William McDonough

To familiarize students with key authors, during the course, having them “investigate an author”, as a homework project that can be presented to the class, would cover important terrain in this area.

Reading DfS related books in advance will prepare students better and will use the course time wisely. In the professional field, designers do not prepare themselves to approach a new project *during or after* the design process, they research, read and gather information related to the topic *before* starting the design. So do the students *before* working in an assignment. In the case of DfS students should be able to get basic literacy through these books, in order to take full advantage of the course content. This can be agreed and done when the schedules are planned in advance before every term or year. Asking for readings as a requirement to apply for a course can be easily implemented if previously planned. A DfS course should also facilitate the access in advance to this material to students interested in taking DfS.

Navigating routines in class

Taking advantage of internet technology is a way to involve a class with external issues by extending the boundaries of the classroom to the virtual space. Not only to interact

with other DfS classes and practitioners, but also to keep the class informed and up-to-date with the latest discussions and events related to DfS issues. Sustainability, as a slow revolution, involves many fields simultaneously. This permanent changing process only can be achieved by incorporating a planned internet routine, visiting the appropriate sites and detecting new initiatives on a regular-basis. At least once a week, the instructor should navigate online, looking for news with students' participation, but this of course can be adapted to the pace of the course and the amount of information uploaded worldwide.

Igniting debates

Very frequently in design classrooms, instructors in different course levels include critiques for finished projects or projects in progress, in which students are asked to participate actively, giving opinions and suggestions to their class mates. A connection exists between this interactive method of discussion and the necessary critical methods to include debates and discussion in DfS classes.

In addition to discussing and criticizing work in progress, a DfS class will include space for discussion and debate about the design work and related to the work in progress. In a DfS class, students will analyze natural systems and patterns for inspiration –by studying biomimicry and other concepts given along the DfS units. There is no point however, in arguing if such a system (nature) works. It is important to understand *how* it works. DfS theories make the point that current systems (man-made) are not working properly, here the question is *why*, and the method to approach this must be by discussing, rethinking, and applying critical analysis. Any solution given must be tested from a critical perspective, assuming that there is movement from something that is not working to something that should work.

It is necessary for this objective to include some techniques to challenge students, such as De Bono's *Six Thinking Hats* and *lateral thinking* or *wicked problems approach* (see chapter 4.2 for more details).

Pictures from DfS testing classes



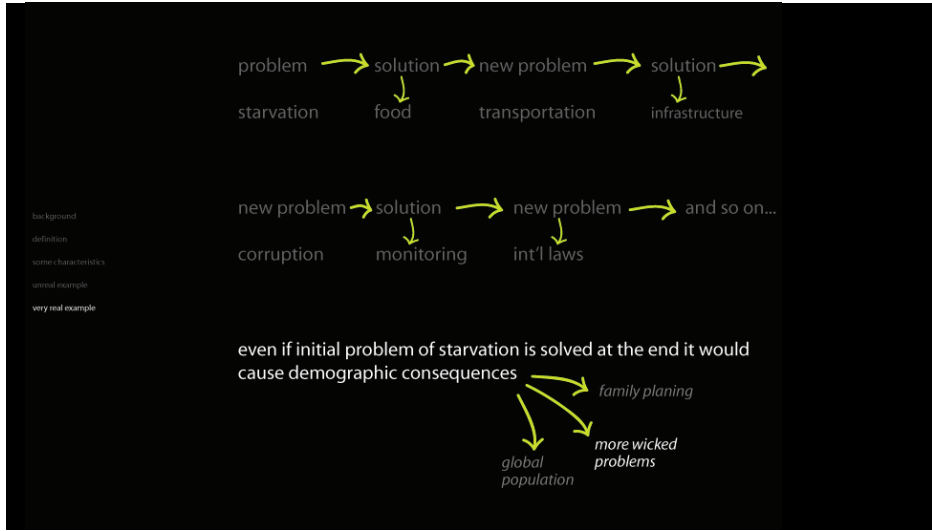
Slides from a presentation about Horst Rittel's wicked problems, introduced as class project at DES483, prior to this thesis project

some problems are so complex that you have to be highly intelligent and well informed just to be undecided about them
Lawrence J. Peter

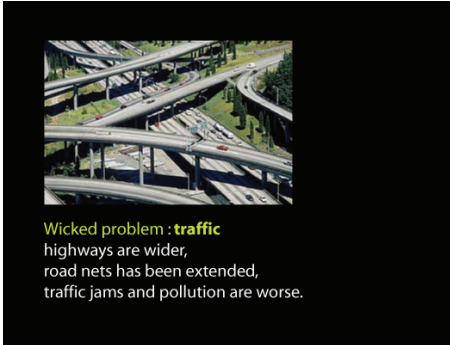
design facing wicked problems

wicked problems:
a class of social system problems which are ill-formulated, the information is confusing and involve many decision makers with conflicting values

some characteristics of wicked problems:
-> for every wicked problem there is always more than one possible explanation
-> solutions cannot be true or false, only good or bad
-> every wicked problem is a symptom of another, "higher level", problem
-> no formulation or solution has a definitive test
-> there is no room for trial and error
-> every wicked problem is unique



most of the problems addressed by designers are wicked problems
Horst Rittel



Problem identification: introducing projects

As mentioned before, one of the paradigms of DfS is to materialize theory into practice, turn DfS into realizable projects. For the DfS curriculum this issue is approached connecting assignments with the idea of field trips and expanding the teaching space concept introduced early in this chapter.

Students have to go out and detect unsustainable situations and behavior, manifested visually, or demanding visual intervention. The “chasing” of situations can be based on everyday observation, in student’s routines, at home, at work, on campus, etc. Problem finding must be focused on real and tangible problems, preferentially at small scale (domestically, locally). The more complex or inclusive the finding problems were the more appropriate would be to approach these exercises as teamwork (project in groups).

6.2 Developed content and materials for introducing DfS

As a part of this thesis project, a narrowed selection of class materials, methods and exercises from the DfS curriculum was included for a pilot class. This material, originally designed to be part of different DfS units, was adapted and prepared to fit in just one session for evaluation purposes.

The study included the following DfS curriculum material:

An introductory lecture consisting in a slide presentation that included basic information to approach design for sustainability conceptual framework. This visual material is taken from the lectures collection included along the six units of the DfS curriculum. Some tentative titles of this collection are:

We have turned our world unsustainable, how did we get here? (Unit 1)

Sustainability: brief and extended definitions (Unit 2.1)

Design within limitations (Unit 3.5)

Energy, waste, environmental harm, human health, social side-effects (Unit 4)

Products of design (Unit 4.6)

Conceptual tools gallery (Unit 5)

Design for Sustainability gallery (Unit 5.4)

Exercise A: “Associations”, described early in this chapter under interactive presentations, and more detailed in chapter 7

Exercise B: “Picking a Message”, described in this chapter under Sketching from statements and facts part B

Exercise C: “Sketching”, also described in this chapter under Sketching from statements and facts part C and illustrated in chapter 7

7. Testing

Without the possibility of testing, established rules cannot be broken or even changed. If we do not try we are not only losing a chance, but the freedom to fail.⁴⁷

47. Inspired by the Mike Reynolds' movie *Garbage*

Warriors. Mike Reynolds is an architect who created the concept of *Biotope*, see more details in chapter 5.4

This study was conceived in order to evaluate the appropriateness and performance of content and methods included in a pilot class, as part of a course dedicated to design for sustainability. It was intended to determine the effectiveness, and the level of comprehension of the general structure, methodology, quality of content, and the level of engagement of students with the concepts given. The findings of this study helped to identify which aspects of the methods, tools and content might be adjusted/ altered and helped to determine how the dynamic of the class could work in a future pilot course. The BDes Social Sciences Route in Visual Communication Design at the University of Alberta was used as a context for teaching the DfS pilot course content. This study helped to test this assumption.

The results of this study support the hypothesis that through design education, design and sustainability can be connected, and future designers can be guided to play a more meaningful role in the creation of sustainable futures.

After this first result is established, more specific questions related to content are asked:

What knowledge do designers need to address the issues involved in Design for Sustainability?

Related to concepts, design thinking and DfS principles included in the curriculum:

Can future designers be trained for a responsible design practice with long-term effects? How?

Related to the level of design literacy required:

How early can future designers approach these issues from a design perspective?

Related to the time and context for implementing a DfS curriculum:

Are the actual design programs adding these issues at an appropriate rate and depth?

Finally, related to methods and tools developed for DfS course:

What approaches and tools are successful in learning DfS?

7.1 Description of method

The participants in this study were provided with introductory information, and were asked to work on a design project, using information provided, and combining DfS tools and methods with tools and materials commonly used in studio-based design classes.

The pilot class consisted of a group of five undergraduate student participants, all of them from the Department of Art & Design senior level Bachelor of Design program.

The DfS testing class outline

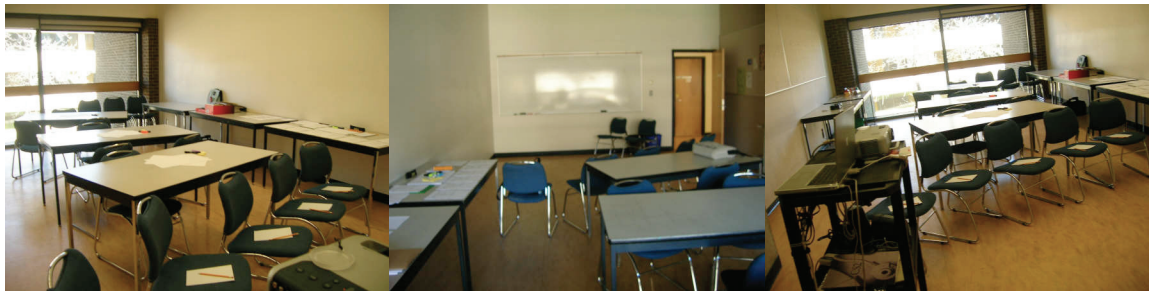
The first part of the study consisted of a visual presentation about *design for sustainability*, before going to work on practical problems. The material selected is part of the compilation of lectures included in the six units of the DfS curriculum, which titles were mentioned early in this chapter. This visual presentation was completed by an instructional handout, distributed before start the exercises. Students were asked to detect and then propose a solution to a problem inspired by ideas and concepts previously delivered in the lecture. After the exercise, the work was shown in class for critique, open discussion and conclusions. Finally, students were asked to fill out a short evaluation form, which provided feedback about their experiences with the pilot class. This evaluation was the most important quantitative information obtained. The whole pilot class took about three hours of intensive work.

Recruitment

For this study, an invitation to participate –written and signed by the researcher– was sent by e-mail to undergraduate design students. The invitation outlined the project and the objectives of study (see appendix IV). As a reminder, close to the session's date, a small poster was posted at VCD common areas and classrooms. About 60% of students contacted replied, and more than a half of them attended to the testing session. The study was planned to be after the end of term, independent of courses, thus avoiding any perception of a coercive situation.

Location

The pilot class was developed in a classroom in the Visual Communication Design studios at the U of A. This classroom was chosen because it is the usual environment for senior level design classes.



Call for volunteers

VCD students

Preparing designers of the future: *Design for Sustainability*



Living the way we are now, we will need the resources of 5 1/2 planets to survive

Carlos Fiorentino
testing sessions
for the thesis research

Design can be a powerful tool to create awareness, change human behavior, and lead change towards viable solutions. My research focuses on preparing future designers, like you, to play a meaningful role in the practice of sustainable design. The results of this study will allow me to complete a model for my thesis research. Additionally, this study will help to determine the content, organization, and tools for a potential *design for sustainability* course.

I would like you to be a part of this study. It consists of a design class that will include a brief lecture, the introduction of some tools, your participation in an exercise, and a short final discussion.

Your participation is voluntary, and is in no way associated with your classes, grades, performance or any other form of evaluation connected with your program.

I hope you can participate in this challenging new design talk !

for more details please contact by April 23th.
carlosf@ualberta.ca

Poster recruiting students for DfS testing classes

The lecture

The first part of the class was intended to provide a conceptual background for addressing DfS. A slide show was designed to meet this basic goal. The presentation included diagrams, definitions and pictures in order to frame design in sustainability terms, approach sustainability in design terms, and connect both aspects with education as a medium for delivery. The slide presentation consisted of five components:

1. introduction to basic concepts connecting design and sustainability.

This part establishes connections between both fields. It introduces definitions, paradigms, and a holistic approach to design. Emphasizes design as a process and a multidisciplinary field, and designers as problem identifiers and generalists. It also introduces the most accepted definitions and principles of sustainable development.

2. important definitions (introduction to sustainability terms)

This part brings a basic list of sustainability terms and their definition, and intends to be a basic step in DfS literacy. It includes a narrowed list of 13 keywords.

3. designers as problem identifiers, illustrative examples

This part reinforces the role of designers as problem identifiers. Students are asked to analyze real information connected to environmental issues. Through illustrative examples they can understand how designers can “read” differently (by analyzing information and “reading between lines”) and how designers can “talk” differently (by managing visual messages to show what is hidden or invisible). It introduces the first step of critical thinking about the models to follow, and introduces the notion of mimicking nature.

4. important differences (introducing DfS critical thinking)

In this part, students are challenged to differentiate between a selection of the words introduced in chapter 4, commonly taken as similar, but substantially different in meaning, and pay especial attention to these words for later application to the design process.

5. long term thinking and design

The last part of the presentation consists of a diagram of a central timeline, which shows a short-term, a mid-term and a long-term spatial representation. The diagram is completed by a series of “word boxes” containing the groups of words previously analyzed. These words are taken out of the boxes and organized in columns in terms of their relation to time. Finally, design is positioned on the time line, revealing that short-, mid- and long-term goals can be all addressed by design. This part leads to the first exercise.


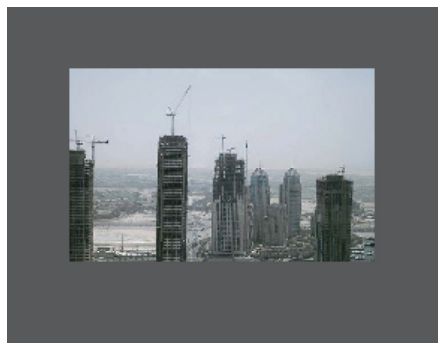
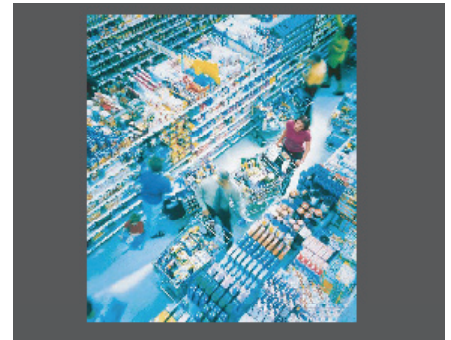
The lecture was evaluated in three different ways: through the observation of students’ work, processes and results, through the recording of students’ words, and through including questions on the feedback form. These three actions helped to detect how students incorporated vocabulary and concepts in to their work.

Slides from DfS presentation for DfS testing classes, (see complete series in appendix 10.5)

maximum : the highest limit

VS.

optimum : the best or most favorable condition, or the greatest amount or degree possible under specific circumstances


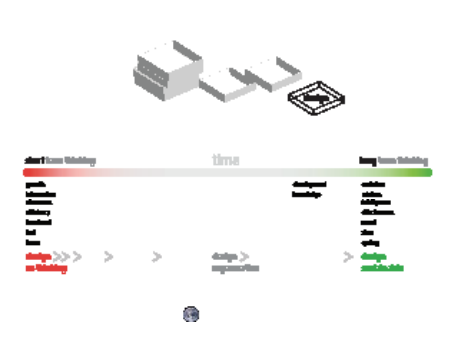
consumption : the act of consuming something (of energy), use, use up
 (ast): devour, eat, eliminate, obliterate

VS.

consumerism : a materialistic attachment to possessions

VS.

waste : excess of material, useless by-products or damaged, unsealable products; garbage, rubbish.

Exercise A: associations

This exercise acts as a transition between the lecture and the working class, and a bridge between analyzing DfS theory and applying critical design thinking to project-based tasks. It is one of the methods for teaching DfS described as interactive presentations in Chapter 6.1. This is an exercise that uses a slideshow and whiteboard. Projecting images related to iconic objects of consumption, man-made and commercial messages, and projecting “word boxes” containing keywords, the students were asked to fill in central column close to each image with just one word from each box, by writing it on the whiteboard. After this step, a second projection showed a second series of images, this time related to natural elements. Students were asked to repeat the procedure, associating one keyword from each box with one image. The last step revealed the two columns, clearly showing a pattern that group words connected with long-term thinking –and with natural images– from those connected with short-term thinking –and with consuming.

This exercise concludes the theoretical part of the class and introduces the application exercises. It was evaluated by observing and taking notes about the students’ reactions and conclusions, and also by test questions included on the feedback form.

Images from exercise

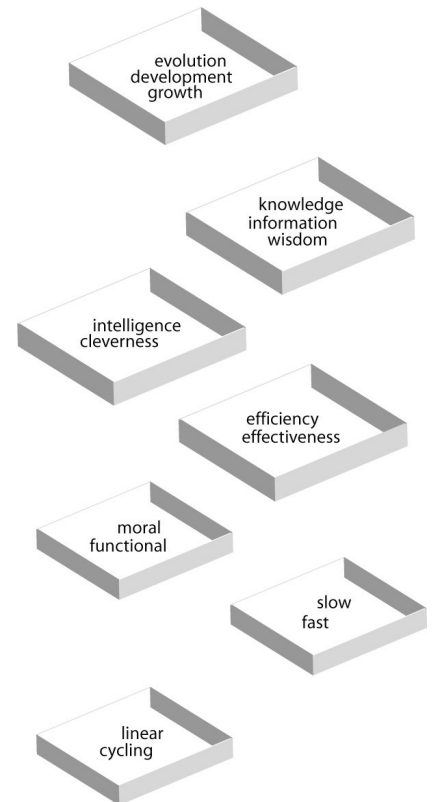
A “associations”. In the first part, students had to associate iconic objects of consumption, man-made and commercial messages with keywords included in the boxes





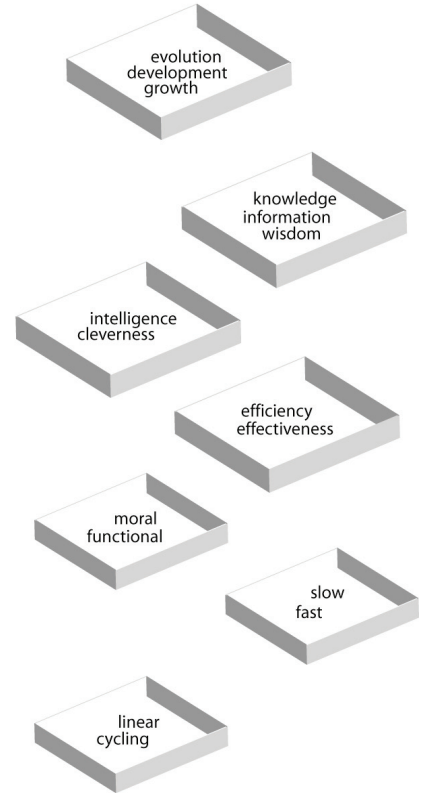






In the second part of "associations", students had to associate images related to natural elements with keywords included in the boxes. As a result of this exercise, students can find a pattern that group words connected with long-term thinking –and with natural images– from those connected with short-term thinking –and with consuming.



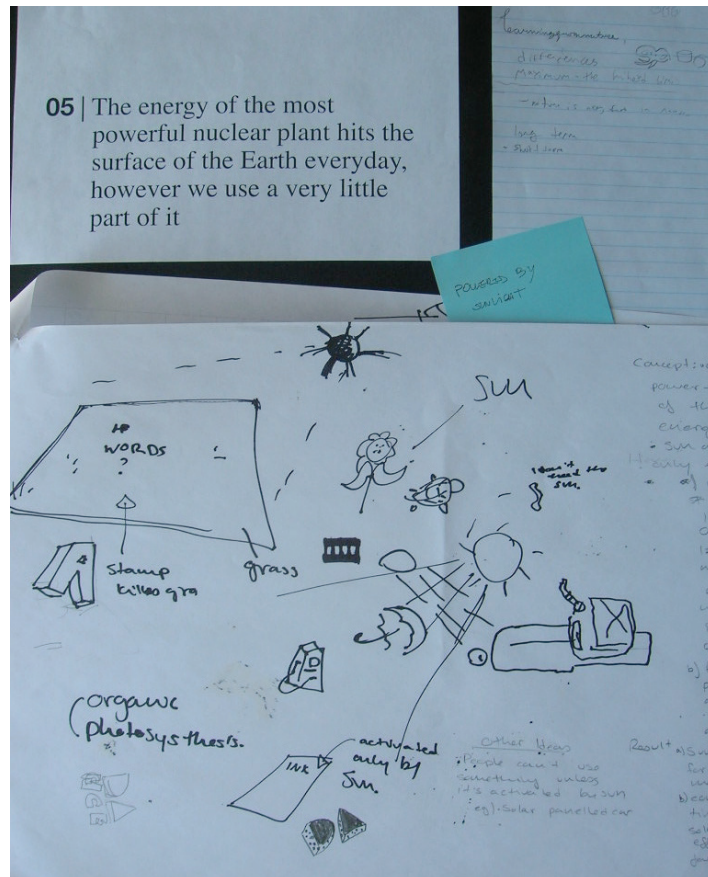


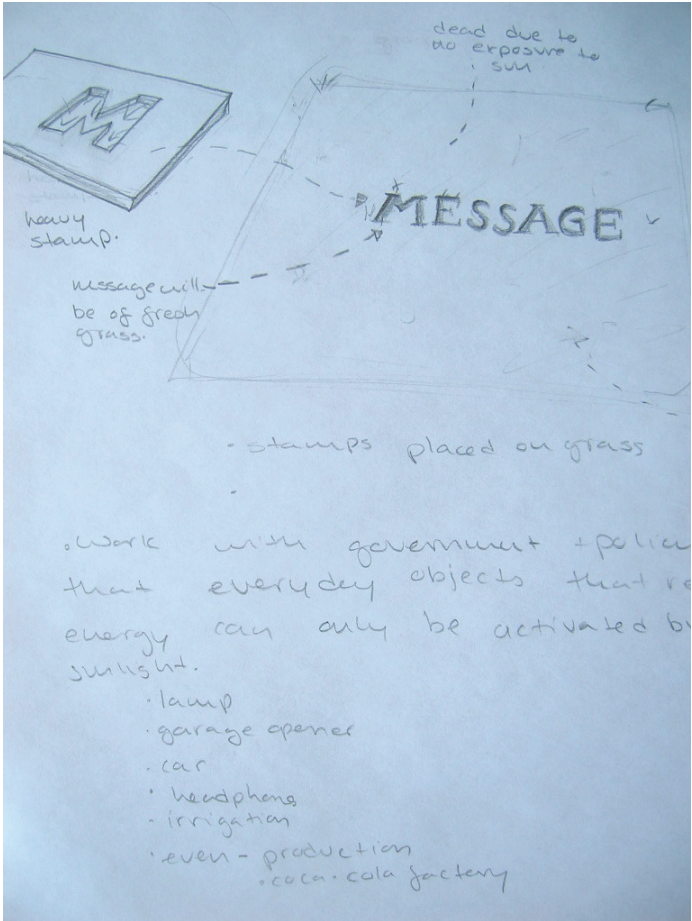
Exercises B and C: communicating sustainability by thinking and sketching

The class of 5 students was divided into two groups of 2 and 3 for this stage. In exercise B students were asked to pick one message to work on, from a list provided. The messages included meaningful thoughts from key DfS authors as well as facts related to environmental issues and human behavior detailed in chapter 6.1. Students had to connect the previous critical thinking steps in this stage, with possible implementations or materializations inspired by the messages. Exercise C is the culmination of the process initiated by the presentation projected at the beginning of the class and ending with the design project, created during the period of sketching. Students were provided with sketching materials and they worked in their natural studio context for an hour. The assignment was to communicate the selected message, using visual communication design strategies with impact, to an audience in order to persuade them about the postulated concept. This task gave students freedom of action and use of resources/materials, as long as it met the principles of sustainable development.

The results showed innovative ideas and a broader vision of the use of materials, design tools and new media. The ideas sketched and discussed in class crossed design boundaries in terms of traditional approaches like market-oriented or user-centered design. The results of removing these boundaries revealed original approaches like the use of unlimited and renewable natural resources, not necessarily attached

From exercise C: "the message powered by sunlight"





From exercise C: "the message powered by sunlight"

A sketched project that used the statement: *The energy of the most powerful nuclear plant hits the surface of the Earth everyday [sunlight], however we use a very little part of it.* The phrase inspired an innovative idea: using the light of sun to reproduce the message on a natural surface, in this case grass. The message was shortened and the idea optimized to meet typographic principles of readability, legibility and scale.



to the use of high technologies. The proposals suggested a diversity of resources and multidisciplinary, like the combination of printing media on biodegradable materials or the combination of natural forces like sunpower with man-made tools like typography and stencil techniques (see page 75).

Feedback questionnaire

A feedback questionnaire was included for the last part of the testing class, then students were asked to take 15 minutes to fill in the form with their opinions about the class experience. This provided an effective way to measure quantitative information, but also provided qualitative details.

The questionnaire asked for information about the student's design background (see questionnaire's column 1), and about students' opinion over the DfS pilot class experience.

Firstly questions were intended to test previous knowledge in DfS issues prior to attend the testing. Questions about the student's background were presented as yes-no items and boxes to be checked.

Secondly questions were intended to get qualitative and quantitative information about the study (see questionnaire's columns 2-6). The quantitative aspects were covered by measuring the level of agreement with statements concerning their experience in the study in order to detect the level of learning of DfS concepts, class material and methods used. The qualitative aspects were covered by space for writing extended explanations. Some qualitative information was also deduced from quantitatively-oriented questions, analyzing cognitive aspects involved in some of the answers. One example is shown in column 5 of the questionnaire:

Based on this pilot class, the content of a DfS course could modify your perceptions and assumptions about:

- *what design is for*
- *the designer's role for the future*
- *how urgent a holistic approach to sustainability is for the designers*
- *design as a multidisciplinary field*
- *design as a process*
- *the reductionist idea of specialization in design and the idea of designers as generalists*
- *short-term and long-term thinking in design*
- *consumption, consumerism and waste*
- *effectiveness and efficiency in designs*
- *information, knowledge and wisdom*
- *functionality and morality in design practice*

Answers to these points show previous knowledge about design issues, and by the incorporation of new concepts introduced by DfS, students' answers reveal a more holistic approach and soundly supported arguments.

Diagram of form

The diagram illustrates the layout of the 'Design for Sustainability Feedback form', which is organized into three main columns based on the type of information they collect:

- Column 1 (Background data / assumptions - Blue):** Contains sections 1 ('about you') and 2 ('Mark / write.'). Section 1 asks about the student's program, route, and levels, and includes a list of authors to check familiarity with. Section 2 asks about the student's background knowledge of sustainability and requests names of courses, instructors, or institutions.
- Column 2 (Qualitative information - Green):** Contains section 3 ('about the study') and section 5 ('COGNITION'). Section 3 asks about the student's expectations, the appropriateness of content, and the methods/dynamics of the class. Section 5 asks about the student's perception of the course content and their level of agreement with various statements.
- Column 3 (Quantitative information - Orange):** Contains section 5 ('COGNITION') and section 6 ('COGNITION'). Section 5 continues with more statements for agreement. Section 6 asks about the student's expectations of the class, the appropriateness of the content level, and the duration of the course, and includes a list of words to describe their experience.

7.2 Evaluation of results: quantitative and qualitative analysis, conclusions and quotations

Analyzing the notes taken, observing the working processes and the recorded comments and evaluating the sketched design work, completed the evaluation of qualitative results.

Below the points raised in and the results obtained from the questionnaire are described.

Columns 1 and 2: about student's background

Question 1.1 – About your program, route and levels you are taking

All students tested had a VCD background, one of them also had ID background. While participating in the testing all, of them were taking senior level studio courses. 3 were enrolled in the general route and 2 the business/marketing route (these two routes make up 77% of the enrollment). There were no social sciences route students in the group.

48. See details on chapter 5.2 *Understanding the teaching environment*

Question 1.2/1.3 –Have you taken courses in or had any background knowledge about sustainability prior to this pilot course? If yes, please name courses, instructors, institutions, etc.

4 of 5 students responded “yes” to this question, and they mentioned courses taken in VCD, ID and HADVC, which involved sustainability issues. They also remarked the **Open Talks**⁴⁸ sessions delivered as preliminary pilot discussions in intermediate VCD classes, as background.

Question 1.4/1.5 –Are you familiar with some authors, books, theories and material related to sustainability? If yes, mark the authors you know from the list.

4 of 5 students responded yes and marked three DfS key authors: Victor Papanek, Paul Hawken and William McDonough. Seven more suggested authors were not marked: David Orr, Janine Benyus, Hazel Henderson, James Lovelock, Tim Flannery, Herman Daly and John Saul.

This list was intended to offer a broad range of DfS key authors from different disciplines, mixing most well-known authors with less well-known ones within design education. The results showed that certain authors have written references of eco-design over the last two or three. More recent works, and in some cases authors works connected to current sustainable design issues, such as those of David Orr or Janine Benyus, were unknown by students despite of some knowledge about sustainability.

Only 3 out of 10 selected key authors were recognized by students in the testing

unknown

known

David Orr
Janine Benyus
Hazel Henderson
James Lovelock
Tim Flannery
Herman Daly
John Saul

Victor Papanek
Paul Hawken
William McDonough

Question 2.1/2.2 – Would you take a course entirely dedicated to Design for Sustainability at U of A? Please explain why or why not.

The 5 students answered yes to this question. Students added comments, describing their perception about the state of the issue at current design programs and the potential inclusion of more focused DfS content. Among different considerations they demonstrated interest in:

- The convergence between VCD and ID to work on common projects.
“it is pertinent [sustainability] to both ID and VCD, despite the tendency for ID students only to focus on it”
- The inclusion and study of biomimicry in design programs
“I realize the importance of it [a DfS course], of how things can be designed according to biomimicry [principles]”
- The opportunity to address sustainability issues and understand the responsibility of design.
“These issues [sustainability] are new but imperative...as designers we have a huge responsibility to contribute to a sustainable future”
- The capacity of a DfS –focused course to extend sustainability issues from theory to practice.
“Sustainability should be extended from discussion to practice and a way to do this is teach it in the classroom.”
- The approach to design and sustainability through a DfS curriculum that integrates multiple disciplines
“We have all heard about sustainability yet we know very little about its depth and interdisciplinary needs.”
- The possibility for change and restoration, and the ultimate effect on the mindset and behavior of students.
“To have a class [DfS] that solely focuses on I think would get people starting to think about smaller steps and coming together in efforts to stop and repair some of what we have done to the environment sustainability [the results of sustainable design]”

Columns 3-4: about the study | testing dfs materials and methods

Question 3.1 – Overall, this experience fulfilled my expectations about the approach to Design for Sustainability (DfS).

The 5 students agreed with this statement, ranking with 4 points over 5 possible. The subtle difference between “agrees” and “strongly agrees” was given by some difficulties and detected weaknesses in some of the exercises, which decreased the overall perception. These adverse points are described in question 3.6.

Question 3.2 – The content is appropriate for future classes dedicated to DfS

4 of 5 students agreed and 1 strongly agreed. This expressed a positive attitude from students that participated in this study, the level of agreement was impressive. The DfS content was appreciated. Results confirmed that choices related to authors, ideas, concepts and methods to deliver were appropriate and well-oriented in terms of complexity.

Question 3.3 – The methods and dynamic of the class are appropriate.

The 5 students agreed on this point, even though they knew that the methods were prototypes yet to be improved. Despite the short time used for the many issues tested (3 hours) the methods and dynamics appear to have worked properly. The portion of time dedicated to each part and the connection between them seemed to work harmoniously, and students were motivated to keep working until the very last minute. The strategy consisted of introducing the issues gradually in terms of the complexity of the issues delivered and in terms of the role of the students (as listeners, thinkers, players).

Question 3.4 – The information delivered to develop the work in class was appropriate.

1 student strongly agreed, 2 of them agreed and the other two did not know. These proportions can be attributed to cognitive aspects described in the questions 1.2/1.3, and 1.4/1.5. For instance, most of the students were aware of well-known authors, but were unaware of more recent authors, and recent sustainable design issues. This could influence their perception of new concepts vs. known concepts so that, the 2 students that did not know cannot be interpreted as disagreement but rather as neutral responses.

Question 3.5 – I found the lecture content meaningful to approach DfS.

4 of 5 strongly agreed and 1 agree, which for the purpose of this study means 0% of failure in introducing the concepts. Passing this point is a core issue in terms of evaluating affordability, clarity of messages, and most importantly, how potentially overwhelming issues can be handled to encourage students to work on solutions. Reactions like pessimism, apathy or anger, were neutralized by the perception that if DfS logic were followed it would drive appropriate and effective solutions. The promise of addressing some of these DfS issues in class worked as alleviation to any initial bad feeling.

The visual components, including images illustrating and emphasizing the issues addressed, were of remarkable benefit:

“Overall, I think the presentation was informative. The definitions were useful in understanding the terms [DfS definitions and differences]. More pictures relating to actual degradation and devastation to the environment I think would be useful. As designers we are visual people and in my opinion would respond quite well to images like these” [designers “reading” different series of images].

Question 3.6 –I found the exercise A (associations) to be useful to understand short- and long-term thinking

2 of 5 students disagreed. They argued about the amount of time needed for better interaction and thinking processes required by this exercise. This point was easily observable during the testing session, fifteen minutes or so were not enough for students to catch the dynamic of this exercise. As a result, the instructor had to intervene to help generate thoughts instead of acting only as a moderator. By correcting the time factor, say by dedicating a full 2-hour class to associations *on the whiteboard* would be beneficial. Nevertheless, 3 of 5 students took this experience as a positive one. One of the students, enthused by this exercise, added three more points –to the 1-5 scale– giving an 8 mark instead to this item and marking it as “really good”.

Question 3.7 –I found the exercise B (messages) to be useful to work on exercise C.

4 of 5 students agreed about the usefulness of exercise B, and 1 of 5 did not know. It can be assumed that *pick a message (and reflect about it)* exercise leads effectively to *sketching*. Both exercises were naturally connected in timing and process. The information gathered in A, leads from B (analysis) to C (design response).

Question 4.1/4.2 –I found the exercise C (sketching) and the late group discussion was a meaningful experience. In a future DfS course, I could connect visual communication design projects with issues involved with sustainability. Whatever your level of agreement be, please explain briefly why.

This question was meant to check if students could associate the content of a DfS focused course with the practice of visual communication design applied projects. 100% of students agreed with this point. Some students questioned the time frame, because the class seemed to be short. Some of them found this part very exiting to work on, even for more than one message and for longer than just one class. This idea already included in the draft curriculum (see appendix 10.7). Students expressed the satisfaction of being “hands-on” DfS projects –interacting and sketching– and not only listening and eventually talking about the issues.

“We designers need to make these concepts concrete and tangible and the perfect way to do this is sketching. It’s nice to generate deliverables rather than just discussing the matters”.

This reveals a path to follow in order to address the DfS instructional paradigm: theory can be tried and applied in design projects.

Columns 5-6: about the study | testing DfS content, delivered concepts and class format

Based on this pilot class, the content of a DfS course could modify your perceptions and assumptions about:

5.1 – what design is for

4 of 5 students agreed that their perceptions could be modified by a DfS focused course, and 1 of 5 did not know. None of them disagreed. This is an essential question that every designer asks her/himself and other designers, and at the same time tries to explain to non-designers –that our questioning is natural to design, since design is a human concept that can be applied generally and universally. Asking such questions

to design students in a DfS class context acts as a door being opened. As defined in early chapters, a DfS class connects design with its original purpose, and design spirit with human-oriented design practice. Through the content of DfS course, students discovered a broader approach to design as a discipline, in such a way that it can modify students' perceptions and assumptions about the role of design.

5.2 – the designer's role in the future

All students agreed, and more than 80% strongly agreed with this statement. This indicator confirms the strong connection between sustainability and design, and that it is perceived by students as an issue that defines their future as designers. The content of a DfS course can modify students' perceptions and assumptions about the designer's role in the future.

5.3 – how urgent a holistic approach to sustainability is for the designers

1 of 5 did not know, 1 of 5 agreed and 3 of 5 strongly agreed. It is important to consider that for some of the students, sustainability or holism applied to design is a new concept, whatever the level of agreement was, the reception of an imperative, holistic view of design issues was very positive. The content of DfS course can modify students' perceptions and assumptions about how urgently needed a holistic approach to sustainability is for the designers.

5.4 – design as a multidisciplinary field

Since students are aware of this characteristic that is inherent to design, this question was intended to test if the concept was reinforced after the DfS pilot class. 4 of 5 students agreed or strongly agreed while 1 of 5 did not know what to answer, which means no disagreement suggesting: the content of DfS course can modify students' perceptions and assumptions about design as a multidisciplinary field.

5.5 – design as a process

There was an equal number of students agreeing and students not knowing the answer. This might mean that they weren't sure about it or the point was not clear. The rest of them strongly agreed. There was no disagreement at all, therefore, most of the students accepted that the content of DfS course can modify their perceptions and assumptions about design as a process.

5.6 – the reductionist idea of specialization in design and the idea of designers as generalists

4 of 5 students agreed and 3 of them strongly agreed. However, it was one student between disagreement and not knowing the answer to this question. This hesitation can be attributed to the lack of depth possible in covering this issue in a short session. One of the students, who strongly agreed, commented:

“I think this needs to be more elaborated [and extended] –it's really interesting [the concepts]”

Most of the students agreed that the content of DfS course can modify their perceptions and assumptions in both ways: about the reductionist idea of specialization in design and the idea of designers as generalists. The main point for further consideration is how specialist and generalist approaches can coexist.

5.7 – short-term and long-term thinking in design

5 of 5 students agreed, 4 of them did it strongly with this point. The content of DfS course can modify their perceptions and assumptions about short term and long term thinking in design, and doing so, working with time factor as an allied rather than a constraint. The understanding these concepts is one of the most relevant turning points towards DfS thinking. Students, who can incorporate time as a factor to include constructively, instead of competing against it, will experience a mindset change.

The next four questions are connected with the method of analyzing differences introduced in the lecture and explored in exercise A. All these questions allowed students to develop a critical approach towards DfS thinking.

5.8 – consumption, consumerism and waste

3 of 5 students strongly agreed, 1 of 5 agreed and 1 of 5 did not know. No one disagreed suggesting that the content of DfS course can modify their perceptions and assumptions about the differences between consumption, consumerism and waste. By establishing the differences between these concepts, students understood the role that designers have to play in communicating those differences. Understanding them helps to define the audiences and the tools to use for changing behavior more precisely. But perhaps most important, it helps to understand how nature gives us efficient and effective models of functionality and behavior to follow.

5.9 – adding effectiveness to efficient designs

5 of 5 students agreed, 1 of them did it strongly. Students were convinced about the powerful approach of adding effectiveness to efficiency. But also they appreciated the critique, evaluating design only from the efficiency point-of-view means losing a big part of the designs' effects. Effectiveness is about the ultimate objective of any design. It means following the whole life and consequences of a design. Students' responses show that the content of DfS course can modify their perceptions and assumptions about the importance of adding effectiveness to efficient designs.

5.10 – information, knowledge and wisdom

3 of 5 students agreed and strongly agreed, but 2 of 5 did not know the answer. Probably, because it needs a more detailed discussion; this differentiation is a core concept that involves a different conception of time and a holistic approach to human communication phenomena. Nevertheless, no students disagreed meaning that it is possible to include this analysis in DfS content. Most of the students agreed that the content of DfS course can modify their perceptions and assumptions about approaching differences between information, knowledge and wisdom.

5.11 – functionality and morality in design practice

All students agreed that the content of DfS course can modify their perceptions and assumptions about functionality and morality in design practice. 3 of 5 students agreed and 2 of 5 strongly agreed. This demonstrates a high level of engagement of students with the concept of a responsible practice of design. At the same time, students assume there is a strong connection between issues involving DfS and issues involving

professional responsibility, real purpose, and moral values. By contrast, none of these issues is centered on the pursuit of profit.

6.1 – This pilot class fulfilled the basic expectations of any design class I have taken.

This question was intended to test if, by comparing with previous design courses taken, the DfS course could offer same quality of content and methods as a starting point. Also it was intended to test if students feel comfortable working on DfS, as much as in any other course subject. 5 of 5 students agreed or strongly agreed with this statement. It can be said that suggested DfS content and methods are in tune with what students expect from current design classes.

6.2 – An intermediate level class is the appropriate level to introduce DfS content.

It was assumed early in this thesis project that, an intermediate level is the most suitable course level for focusing a DfS curriculum. This does not mean that DfS can not be also included in other levels and in different formats. In any case, a program that integrates the DfS content throughout is always recommended.

3 of 5 students were convinced and strongly agreed. 1 more student agreed and the 1 remaining student slightly disagreed. The 80% agreement is supported and justified in this thesis project (see Chapter 5.2). However, is important to focus on students who disagree. The reasons for their negative opinion indicating that intermediate level is the wrong level, but trying to suggest that other levels are also appropriate for DfS content, which is demonstrated in the next iteration on question 6.3.

6.3 – If not at an intermediate level, at which level of Design program do you think this content should be introduced? Introductory, junior or senior level?

Only 2 of 5 students answered this question –the same ones who weren't convinced in question 6.2– and the results show that one of them thought that junior level would be appropriate to introduce DfS and the other thought the senior level. In the second case, two interpretations can be considered: DfS contents would be continued from previous levels or it could be introduced at senior levels, closer to the degree. In any case, two conclusions were obtained: the most appropriate level to introduce DfS seems to be the intermediate level, but can be extended from junior to senior too, and seem to be that introductory level is not appropriated –or too soon– to introduce these issues.

6.4 – I think a future DfS course should run for: 1 (3 month) term, 2 terms or more

3 of 5 answers were for 1 term and 2 of 5 answered 2 terms or more. Again, there was a correlation between the answers in question 6.3 –supporting that DfS can be extended to a junior–senior range level– and same students answering that DfS can be extended to more than 1 term, which is absolutely consistent with their opinions. Some of the students added:

[having chosen intermediate level] *“but earlier is always better”*,

[having chosen junior level] *“some background may be required though”*,

[having chosen more than 2 terms long or more] *“it is really important”* [to extend DfS]

[having chosen 1 term] *“with a second term as optional, like for example [DES] 437, 438, etc.”*

6.5 – Choose the most suitable words to describe your experience in this pilot class and the issues of DfS.

This question was intended to measure the level of optimism/pessimism after working intensively on DfS exercises for 3 hours, and having experienced the process from receiving information to delivering their input. Students chose from 8 words given, the first 4 reflected positive aspects, the second 4 reflected negative aspects. 76% of the responses remarked the positive aspects, 24% the negative aspects. The results were:

60% inspiration

60% motivation

40% innovation

40% hope

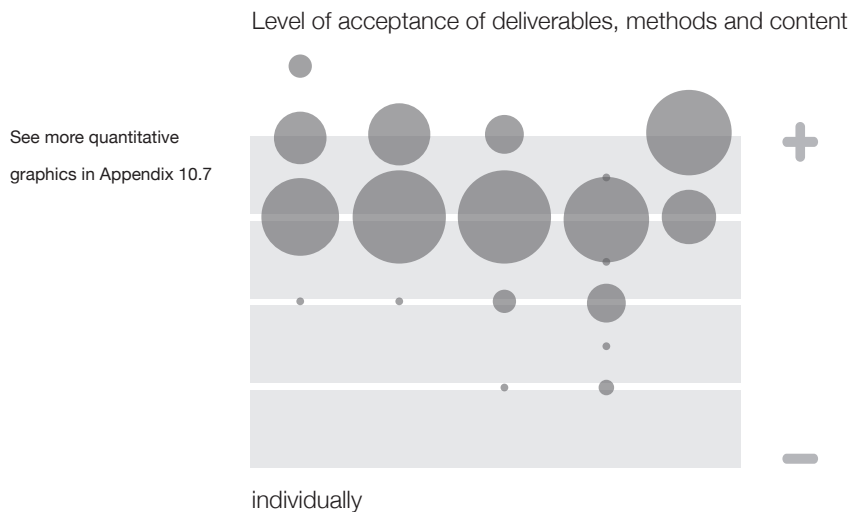
0% conflicting

20% confusion

20% skepticism

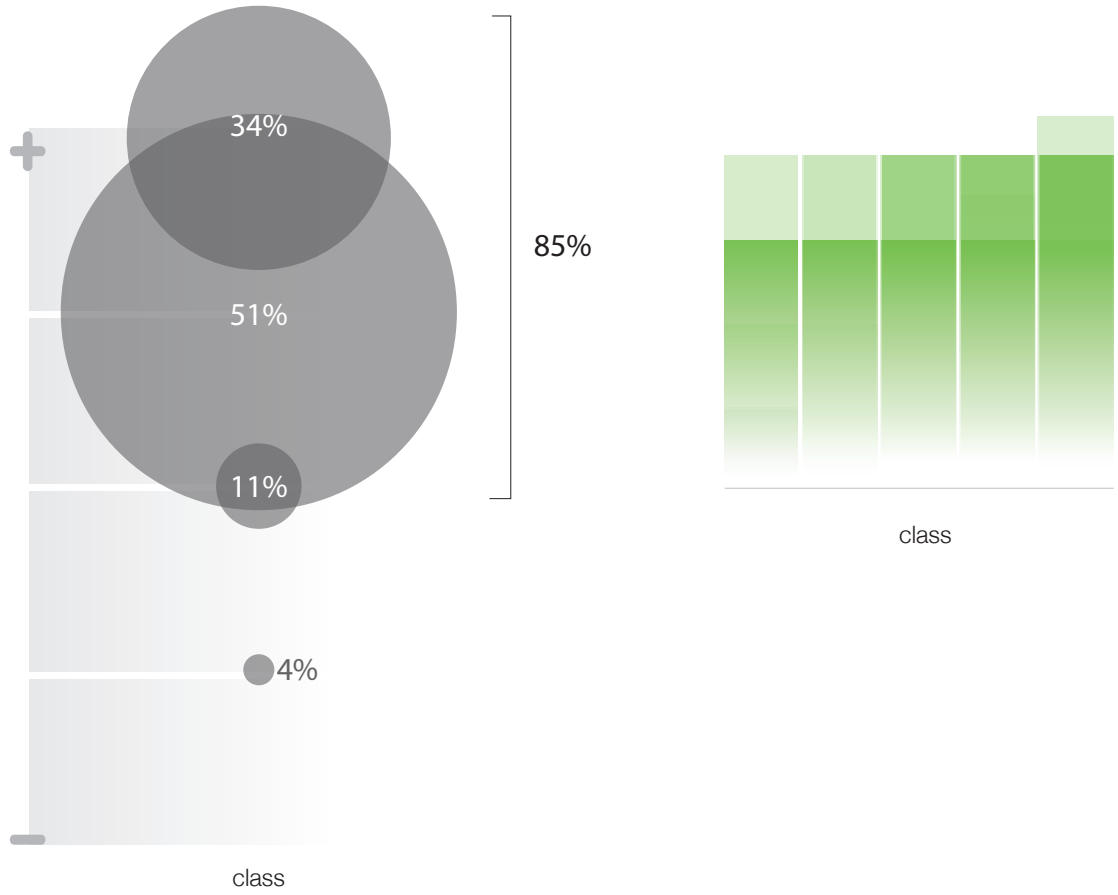
0% indifference

Although not included as positive aspects, some of the negative aspects can be seen as an opportunity to react to or modify the approach of the course. Students who remarked “confusion” related this definition to the complex nature of the issues involved and not to the DfS class content in particular. Students who remarked “skepticism” meant it as a constructive way of thinking, one of the students after chose “skepticism” added: “*in a good way though!*”, which can be understood as *there are lots of problems to solve, but we are here to work them out.*



Level of acceptance of deliverables,
methods and content

See more quantitative
graphics in Appendix 10.7



7.3 Summary of outcomes

Positive outcomes

- The interest demonstrated in the issues was a positive factor to engage students to participate and facilitated the recruitment process for this study.
- Students connected the content of DfS pilot course with, among other background experiences, the Design Issues Seminar and the **Open Talks**⁴⁹ delivered as preliminary DfS discussions in the Concepts and Systems class, both at the intermediate level. The seminar and the talks were substantial steps towards building the educational model included in this thesis project.
- All students demonstrated interest in taking a focused DfS course. Among the reasons, they committed on the importance of including these issues and the advantage of having a course that connects theory and discussion with practice.
- The pilot course experience fulfilled students expectations about the the topic of Design for Sustainability.
- Choices made related to authors, ideas, concepts and methods, included in the DfS pilot course, are well-oriented and well received by students.
- Methods and dynamics tested in the DfS pilot class worked well. The portions dedicated to each part of the class and the correlation from the first to the last part worked harmoniously, and motivated students to work intensively. Introducing the issues gradually, in terms of complexity, and making students participate as listeners, thinkers, and players, kept them engaged with the class and topics.
- The lecture content was appropriate and functionally related to the class activities. Common reactions like pessimism, apathy or anger, were diffused by students' perception that if they followed DfS logic, it would drive them to appropriate solutions.
- Exercise B (picking a message) worked very well as a reflective exercise, and leads naturally to the next exercise (sketching)
- Students found exercise C (sketching from statements) a core part of the DfS class, which allowed them to apply theories and discussions to project-based work. In a future DfS class, every issue approached from theory would be worth trying it in practice through studio projects.
- Based on this DfS pilot class, most of the students tested suggested that a future DfS courses would modify their perceptions and assumptions about

49. See details on chapter 5.2 *Understanding the teaching environment*

meaningful principles (from sustainability concepts to the understanding of design) in a holistic manner.

- Compared with other design courses taken, students believe that this DfS course would fulfill the expectations, as any other studio-based course would.
- As it was suggested in this study and confirmed by students' opinions, intermediate level is the appropriate time to develop a DfS class, however it could be introduced at lower levels and extended to higher levels, depending on how integrated a DfS curriculum could be with other courses of the design program.
- About the length of a DfS course, two conclusions can be taken from students' opinion:
 - One term (3 month) is enough for a DfS course at intermediate level
 - Two or more terms would be appropriate to extend a DfS course into junior and/or senior levels
- Most of the students defined the DfS pilot class experience in positive terms. Negative reactions or perceptions were minimal or absent.

Negative outcomes

- Most of the students recognized some DfS key authors, however they showed a lack of knowledge about more recent DfS literature and interdisciplinary reading.
- A significant proportion of students could not evaluate the appropriateness of the information delivered to help them develop the work in class, because they had insufficient background to make such a comparison.
- Extending images included in the presentations, with more visual information and more visual examples would help the comprehension of the texts, and would help integrate theory with practice.
- Exercise A (associations), would need more class time, which would provide more interaction, would reward students' participation, and would enrich the experience and results.
- Early levels of a design course (design fundamentals) are not appropriate for introducing DfS curriculum yet, as it is developed in this thesis project. The reasons are connected with the lack of design background on basic design knowledge in new design students. Far from totally excluding DfS at these levels, the DfS issues should be introduced along with the design learning process.

7.4 Unexpected outcomes

The most unexpected outcomes were those related to the quality of design ideas and products of students' work. Students considered that in DfS, the medium is the message, and as a result they cross boundaries in terms of materials, processes and innovation. They also took a holistic approach by considering all the factors involved in their design solutions. Innovative design ideas support the links between DfS theory and practice. Projects conducted in this way could create a DfS "lab-like" environment for experimentation that might yield better designed solutions.

7.5 Recommendations for future DfS courses

General considerations

- Based on testing results the curriculum can be focused at the intermediate level, given in one or two 3 month terms, but also can be implemented from junior to senior levels of more than two terms. Later, a coordinated plan that adapts the content for the three different years of study could be implemented.
- It is possible and recommended to create a network with other institutions teaching DfS, as a part of the duties shared by students and instructors, and oriented toward sharing information with design departments.
- Field trips and outdoor experiences are strongly recommended as a part of the DfS curriculum activities. Recognizing the natural systems that surround us is not only inspirational, but it can also provide simple answers to complex questions. It is much better seeing nature in action and imagine how to use it for designing than recalling what we learned from school, read from books or watched in TV.
- It is important to consider suggesting pre-readings as a condition to take DfS courses. As mentioned in Chapter 6.1, being familiar with key authors and their approaches to design and sustainability, allowed students to be better prepared and to use the course time wisely.
- In a future DfS class, every issue approached from theory would be worth trying it in practice through studio projects. All the theories and discussions should be transformed in to actions: researching, brainstorming, sketching and producing proposals, in other words fulfill a design process. DfS courses must be studio and project-based classes. This strategy helps to minimize negative reactions such as apathy, pessimism, frustration, etc., when students cannot foresee their work applied as real solutions.

Considerations concerning DfS methods and tools tested in this study

- Presentations should include a number of visual representations: images and diagrams in proportion to the text. This helps students to go through the issues more comfortably, since they are mostly visually-oriented learners. This conclusion is supported by students' opinions expressed during the testing session and by their reactions, but also by observing their reactions to the material delivered at the presentation; based on how they made connections between what they saw, heard and read, and how they made decisions along the design (sketching) process.
- Interactive presentations must be taken as longer thinking processes. A big part of a class or a series of classes must be considered for implementing this type of methods.
- Sketching from concepts given is a long process with different stages but still the resulting proposals cannot be taken as final proposals, rather as preliminary steps toward final solutions.
- Exploration of innovative solutions should be the aim of a DfS course. This would involve close contact and teamwork with Industrial Design in the generative phases and in the proposal phase of a project. Industrial designers would need to redirect their designs to necessary objects, visual communication designers would need to look for alternative media in applying visual messages. This would be just the beginning of a promising combination of skill sets.

8. Conclusions and Further Research

“Human ignorance is not an entirely solvable problem; it is, rather, an inescapable part of the human condition”

– David Orr

While Edward De Bono encourages us to approach thinking as, rather than a natural human ability, a skill that can be taught, learned and improved with appropriate exercises and habits (see Chapter 1), humanity is obstinate in learning what nature did not include in our “original genetic package”.

50. Inspired by Alberto Manguel's words in 2007
CBC Massey Lectures Series.

In our current society human stupidity is acquired through years of persistence until we become adults. When born and childhood, we are yet the most gifted, intelligent and capable species on earth.⁵⁰ Somehow we unlearn and become unintelligent in the following years. Proof of this is that more information and accumulation of knowledge does not necessarily lead to wisdom, and that maximum is not necessarily better than optimum.

Environmental studies vs. Design vs. Design for Sustainability



What issues these disciplines are focused on

	Environmental	Design	DfS
process	1	5	5
effectiveness	2	5	5
long term	5	1	5
efficiency	3	5	5
project-based	2	5	5
economic	2	5	5
holistic	4	2	5
social	4	4	5

Neither, stupidity nor thinking skills come naturally.

Education has a meaningful role to play in this contradictory situation: concerned with learning and unlearning (a polite way of referring to the justification of negligence and denial). Education can lead us to enlighten and re-humanize our values and bring us ecological literacy or, conversely, it can drive us to dehumanize our systems, show a lack of true intelligence focusing only on utilitarian values. Unwished for results, the consequence of misunderstanding real costs, or ill-formulated problems can create more problems. In other words, education must help to clarify where the true values are, and not to support and promote systems that kill diversity and the complex balance that sustains life and beauty; for example, the number of graduates from engineering oriented to *alternative* sources of energy (like wind-power, geothermal or sunlight) should surpass the number of graduates oriented to fossil fuels industry.

In the context of planning a sustainable future, design is in a privileged position. This is an unprecedented opportunity for leading change, and powerful design skills can allow us to take action.

The first step, design education, comes before the second, design practice. This thesis project was an investigation in to whether a focused curriculum dedicated to *Design for Sustainability* could be implemented effectively at undergraduate level.

The results of this study support the hypothesis that through design education, design and sustainability can be connected and, as a result, future designers can play a more meaningful role in working towards sustainable futures.

8.1 Research questions formulated in the study and answers intended by the DfS curriculum

The first research question: “*How can design, and designers, play a more meaningful future role in connecting design and sustainability*”, and the subsequent questions derived from it, were addressed through research strategies and by incorporating the idea of a focused DfS curriculum, in order to address the questions formulated.

-What knowledge do designers need to address the issues involved in Design for Sustainability?

Designers need a broad selection of content, based on the core issues of sustainability—social, environmental and economic aspects—and the redefinition of the role of design. But this is just the basis for building a broader understanding which can be acquired by practicing DfS. The DfS curriculum introduced by this project is oriented toward this broad selection of content as a first step towards DfS literacy.

-Can future designers be trained for a responsible design practice with long-term effects? How?

The answer is yes, as long as this preparation starts early enough during design education, and as long as this preparation includes a shift in design thinking, facilitates

the comprehension of core concepts, and encourages the implementation of DfS values and principles. The concepts introduced in this thesis project, and developed as a part of the DfS curriculum, approach and promotes responsible design practice and long-term design thinking.

-How early can future designers approach these issues from a design perspective?

It is true that the earlier the notion of sustainable design is introduced the better it is for students to consolidate their knowledge. It is also true that a minimum level of design literacy is required prior to working with DfS concepts. For this reasons a DfS curriculum is recommended for intermediate level (third year of design studies) or from junior (second year) to senior (last year).

-Are the actual design programs adding these issues at an appropriate rate and depth?

As demonstrated in this thesis research, DfS is not widely understood, approached, planned and implemented currently at most design programs or is not being done as quickly as the circumstances require. Ideally, a design program should include DfS as core content as soon as possible, following the design principles of being active rather than reactive. The first concerns about sustainable design were raised three decades ago, and the need to act is becoming more and more urgent.

-What approaches and tools are successful in learning DfS?

Ideas tested in this study showed that less conventional and more dynamic methods result in more engagement from students. For example, using slides combined with a whiteboard in a dynamic exercise open to the class, or sketching from statements and quotations.

Comparing keywords and concepts, in order to understand the DfS approach, is a successful method applied in this class. It helped to immerse students in a design environment of critical thinking. The inclusion of visualizations and images reinforced the critical approach to these concepts.

In a DfS class, the medium is the message. Exploring new media and materials is a main point in DfS solutions. Is about rethinking the current systems rather than adapting solutions to them. This innovative attitude was demonstrated by the nature of students' proposals in the testing.

The path from analyzing the issues to working on proposals is a relief. Making the theory applicable and the discussions materially experienced succeed in keeping students motivated and inspired. A studio-based or project-based DfS class demands conviction, consistency and energy to keep it in a positive loop.

8.2 Thesis research experience

For the last 18 months this Masters thesis research experience has consisted of an immersion into issues concerning sustainability and design, and an exploration of the

through the potential of design education to connect both areas. It has been also, and in particular, an enjoyable learning experience for multiple reasons. The following is a list of “what has been learned”. What is not possible to list or describe in words, is the many ways in which authorities, colleagues, educators and students from UofA have participated and supported this work, and the inspiring environment in which this thesis was developed.

This Master’s thesis project allowed the researcher to:

- get a better sense of how design can evolve towards a more integrated discipline in the future
- understand how close design practitioners, design educators and design students, are in sharing the responsibility of shaping the future of design discipline
- introduce new methods of research and learning, and organizational skills applicable beyond any degree and beyond design practice
- access to necessary knowledge for producing scholar materials
- incorporate new concepts and vocabulary
- connect the field of design with other fields (anthropology, education, sciences, engineering, etc.) by sharing the process and outcomes of this thesis project with other scholars and professionals from those fields
- expand professional practice towards design education practice
- understand cultural differences and coincidences between different design programs in different parts of the world, in approaching a global issue like DfS
- renourish the idea of design for the good causes
- discover and re-discover important authors in design and other fields related to sustainability, and learn old and new theories
- interconnect different aspects of design converging in a focused goal (DfS)
- have a holistic approach to design, connected to all human concerns
- learn what needs to be taught in DfS

51. According to Robert L. Peters, former president of the International Council of Graphic Design Associations (Icograda), in 2003, and only in Graphic Design, there were 1.1 million practitioners worldwide.

8.3 The contribution of this thesis project

The development of the DfS curriculum and the supporting research included in this Master’s thesis project incorporates a consistent approach to sustainable design education at the undergraduate level.

Methods and teaching tools included in this work can contribute to the process of incorporating DfS issues faster, more efficiently and effectively. The issues approached in the research content and summarized in the draft curriculum allowed the building of a starting point to help introduce DfS in to design curricula at early stages. This material works as a collection of concepts that can be considered as basic DfS literacy.

The nature of the issues addressed by this thesis project demands further research and studies to help and inspire other initiatives for the teaching of DfS to future designers. More research and developmental tools, methods and strategies for teaching and practicing DfS are needed urgently. It is not an individual challenge, rather it is a goal for the international design community⁵¹ working for 7 billion people globally. This responsibility is being understood and increasingly assumed in design programs worldwide. Every initiative involving design education and sustainable design is a step

forward. Individually, none of them can be realistically measured today, but collectively and projected over time, this evolution will be appreciated by future generations of designers. This Master's thesis project, and its first result in the form of a draft curriculum, is one of these steps. Success in the short term depends on how effective the process of incorporating the curriculum content in current design programs is, and how accessible, understandable and welcome this material is by other design educators. In the mid and long term, any mimic, replica or any other DfS initiative inspired in, connected with or engaged by this thesis project will be a proof of success.

8.4 Further research and future DfS class

The next steps are related to further and more detailed pilot sessions, in order to refine details and adjust methods and tools, before moving to implementation stages. In the process, a planning stage is necessary in order to introduce the curriculum in current design programs gradually. Every design program will require its own adjustments to the DfS curriculum. Design programs have to be developed locally although with a global vision. This DfS curriculum was conceived with a broad vision but tested and contextualized in a specific design program running at the University of Alberta.

Further research and implementation of DfS tools, methods and content included in the curriculum can lead to the development of more complex curricula. The more areas of a design program are involved –Visual Communication Design, Industrial Design, Architecture, Fashion Design, etc.– the more complex the DfS curriculum can be, integrating all the fields with the same background concepts.

To implement the DfS curriculum, it is necessary to continue testing the creation of new teaching material and introducing the most suitable material to current design programs. The most immediate way is by including DfS class elements –like the included in this Master's thesis project– to current curricula. It would be a scattered version of a focused course, but still would help to incorporate DfS more effectively than waiting for a future DfS focused course implementation.

The urgency of the issues connecting design and sustainability will make evident the integration of both fields in the near future. Sustainable design will not be seen any longer as a complementary content or a “green version” of current approaches to design, but it will take the place of core issues to design. Just as “new” digital media (especially webdesign) is no longer seen as “new”. Sustainable design will become mainstream.

Two decades ago the digital revolution changed the toolsets of design, but not the values –ethical, moral, social responsibility. Today sustainability needs will change the way of thinking about design. Design students, as well as people in general, are noticing the changes and the new paradigms that are emerging. Creating a DfS course is a matter of anticipating the course of future needs. Anticipating and planning are matters for design. DfS is about planning for hope.

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