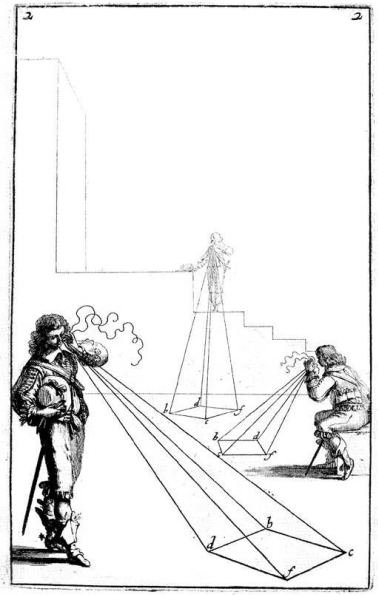
Børre Ludvigsen

Notes on the Nature of Design



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Cover illustration: Abraham Bosse (1602-1676) Plate 2 from *Manière universelle ... pour pratiquer la perspective, 1647.'*

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Every art and every inquiry, and similarly every action and pursuit, is thought to aim at some good; and for this reason the good has rightly been declared to be that at which all things aim.

Nicomachean Ethics
Aristotle

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Preface

These notes have been specially compiled for the course "Design of Digital Environmants" given to masters degree students at Østfold Univerity College in the autmn of 2006. They are parts of a book being written on the design of disigtal environments which was started during a sabbatical at the University of Chicago 2004 - 2005.

Not all parts of these notes are complete, nor are all proof-read. They are provided for the convenience of the students so that they may easier follow the lectures and participate in discussion.

Of the friends that need to be thanked for help, guidance and inspiration are Tor Gunnar Syvertsen for pointers to good sources, John Woods and Martin Stokes, my hosts at the Center for Middle Eastern Studies at the University of Chicago, Toufoul Abou-Hodeib for good discussion, criticism and support and Audun Vaaler for reading and pointing me to LaTeXand Helmut Kopka's *Guide to LaTeX* [23].

These notes do not pretend to teach how to design. They rather try to answer the question of why and how things come to be designed. The primary audience of these essays is meant to be the student who aspires to create a digital environment of some sort. The thoughts that follow will hopefully help the student in her awareness of the investigation, discourse and activity that is in-

volved in organizing the resources necessary to suggest a solution to whatever question the design problem seeks answered.

Note: When using the linked URLs in the PDF version of this book, a spurious space character is added to the end of the URL. This prevents the browser from finding the correct page. The work-around is to remove the space (which looks like this: % 00) and then reload the link.

Introduction

Quite often the common understanding of design is limited to that process which leads to the shaping of visual objects of utility or communication. In reality design as a concept covers so infinitely more. It is an academic discipline in its own right, has a history in both physical manifestations of made things and in theoretic inquiry. On the other hand, design is a matter of everyday practice on the part of all those who organize and order systems and objects of common utility, thought and amusement that surround us. This collection of essays will attempt to address the area that lies between the two worlds of inquiry and making. That transition of thought when inquiry becomes invention and description of that which is to be made and especially as it relates to making environments for conveying information digitally.

This book consists of three parts. The first is a discussion on the nature of design as a concept and field of study. It explores what design is, how we conceive of it and how it manifests itself in the plethora of human thought. It also discusses design as an activity that goes beyond its manifestation as thought in writing as it is applied to the making of things, organizations and systems. The second part explores design as it applies in particular to digital environments - those systems and organizations that collect, store, process and convey information and knowledge by digital means. The final part illustrates a series of cases where design

has been applied to digital environments that primarily convey information and knowledge of a cultural nature as both passive repositories and real-time broadcasts .

These essays are an inquiry into the nature of design as it might be construed to relate to the planning and construction of digital environments seen both from the perspective of the commonly understood underpinnings of a western perception of the field as it is discussed, but also from a global empirical view using physical and written evidence as sources.

What is it that determines "good" and "bad" design? What in fact is design? One definition might be that design *is the assembly of resources, be they objects or thoughts, artificial or natural, into an order (and by implication, disorder) that fulfills a function or need of an animate or inanimate system*.

Such a definition, however, only covers the activity of designing something. Design as subject covers a much wider field of thought. In observing our surroundings one might easily come to the conclusion that design is the process by which theory is applied and implemented in practice. In as much as no part of our environments, barring the most distant and inaccessible places, is untouched by the activities of humanity, all such surroundings as orderings of objects of nature and otherwise, take their form and character by design incidentally implied or consciously applied.

Thus design becomes a nature of thought, the subject of discourse as a matter in itself, to be kneaded through rhetoric, and humanism, occupying as it does the complex transitory world between the forces of the social sciences, arts and technology and those of production, capital and consumerism.

As an activity, design is concerned with the inception and planning of the making objects or systems, and as such is practiced in many ways spanning from the incidental and evolutionary, to the consciously contrived. Some designs are successfully executed

intuitively or on the basis of experience, others strictly adhering to published methods. Thus the conflict between design theory, methodologies and design as an everyday practice emerges as another of the many paradoxes that holds design as a discipline, poised in that evanescent place between thought and making.

In a world of global communications and markets, the ethical issues involved in making systems and products are increasingly the subject of international regulation. The value of those objects and systems are also discussed both in terms of environmental sustainability and social viability. Increasingly attention is being paid to the attempts at monopolization of information systems, software development and accessibility to data formats as carriers of content.

This books is largely concerned with how digital systems are designed and how design as a field of study impends on the way in which systems for handling digital content are created. Designed objects are discussed only to the extent that they may be conceived as components of more complex systems or used as analogies to explain concepts.

DESIGN:
On the nature of design

Our understanding of design traditionally builds on interpretations of the history of the nature of inquiry as expressed as "forethought" based on knowledge adapted to the "making" of things. These interpretations spring out of the way surviving writings are read and what writings have actually survived.

It appears that the writings take precedence over the physical evidence presented by objects, systems and historical evidence. Many things, especially objects for everyday use, our traditional tools for living, have assumed their shape and form through evolution. Surprisingly though, similar objects for identical tasks can differ widely in shape, form and usage from place to place.

Occasionally, the influence of a single, anonymous designer will shape a thing leaving that form to live on and take root as the single, authoritative version of the object. Cultural associations of language, material, technology, history, even nationalism will remain attached to the object as it migrates through time and place often spreading to other societies than its own and also there finding great success, while still retaining its original qualities.

It is the way in which the character of the subject matter of a design is reflected in the form of a thing that determines its success as a functional object (or system for that matter). The paradoxi-

cal juxtaposition of domestic usefulness and facility of slaughter in the shape of a simple kitchen knife. The irreconcilable in that social mobility and ecological un-sustainability of the 20^{th} century automobile. The iniquity of national government purportedly designed to serve **all** its citizens, while in fact answering to the needs of the most powerful elite that by virtue of their fortune are least in need of institutional protection. Those paradoxes in many ways represent all that is difficult in design, the transformation of thought to thing.

Design in general extents to a series of social activities concerned with planning the future. It spans from the study of design as a social phenomenon, its history, design as an applied art, the activity of designing, and finally the practice of design for economic sustenance.

Figure 0.1: Japanese fish knife.

1 Design and making

Design is not so much about how things are, as about how they can be. It is the assembly of knowledge and other resources into an order (or disorder) that fulfills a function or need of an animate or inanimate system, organized in a manner that best appears to satisfy contemporary or future social, political and technological constraints and demands. Thus by implication, designs embody the ethical and aesthetic concerns of their time.

1.1 What Design is.

Let us suppose for a moment, that the above set of definitions are viable in discussing the essentials of the subject. How does it break down into its separate parts? What is this process that takes an idea from thought to reality, anticipating needs and aspirations.

The Ugly and the Beautiful

Before discussing the various modes and components of design, it might be expedient to address the matter of beauty and ugliness,

as it is a question that will constantly rear its head. What is it that makes some things seem beautiful to all, while other things evoke both admiration and disgust, and what is it that makes us all agree that particular things are exclusively ugly?

Figure 1.1: PH-5 lamp (1958) by Paul Henningsen (1894-1967).

Our need to organize the complexities in our lives forces us to utilize elements of mathematics and geometry to form patterns that afford us the necessary overview and control to maintain personal stability and security. Thus manifestations of symmetry, grouping, patterns that we associate with feelings and sensations of pleasure and control are those that in their purest instances are considered beautiful. For instance in Paul Henningsen's lamp PH-5, symmetry, balance, lightness, the ingenious way in which the glare from the light bulb is hidden, all contribute to form an object of singular beauty that belongs uniquely to our time. (Fig. 1.1)

Much of the object in design itself is expressed in the success of Henningsen's lamps and similar objects. The application of visual forms and patterns that underscore out ability to form and control forces of nature or our own making. Beauty emerges when such endeavors are seen to be solely benign, for the common good and to personal advantage or pleasure. It is when those characteristics are in some way compromised, that our perceptions of beauty become compromised.

National flags are objects designed specifically to evoke positive patriotic associations and feelings, specially in with citizens of the country represented.

Figure 1.2: Norwegian *flaggborg* (Lillehammer 1994).

At the 1994 Winter Olympic Games at Lillehammer in Norway, the Norwegian flag was everywhere. Norway as an independent nation is a mere 100 years old. The feelings of nationalism associated with its campaign for independence from Sweden fought in the 18^{th} century, were reinforced by the patriotism fostered by occupation during the second world war. The flag is widely used, especially in parades that celebrate independence day (May 17.) centered around the public school system, and completely devoid

of any military demonstrations whatsoever.[1] After 500 years of first Danish, then Swedish occupation, the flag became an important icon in the demonstration of identity and national viability on the world stage where recent financial success from the petroleum industry has replaced the world dominance of shipping in the middle of the 1900s. The opportunity of celebrating that identity and success in competition with other nations was welcome in the form of the Olympic Games that came in the wake of the successful design and building of a new national airport just a few years before. Both occasions were ideal instances where nation and state are able to exert their power on behalf of capital in seemingly non-intrusive areas where non-military technology, pseudo-ideal sports are marketed as benign ethics and design. In the hands of the Norwegian audience to competitions in sports the country as a whole perceives as particularly Nordic, the flag became a commonly available symbol of identity, support, and *supermacy* in the face of much larger and stronger nations.[2]

Many were therefore filled with surprise and no little dismay when they were confronted with the quite different reactions of many continental Europeans who did not quite see the vast seas[3] of red, white and blue flags, especially in the cross-country and ski jump arenas as the friendly celebration it was conceived as by both public and media in Norway. Not even when the waving was aimed at particularly popular winners or losers from other, competing nations. (Fig. 1.2)

That the flag's color and form was seen as reminiscent of the symbolism of fascist public rallies of the 1930's in Central Europe came as somewhat of a shock. Even though those criticisms may have

[1] The public school system in Norway educates the overwhelming majority of the population, with even a large number of privately run institutions of learning at all levels receiving substantial public funding.

[2] Norway finished second overall after the Russian Federation in the Lillehammer Games, that were declared "extremely well organized" by the IOC.

[3] In Norwegian, a large assemblage of flags is called a *flaggborg*, literally "flag fort".

been unfair in some ways, the more chauvinistic aspects of the use of the flag became clear to point where those enthusiastic celebration of the games are remembered not without some embarrassment ten years later.

And so an object which in its design is purposely meant to carry with it the political sentiments of a national elite becomes a thing of powerful or dubious beauty strongly dependent on its perceived context.

In the context of design being a way of using shape and form to create associations with feelings of security and control, it should not be difficult to find man-made things that are uncompromisingly ugly. As little designers we are confronted by the sense of helplessness the infuses us when we first attempt to shape letters and words in communicating with others, over which we have neither control nor which instill much confidence. It is no wonder that handwriting has traditionally been used as a means of judging a person's character. It is only the knowledge that it might be the work of an innocent child that allows us to accept the ugliness in bad penman-ship.

Some do find a particular beauty in ugliness that is tied to their particular, personal association with the thing. (Such as the make-up artist, plastic surgeon and of course, the mother of the child, no matter how ugly it is.) Even the readers of monster comic books will concede that no matter how "lovable", their favorite monsters are **ugly**.

A thing is ugly simply because it instills fear and revulsion, making us feel insecure and out of control.

In his disarmingly modest *En Bok om Stygt og Pent*[4] from 1953, the Norwegian architect Odd Brochmann guides the reader through "the form of objects, character and content and the impression they make on us". His main thesis for the common understanding of what pleases and what does not is that *We all live in a society*

[4]Literally: "A book about ugly and beautiful" [9]

Figure 1.3: An ugly monster ©2005 Marvel Characters, Inc

built on the common feelings of cooperation and fellowship. Although his discussion of aesthetics is set in the post-functionalist of post-war Scandinavia, the themes which are used to define what we perceive as beautiful are themselves familiar from basic design literature:

Utility, efficiency and experience The idea that most common utilitarian objects are created simply to fulfill their function in the most efficient manner and that the development of that form is based on the efficiency of the previous to attain greater efficiency, by experience. The ability to understand the function of a thing

becomes a prerequisite for judging its aesthetic value or beauty. Our experience of materials' and basic constructions' characteristics is what enables us to judge whether a structure is over- or under-dimensioned. In other words, what its chances of collapse are, or to what it extent it might be unnecessarily costly. Orderliness and human scale are factors that determine how comfortable or secure we feel about something. Whether in the placement of objects in an environment are haphazard and dysfunctional or their apparent disorder is a consequence of geographic and social factors affects our aesthetic perception of the place. How the scale of a thing or an environment affects our understanding of it function and thereby our aesthetic perception of it.

The discussion of shape as a function of geometry and other abstract values such as softness, direction, weight has its correlations in more abstracts arts such as music and literature, but it is in visual design that it's impact is most apparent to the untrained. Basic geometric shapes and forms such as the square, circle, equilateral triangle, and the platonic solids are fundamental building blocks both in graphic design and structural engineering design. The idea that something visual (or musical for that matter) might be "light", "heavy", "smooth" or "rough" is quite abstract but directly related to things like surface texture, color and the nature of the matter from which the thing is made.

Nature as designer has always been an obsession with designers and those concerned with design. The idea that nature, whether of the evolutionary or creationist kind, is somehow infallible in both design and construction is also a theme with Brochmann. There are many aspects of nature, both the way it has developed and the way it acts, which are not all that successful. In fact nature has itself a host of mechanisms that appear to be specially designed to repair or at least limit the damage. One needs only to think of the inherent geological instability of the earth itself. Plate

tectonics and volcanic activity are two sources of major damage to life and the environment. The former producing earthquakes that on a large scale cause considerable damage and no apparent good.[5] The latter is a major contributer to global pollution, with at least at the present, no apparent positive outfall. It is only the regenerative of the environment itself that provide ultimate recovery from such damage. What fascinates and enthralls us with nature's "design" is its inevitability, the inevitability of our own coming and passing, our own lack of control in the long term and in spite of our attempts at changing it's course, the seemingly eternal benevolence in that design. In that perspective, we are continually moved to compare our own endeavors to that of nature, and find our own lacking.

Other aspects of nature's design that give us pause to thought are the way in which it's handling of complexity generates patterns that we find useful. Another is its handling of scale and modularity. Choice of materials and handling of size are developed so that they become just right for the function in hand and its limiting forces. Consider that average size of a human being. Height, weight, reach and a host of other physiological factors have evolved to that state which puts us at the head of the food chain. The same appears to be true for all other organisms whether at the micro or macro level. Size to weight ratios, total surface areas, surface texture, number of limbs and all other factors add up to a creature, near perfectly suited to its home environment.

In the creative arts nature has continually been a source of inspiration. Even at the self proclaimed most rational of times, when nature is clad in the dialectic of science, it remains a source of resources both at the concrete and abstract levels. Modularization in the sense of coordinating dimensions in planning were initially attributed to the divisions and proportions of the human body in

[5] As opposed to forest fires which when naturally occurring, are necessary for the regeneration and longterm survival of the local environment.

classical Greece. (Modular systems have become the basis for industrialization and planning. See page 86 and 118.)

Both classical and neoclassical design take their inspiration from nature, especially in the embellishments. The portion of entablature of the Temple of Jupiter in Baalbak is quite representative Roman classical design at its most megalomaniac and decadent. (See fig. 1.4 on page 18.) This complex single piece of stone depicts a host of motifs both natural and geometric. At the top are the symbols straight from nature in the plants and the lions head gargoyle. Immediately below them are two rhythmic, geometric patterns in the form of the helix and reverse swastika friezes. Beneath them, the stylized truss footings with flowers between and egg-form friezes as edges and running the length of the edge below that again. Finally there is another geometric braided pattern at the bottom.

The use of motifs from nature pervades all forms of design and decorative art through the Renaissance and neoclassical movements into the early 20^{th} century, including the Arts and Crafts movement (also called *Jugend* or *Art Neuveaux*) at the end of the 19^{th}.[6]

It is only with Functionalism in design, taking its inspiration from maturing industrialization - the *Machine Age*, that nature is virtually ignored, both in basic shaping elements and decoration. But it returns quickly in the organic styles of late 1900's, especially in architecture.

While inventors like Leonardo da Vinci studied the flight of birds in attempts to learn about aerodynamics[7], it has been the advent

[6]See William Morris at http://www.morrissociety.org/.

[7]Until the modern application of high-speed photography and later film, such studies gave only indirect evidence, as it is both the shape of wings and their rapid, complicated movements that allow birds their often astounding aeroelastic abilities of flight.

Figure 1.4: Portion of the entablature of the Temple of Jupiter in Baalbak. Photo: Børre Ludvigsen, 2003

of modern bionics[8] that has seen the real application solutions in nature to engineering design. It is especially in electronics and computing that bionics has come to be applied and thereof the term "bi(o)- + (electr)onics".

In the fields of mechanics and aeronautics breakthroughs first came with the data collected afforded by electronically controlled measuring devices such as the strobe flash photography of Harold Edgerton and sound recording. When sound recording first revealed that bats navigate in the dark by emitting and receiving high frequency sound bounced off their surroundings, that bio-

[8]The study of the application of functions in biological systems to the solution of engineering problems.

logical technology became the basis for SONAR[9] where improvements are continually made on the experience gained by research into the ways sea mammals use sound to navigate.

The ways seeds are packed in casings, capsules and pods have been studied for packaging of medicines. The ways seeds are distributed by biomechanics and aerodynamics have also been studied to design solutions in mass reforestation.[10] Recently bionic research has been enlisted to design solutions for various disabilities such has impairments of vision, hearing and movement.

Rhythm, balance and grouping as a means of creating order, especially in visual communication is basic to graphic design. At their very simplest, these terms define the order in which patterns are organized in order to arrange patterns of objects, light or sound in ways that are comprehensible but also deemed to be pleasing or beautiful in some way. All three are evident in the same entablature mentioned above. But these, mainly geometric concepts need not be strictly rigid in form. They can also be use to express frivolity, aimlessness, fluidity, speed, stability and other expressions of varying degrees of sensitivity.

Form influenced by color, character of surface and light It should be realized that all visual design is expressed as the manipulation of light in some way. This is supplemented by the way a surface feels to the touch and how its material makeup and shape affects reflected sound. The perceived character of shapes are influenced by their color in the way that objects of a light color appear larger in size than dark ones which may appear denser in mass. Surface texture can determine how inviting a thing is to the touch while also affecting the way light is reflected, all the way from rough, abrasive surfaces to the highly polished and reflective.

[9] Acronym for "SOund Navigation And Ranging"
[10] [34]

Figure 1.5: Ashish Kapoor's "Cloud Gate" sculture in Chicago's Millenium Park attracts crowds looking at themselves in its curious, polished surface. Photo: Børre Ludvigsen, 2004

The shape of objects is not only a reflection of their function but the sculptural result of how the designer wants the object to handle light, in the way that light reveals the shape and gives it character. The conscious use of light both direct and reflected is a powerful tool in the forming of a thing. The direction in which it falls can be highly expressive as is the light's temperature and hue. In graphic design on flat, 2-dimensional surfaces, the 3-dimensional forming of light is simulated by the rendering of imagery either drawn or photographic.

How we see things and understand them is an aspect of design that is almost totally out of the designers hands. Granted, the stage can be set and environment in which something is used can be predicted, but what preconceptions and experiences the user brings with her can only be guessed. However, how a designer wants a thing to be seen is something that can be manipulated in great detail.

One aspect is that part of our cognitive experience that builds on intuition and experience. The understanding of the structural and

mechanical integrity of a thing is what decides the way it is approached and handled - the perception of whether a structure is stable and constructed in such a way that it will actually remain standing under normal loading conditions and natural strains. Thus, the way in which the designer allows a thing to expose its structure is importance to the confidence of the user. This applies not only to physical objects but also to complex organizations.

However, such cognitive understanding is reliant not only on experience, but knowledge and cultural background. A basis in mathematics and physics from common schooling provides knowledge that influences the way we perceive and understand the world around us and its things. In addition to knowledge acquired by learning, there is the experience gained by play (experimentation), practice and skill. Such skill and knowledge can also be projected into unknown or unfamiliar situations where variations in scale and magnitude or similarity to understand a situation or construction. There are however, often cultural peculiarities where no amount of knowledge or experience will provide the information necessary to understand how a thing functions. It is also often surprising how short a passage of time from one generation to another is necessary for such knowledge to virtually disappear from "common knowledge" or the "general public". This is especially true of technologies or organizational systems.

Figure 1.6: Solar disinfection of drinking water.

An excellent example is the traditional method of disinfecting drinking water that has been used in the Middle East from the early days of glass technology. Clear water from a source that might be contaminated with pathogens is placed in the sun or under

open sky in a clear container for one to four hours, thus becoming potable.[11] Even though the method has been scientifically documented both in the laboratory and field, it is often not believed. While older people in the Middle East familiar with the method from childhood take it for granted, scientists (both from East and West) not familiar with the physics involved, refuse believe that it works, often insisting that the temperature increases involved will have the opposite effect of increasing dangerous contamination.

Our cognitive abilities are particularly useful to designers when attempting to instill confidence in a thing. While lightness, openness, and a sense of flight might be used in characterizing something, it would also be necessary to maintain confidence in the structural integrity of that thing. A sense of confidence that the object remain stable and reasonably free from excessive maintenance and external support to be viable. These are of course, the characteristics that are employed when creating objects of impressive architectural or engineering gracefulness and surprise. Examples are structures such as the thin-shelled parabolic barrel vaults in sun-baked mud bricks of Ramses the Great. Or the thin walls and flying buttresses of the great Gothic cathedrals, modern steel girder constructions such as great trussed cranes or the Eiffel Tower, and early reinforced concrete structures like the Swiss bridges of Robert Maillart.

The cheap and expensive, necessary and luxurious Brochmann's book was aimed at the emerging middle class after the second world war and as such was not overtly modest in imparting advice in directions the architect considered "correct" in the highly homogeneous Scandinavian society of the time.

He juxtaposes the heavily ornate and excessively expensive against the modern, mass produced and "good enough" utilitarian ob-

[11] For further discussion of solar disinfection see page **??**

jects of daily utility.[12]

In discussing the relative merits and intrinsic value of such objects, he builds up his arguments for what is good or bad taste in design. And in so doing identifies the cultural difference between not only national and geographic variations, but also those of class. Making such judgments was somewhat easier in a society that had recently come out of a conflict where the values of a predominantly working middle class were made the basis of the rebuilding of the occupied Nordic countries[13] through prudence and solidarity.

In addition to the dominance of the (social democratic) labor government, luxury and excess were easily associated with the excesses of collaborators who had made their fortunes on war profiteering. Thus the affordable, necessary and "good enough" easily became socially preferable and identified with "good taste".

Convention and style involves surrounding ourselves with things that identify us and our attitudes towards the world around us. Conformity and thinking alike, the fear of the strange and change, identification by being different (but not too different) secures us a place in our immediate group. Although this might be associated with fashion (see page 29), it is of a more permanent character.

Conventions of language, dress, behavior and other characteristics, that are formed and adopted by invention, experimentation, peer pressure and external circumstances determine whether we are accepted or rejected by the society in which we live. The success of our contributions and adjustments to such conventions easily become a measure of the security of our social position.

[12] A great number of which have paradoxically become "designer" products and quite expensive today.

[13] Brochmann's books were far more popular in Denmark than in Sweden or Finland

Tolerance for the different . The dichotomy of interest in change and the need for stability feeds the continual contesting of the *status quo* in exploration for personal and common welfare. The adventure of the modern and avant-garde contrasts with the safety and security of the familiar.

Where there is little risk to life, limb or personal prestige, the different may easily be embraced where the advantages are obvious. The use of contact lenses in contexts where the shape and style of eyeglasses are important identifiers come to mind. The use of glasses are often an impediment to the entry into or advancement in some professions where outdoor eyesight is important. The adoption of contact lenses as alternative sight correction devices when they were introduced went almost unquestioned even in remote and conservative coastal fishing settlements.

In high-risk environments the tolerance for change are lower unless the advantages are obvious and the disadvantages tolerable. In systems such as air traffic control, design for dependability and safety becomes indispensable for the adoption of any change in the existing modes of operation.

The exploration of the different towards adoption and change is seemingly perpetual, driven not only by commercial and financial forces, but also the natural penchant for curiosity and innovation.

While many of these premises for making aesthetic judgments of things are culturally related, it is the idea of sensitivity to form and function that pervades Brochmann's simple guide to finding what we might have in common as ways of agreeing that something might be beautiful or pleasing both in form and in the way it fulfills its purpose. The same idea is that which Buchanan fleetingly touches on, declaring that; *The problem is how to accommodate sensitivity to expression with the intellectual and analytical issues be-*

longing to communication, construction, strategic planning, and systemic integration.[14]

Our common understandings of what is beautiful and what is not are acquired by learning. But is it true that we conceive of nature's forms as esthetically pleasing only because we are taught so? Children see many natural form as ugly or frightening as was also common in folk traditions of only a century ago.

It was the age of romanticism, widely understood as beginning with the writings of Rousseau, that built an intellectual understanding that all nature's designs should be conceived of as beautiful. Additionally, modern recreational activities have conspired to dictated that all that has to do with nature is beautiful because it is somehow healthier both for mind and body.

The paradox of course is that the cynicism of greed and gain quickly step into the fray and adopt "beauty" as a characteristic of both prestige and the display of wealth. Dictates of what is nice and what is not quickly become permutation on the production of admired artists, of rareness, and not least, price. One need only look to the daily media to find esthetic quality commonly equated with profit margins or turnover.

In an age that somehow manages to live in the delusion that romanticism is absent from serious thought, attempting to bring aesthetics to the personal (where it inevitably belongs) is that which most strongly distances design from the natural sciences. In those sciences, where things are discovered, not invented, beauty and ugliness are left for other forces to make.

Thus it is that cultural differences very quickly become arbiters of what is beautiful and what is ugly. While certain objects and forms have an almost universal appeal, the well-formed source of light, badly formed letters or the figures of horror stories - which in themselves or their equivelants can be found in any culture, it

[14][10, p.45]

is those things in between that form the quandries, the things that fall prey to age, style, fashion, class and ostentatiousness.

Form

Form is often thought of as the shape an object takes. For any discussion of design as a more comprehensive endeavor, it is necessary to understand the concept of "form" as more comprehensive than the mere physical boundaries of an object. Form also expresses the structure of a thing. Not, having to do with the material of which it is made, but the manner in which the matter of a thing is arranged, that which gives its distinctive character.

Form, therefore, becomes the result of design, irrespective of the complexity or intricacy of the thing being made. The character of the content of something is that which gives it form. The real problem with the concept of form is that it is, in the context of design, so irrevocably tied up with objects, particularly of industrial design. It is when we look into some of the other common meanings of the word that a relationship to more complex organizations and content is found:

- a way of organizing something ("a form of government")
- a class or rank in an organization or society (the "fourth form")
- that which gives shape to something (a mold or "form")
- the physical human condition (being in good "form")
- that assemblage of the elements of a concept made up of thought as opposed to its subject or content.[15]

[15]Common dictionaries list almost a dozen contemporary meanings of the noun *form* and two distinct meanings of the verb. There normally around 100 instances of the word and its derivatives.

While the character of the content of a thing contributes to its form, it is the structure which that content is given that defines the form itself. It therefore becomes difficult to distinguish form from being anything other than the result of design as a consequence of conscious actions taken as the result of some perceived need or experience.

Form follows function[16] has been an icon of common contemporary understanding of design, almost becoming a definition for "beauty" in the forming of objects as design became a modern profession. The designers of the Modern Movement that arose in Europe in the wake of the first industrialized war, World War I, reacted against the embellishment of everything made with the decoration of neo-classicism. Why a thing of iron that had been cast in a form as part of an industrial process for a decidedly functional use such as a bridge should be shaped like the vines on a classical Greek architrave had become difficult to understand when that form had nothing to do with structure, content or function in either the production or use of the thing.

The idea of form being a direct result of the perceived function of a thing was most easily explained by looking at the simplest of implements for manual labor. The rise of the socialist labor movements of the late 19^{th} and early 20^{th} centuries did much to encourage that view, which quickly extended to relatively complex design structures such as architecture. However, the modern movement set about celebrating the triumphs of industrial production in such a manner that function alone, both in the way things were produced and were meant to be used, became the guiding concept in the forming of objects both simple and complex. (See 1.3, page 87)

There are many aspects of that adaptation of human living to the demands of mechanization other than industrial design which are responsible for the dictates of function. In retrospect, it is surpris-

[16]Commonly attributed to the Chicago ("Prairie School") architect Louis Henri Sullivan (1856-1924).

ing how easily designers deferred to "functions" such as return on investment, maximization of profit, maintenance of power structures. All of which were instrumental in distancing the user from participation in the planning of daily life and reducing her to the primary role of paying consumer.

It then becomes much easier to understand why things, including quite complex organizational structures take on quite unexpected forms, some times almost grotesquely distant from what one would quite logically expect them to have.

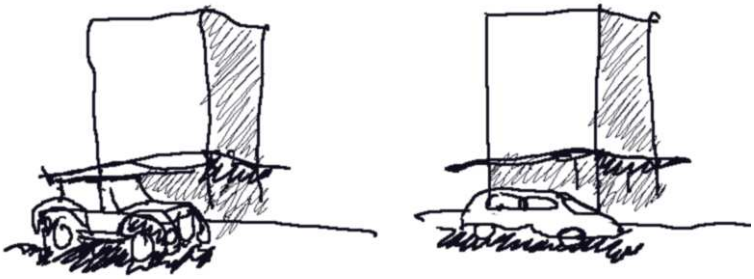

Figure 1.7: 2 cars in front of the same modern building, one old and one new. The building is quite modern in appearance although it is from the 1930's while the car of that time appears quite aged.

Even when "efficiency" and "modern development" is taken into account, it becomes quite difficult to understand the rate at which the design of such artifacts as automobiles changes unless other factors than design for the functionality of the object itself as a tool made purely as a social and commercial tool of transportation is taken into account. Especially when one takes into consideration that fuel efficiency as a function of weight has remained unchanged over the past 2 - 3 decades, or that the visual appearance of heavy duty trucks on US highways has changed very little over

a similar period of time. The question becomes even more paradoxical when visual form of the average private car is contrasted with the average modern building or house.

The proliferation of meanings of "form" all denoting some sort of perceived structure, physical or abstract, attests to the importance of form in our understanding of how things are ordered and assembled. Representation of planned form is the most common way designs are expressed. Form taking other forms. (See 3.6, 112.)

Style and fashion

It is curious that in most of the books on design cited here, there is little or no mention of style or fashion. For while discourse on design from an academic point of view might find the notions to be somehow undignified, those approaching such thought from other fields might wonder why they are not valid subjects.

Style is a particularly identifiable form of a thing that has been shaped by various circumstances and predilections such as technology, environment, context, and other design criteria. However, style first becomes discernible when a group of things display such uniquely distinguishable characteristics and the instances in the group can be related by their character of style.

In that context, style becomes a property that may be attributed to a certain time, but which can be changed only through physical modification of the form of the thing. A disparate list of examples could include the *Scandinavian Design* style of furnishing typical of the 1940's through 60's, an *American* style of government characterized by a tripartite division and balance of power between the executive, legislative and judicial branches, or the *NeXTStep* style of graphic user interface.

Each of the examples above are uniquely recognizable as soon as the typical forms of their styles are known. Poul Henningsen's

PH-5 lamp (Fig. 1.1 on page 10) is a good example of the *Scandinavian Design* tradition as is Bruno Mathsson's chair *Eva* (Fig. 1.8).

Figure 1.8: Bruno Mathsson's chair *Eva* from 1941 on the basis of a design of 1933. © Bruno Mathsson International. (From `http://www.bruno-mathsson-int.com/`)

The *American* style of government as originally conceived in the single document constitution of 1787 was developed in the revolutionary climate of ties between the United States and France with wide aspirations of government *for* and *by* the *people*. While the extent of its success as a means of guaranteeing popular, democratic participation in governance is a continuing subject of debate, it quickly became a style of government copied and adapted by nations around the world.

For those familiar with the various flavors of window managers offered by the three main operating systems available for personal computers today[17], *NeXTStep* will be recognized as a particular visual style of graphic user interface for UNIX/Linux operating systems. Originally designed for the *NeXT* machine in 1985, it evolved into the *OS X* interface for the Apple Macintosh first commercially released as *Cheetah/Puma* in 2001. Its third incarnation are the various window managers for Linux such as GNUStep and LinuxSTEP.

Figures 1.9 and 1.10 show the development of the *NeXT* windowing style. While the first two, NeXT and GNUStep are quite similar, Rhapsody retains much of the traditional Mac OS style even though it was one of the first steps on the way to the present day OS X which is definitely in the *NeXT* style.

[17] MicroSoft Windows OS, Apple OS X, and UNIX/Linux

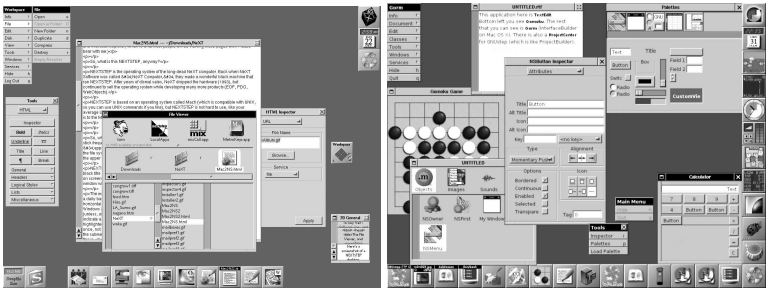

Figure 1.9: Screen dumps from the NeXT and GNUStep window managers. ([31] and [18])

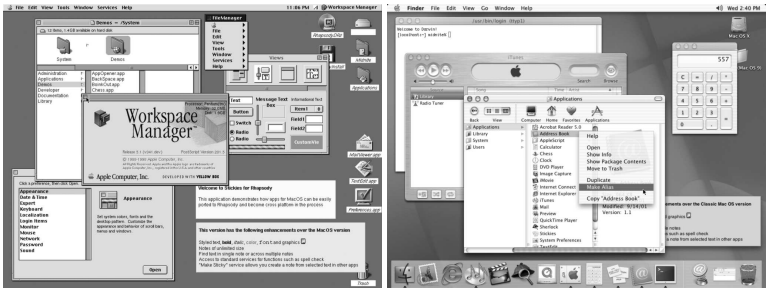

Figure 1.10: The window managers from Rhapsody and OS X 10.1 ([41])

In the *NeXT* interface style, it is the details of the windows and their embellishments that immediately distinguishes it from other GUI's such as the X11 Motif window manager. On a macro level, however, there are aspects of the style that have become cultural prerequisites for the user's understand of the workings of an operating system with a graphic window manager.

While the basic form of say, the Mac OS window manager has been the same for 20 years, details have changed in so many ways as to render it almost unrecognizable. Some very basic things have been changed or added to, but the fundamental idea of the

desktop remains the same.

Thus, parts of style are dictated by common cultural understanding of how things are done and what they should look like. The "desktop", a "filing system" both of which are very culturally specific concepts, belonging to the "office" tradition.

It then becomes very difficult to compete with other graphic user interfaces unless that common understanding is adhered to as illustrated in the way virtually all graphic user interfaces to operating systems on full-size computers (and quite a number of hand-helds) today use the desktop analogy in their approach to handling files. Although there were several graphic interfaces of the kind in use before the original Apple Macintosh popularized the desktop as we now know it, including their own operating system on the Apple I and II, it was the 1984 Mac OS that set the standard for subsequent imitations on personal computers, such as MicroSoft's Windows and the present group of Linux based GUIs like KDE, Gnome and WindowMaker.

By their nature as developments of an initial design, styles evolve as iterations over time, while fashions are trends of styles marketed as vogue, achieving great popularity lasting relatively short periods of time. While the cynic might accuse marketeers of employing fashion in the maintenance of consumer growth economies, some of the almost spontaneous emergence of trends and fashions that are artifacts of earler consumer economies.

So while styles evolve seemingly in response to individual and public need for adaptation of fuctions as external circumstances demand change, fashion appears to be a manner of elliciting faster responds to change and thus greater variations in style that demand i faster turnover in products of any particbular style. This would increase profits by producing a thing in successive fashions of a style.

Style as a holder of identity with which well defined groups on all levels and in groupings of society can identify in a stable manner

over time. Fashion becomes a short term adventure which nevertheless allows common identification with a group.

The English diarist Samuel Pepys[18] reveals that the aspiring civil servant of was quite observant and interested in the latest fashions in the styles of his time. On his trip to the Netherlands in the service of "his Lord" he mentions twice that it was the fashion among women to paint false beauty spots on their faces, of which he obviously approves. But when his wife pretends to the same prettiness, young Samuel is somewhat conservative in his reaction:

> May 1660 14.: The shore is, as all the country between that and the Hague, all sand. The rest of the company got a coach by themselves; Mr. Creed and I went in the fore part of a coach wherein were two very pretty ladies, very fashionable and with black patches, who very merrily sang all the way and that very well, and were very free to kiss the two blades that were with them.
>
> May 15. 1660: Every body of fashion speaks French or Latin, or both. The women many of them very pretty and in good habits, fashionable and black spots.
>
> August 30. 1660: This the first day that ever I saw my wife wear black patches since we were married!

His earliest remarks on the fashion of the *spots* or *patches* are doubtless colored by the enthusiasms of the traveler. Some years later, the by now rather more experienced Secretary of the Navy, displays a more worldly understanding of how that fashion is employed.

> (December 4. 1667: Thence into the House, and there spied a pretty woman with spots on her face, well clad, who was enquiring for the guard chamber; I followed her, and there she went up, and turned into

[18] [35]

the turning towards the chapel, and I after her, and upon the stairs there met her coming up again, and there kissed her twice, and her business was to enquire for Sir Edward Bishop, one of the serjeants at armes. I believe she was a woman of pleasure, but was shy enough to me, and so I saw her go out afterwards, and I took a hackney coach, and away.

Creativity and design ability

Design as a field of study has traditionally belonged to the design arts, where it is admitted to contribute in a limited fashion, to the fine arts. However, it is mainly applied to objects and assemblages in industrial, systems and interior design. As the by-products of the highly intense period of technical research and innovation that accompanied the wars of the 20^{th} century began to reach consumers, it became necessary to apply a certain measure of aesthetic quality to things and systems that were developed in an environment where machine age utility was deemed sufficient to fulfill military functionality.

In the wake of a couple of centuries of increasingly sophisticated industrialization (both military and civilian) supported by applied science, it became a cultural "truth" that any problem, be it friend or foe, could be resolved by the application of enough money and technology. The zenith of that culture was reached with the moon-landings of the early 1970's, which also accelerated the development of digital technologies in use today. Much of that "space race" was a battle ground of the Cold War. When it became clear that the driving motivation behind space exploration was military, and that science had failed to foresee the enormous environmental consequences of industrial/technological solutions to virtually all problems of mankind, public confidence in the invincibility of the field was seriously compromised.

While developing many of the technological innovations that brought about many of the dramatic changes of the last century such as internal combustion engines, flight, electronic communications, photographic imaging, preventive medicines, nuclear physics and digital computing it became clear to scientists that design as a set of solutions to defined problems was not only the result of rational and logical thinking, but that a good measure of reasoning, intuition and inspiration was necessary.

In the late 1960's a movement was under way to formalize design methods as scientific means of solving all manner of problems. [19] Design was increasingly argued to be part of the sciences, but in order to bring it into the fold, design ability - very loosely, right brain thinking - was left out as not scientific. While the importance of design ability to problem solving in any field was quietly acknowledged it somehow marred the idea that design could itself be a science. By some mysterious (but nevertheless, scientific) process, education, method and experience in various portions applied with sufficient diligence and copiousness would inevitably lead to successful design solutions. Words such as *inspriation* and *innovation* were also brought forth, but only as positive characteristics of a presented design, not prerequisites for good problem solving.

Design as a field has come to be understood as a discipline necessary for problem solving in increasingly complex systems, not only of objects but communication and organizations. Design ability has in turn come to be understood as the ability to employ both ration and logic with reason and intuition in measures of decisive quality. This admission has launched design studies on its quest for inclusion in the humanities where thought and theory would contribute to the understanding and development of the field.

I have purposely left the distinction between design and design studies somewhat unclear here reflecting the difficulties in plac-

[19] See 1.1 page 67 and 3.2 page 106.

ing design as discipline in any one of the sciences, arts or humanities. It is sufficient to note that design ability has received deserved, if grudging attention although it remains formally (*viz. scientifically*) as elusive as ever.

Design ability is not necessarily that which creates a uniquely successful solution to a problem. Often the solution is there, design ability and innovation are necessary only to see the possibility of application. Nor do innovative design solutions to important problems always entail unique answers and highly advanced technology. Just the documentation and application of known processes may be enough.

On making clean drinking water. As previously mentioned, solar disinfection of drinking water is a method of obtained cleansed, potable water that has been known in the Middle East and India since the early times of glass technology. Simply put, exposing clear water that might be contaminated by pathogens to the general background radiation of the sky for a certain period of time kills those pathogens, rendering the water potable. The method was widely used in West Beirut during the Israeli siege of that part of the city in the summer of 1982 when the public water supply was cut off. Many buildings had artesian wells, but often the water was contaminated by seeping sewage from damaged drains. A chronic fuel shortage among the general population precluded boiling water for drinking. While those with traditional knowledge and experience of the method were comfortable using it, those unfamiliar with it were understandably skeptical. Especially many with higher education and some knowledge of physics and biology argued that what they perceived as an increase in temperature of the water would encourage the growth of pathogens rather than the reverse. The successful results in using water disinfected in the sun were discounted as luck or coincidence.

In the face of persistent arguments in a difficult situation, Profes-

sor Aftim Acra and his team at the Faculty of Health Sciences at the University of Beirut decided to put the method under scrutiny. Their purpose was twofold as they were primarily working on the safe administering of oral dehydration solutions. Dehydration as the result of diarrhea, especially in children, is often a vicious circle as the diarrhea is frequently caused by contaminated water and the same water is administered to slake thirst. Their report was published by UNICEF in 1984[20] and promptly forgotten outside a very small community of researchers where it is considered seminal research in the field. However, application of the method as a common means of securing clean drinking water is still in the form of "research" projects, 20 years after publishing. It is also interesting that the method is well known in a more "modern" form where the water is exposed to artificial ultra-violet light in municipal water works and public swimming pools.

The normal household method of solar disinfection is to put tap water that is suspect into clear containers of glass or plastic. (See figure 1.11) The AUB team also tested various containers and found the commonly available plastic water bottles sold commercially and especially those with a blue tint to be the best. At the latitude of Beirut (34°N) exposure of 40 minutes in the sun is sufficient to kill all pathogens and 4 hours under moderate cloud cover. It should be emphasized that only pathogens are destroyed, and that the effect on toxins is unknown. The temperature of the water is not important to the process as the pathogens are destroyed by radiation, not temperature.

The AUB team documented the times taken for pathogens to die in exposure to the sky at various latitudes. It also goes into what happens to the same pathogens when they are shielded from solar radiation.

In conversation with Professor Acra in 1997, we discussed how simple, traditional solutions to common problems could be adapted to modern needs. On of the major problems in administering oral

[20] [5]

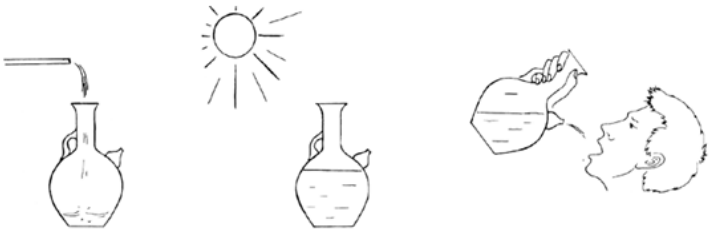

Figure 1.11: Solar disinfection of drinking water. The illustration shows water in a common drinking jug of glass being exposed to the sun. (From [5])

dehydration solutions is measuring up the correct amount of water for each unit of solution powders which usually are obtained in sealed sachets. Not everyone has access to fluid measures with unit markings. One of the usual solutions is to pack the correct amount of powders that need to be added to an empty beer bottle for example.[21] Professor Acra however, felt that a simpler method could be developed along the lines his mother used when she stored boiled eggs in salt water. As he recalled the right amount of salt for preservation was reached when the eggs started floating in the solution. His idea was that an object, maybe in the form of a toy could be added to the powder sachet with instructions to add water while stirring until the object would float, indicating that the correct proportions had been reached.

While the method is not well suited to providing great amounts to large numbers of people at once, simple knowledge of this way of cleaning water would simplify the supply of clean water also during times of catastrophe and greatly reduce disease. One of the main impediments to using the method during emergencies resulting from natural catastrophes often involves supplies of turbid water. Water occluded by suspended particles prevent

[21] The method used in Ghana.

the necessary penetration of light. The next step therefore, is an equally innovative, simple and readily available method for simple filtering of turbid water.

On design ability The perceptions and descriptions of knowledge, skills and traits necessary for the requisite design ability vary both with author and time. In his essay *Discovering Design Ability* Nigel Cross describes design ability as a somewhat romanticized *constructive, intentional intelligence* giving designers the ability to *produce novel, unexpected solutions*. While that may be the case with some, very few and gifted designers, it is certainly not true of the majority of designers' solutions to the majority of design problems. As is natural, the vast body of designs are modest improvements or variations on known solutions and in an ever increasing number of cases, the greatest challenge is coming up with a design which is as similar as possible to an existing product without contravening the intellectual property rights of that product's designer.

In discussing design ability as in the exploration of the nature of design itself, it is the unpredictability of the solution and the indeterminate character of the problem that most characterizes the challenges of design. Cross describes it thus: "Design ability is founded on the resolution of ill-defined problems by adopting a solution-focusing strategy and productive or appositional styles of thinking." and he goes on to summarize the *core features* of design ability as being the abilities to

- resolve ill-defined problems
- adopt solution-focusing strategies
- employ abductive/productive/appositional thinking
- use nonverbal, graphic/spatial modeling media

It is the last point that most poignantly describes the elusive qualities of that intentional intelligence ascribed to designers. "De-

sign ability therefore relies fundamentally on nonverbal media of thought and communication."[22]

In their view of design ability as it pertains to interaction design in information technology Jonas Löwgren and Erik Stolterman offer a set a set of concepts that can be used to frame the abilities need for interaction design[23]:

- *Creating* and *shaping* demands creative and analytical ability.
- *Deciding* demands crticial judgment.
- Working with a *client* demands rationality and ability to communicate.
- Design of *structural qualities* demands knowledge of technology and materials.
- Design of *functional qualities* demands knowledge of technology use.
- Design of *ethical qualities* demands knowledge of relevant values and ideals.
- Design of *aesthetic qualities* demands an ability to appreciate and compose.

Not surprisingly these concepts follow quite closely the areas into which one might group the main ideas with which design itself my be understood.

Not withstanding the notion that designers might be expected to produce innovative, unexpected solutions. It is also expected that those solutions be within the tolerable. Designers must therefore also possess some design abilities that are not exclusively concerned with the unexpected and ill-defined. If their solutions are to be accepted and successfully adopted, certain measures of practical and pragmatic abilities must also be applied. Even though

[22] [14, pp. 105-120]
[23] [27, p.45]

the designer might not be a master of all traits necessary for such success, real design ability should be understood also to cover feasibility analysis, economics, environmental impact and marketing.

Designers work in all manner of environments from large teams with groups and individuals specializing in often quite narrow and focused areas, to designers who are generalists working alone on all aspects of a system or thing from inception to final product. The following is a summary of what must be the knowledge and essential traits that go into an understanding of general design ability for the range of design challenges in bringing a problem to its solution:

- Inception, creativity and analysis
  - Inception and creativity

    The ability to spin multitudes of ideas and to see those that closest match what might be a solution or a way to arrive at a solution.
  - Ideas and forethought

    Projecting ideas into the future and testing them against taboos, experience, feedback, discourse, intuition, logic, etc.

    Reflection, both retrospective and prospective, and qualitative judgment.
  - Fun, irreverence, openness, intuition

    Approaching a problem or testing an idea without preconceived answers, with disregard of taboos, trusting intuition, with openness and humor.
  - Inquiry, rhetoric and discourse

    The ability of exploring and challenging problems and ideas through inquiry, rhetoric and discourse. Being

open to alternatives and willing to rescind quickly when shown wrong.

- Experimentation

  Able to conduct both probing and thorough, controlled experimentation.

- Feedback and experience

  Gather and store user's experience from real situations in such a way that the information can be used by self and others in future designs.

- Feasibility and impact study

  The ability to conduct feasibility and impact studies that clarify the problem and examine whether in fact any solution is viable as a product, economically sound, environmentally sustainable and feasible to design.

- Exhaustive iteration

  To be able to cycle and recycle through the various stages of the design process adjusting results to produce new alternatives as new ideas or variables are parsed.

- Communication

  - Collaboration

    The ability to sustain a design project alone or as part of a team.

    The ability to recognize the need for external consultation and to evaluate and coordinate consulting expertise.

  - Client and user contact

    Able to maintain open relationships of mutual confidence with both users of a system or thing and the

client, bearing in mind that client and user are as often as not one and the same.

Ale to step into and maintain the role of user or client long enough to understand the salient sides of the problem as seen form their point of view.

- Group studies

  The ability to arrange group studies, to gather and use the results of group studies of end users as feedback in the design process.

- Other fields

  The ability to enter, gather knowledge and understand the characteristics and workings of other fields of science and humanity in order to understand problems, pose determining questions and comprehend answers in depth.

- Presentation and representation

  To adequately describe the design at any point in the process to as to be able to develop the design to the next stage and to make effective judgments and decisions.

  To be able to present the design at any stage of its development in such a way that effective feedback my be garnered.

- Structure

  - Grasp methods

    To be able to grasp, understand and use methods to order and structure the resources necessary to solve a problem.

  - Character of content

Sensitivity to and understanding of the character of the content to be structured.

- Organize resources

  The ability to arrange and structure the content of the design for efficient functionality.

- Technological understanding

  Thorough technological understand to explore all possible alternatives of resource management.

- Functionality
  - Technical insight

    Insight and understand of the character and workings of the technical mechanisms necessary to achieve the desired functionality.

  - Technological foresight

    The knowledge of the technology necessary to arrive at a design, implement it and for the design itself to function over a given period of time, avoiding undue obsolescence.

- Ethics
  - Understanding of values and responsibility

    A command of knowledge of the spectrum of commonly understood values past and present.

    A sense and understanding of the designers responsibility with respect to society and environment.

  - Cultural insight and sensitivity

    Insight and sensitivity to the cultural variations that may influence a design and to those in which a design will come to use.

- Aesthetics
  - Observation, sensitivity and composition

    Ability to observe, create and form systems and things with an awareness of the aesthetic norms with which the design is expected to coexist.

  - History

    Knowledge of the history of the design field and of the design of the things beings designed and the environment they occupy.

- Economy and management
  - Price estimates, economic control aid economic outcome

    Abilities of economic management and control to ascertain the viability of a design.

  - Financing and profitability

    Knowledge of finance and commercialization to be able to make reasoned judgments of the economic feasibility of a design.

  - Project management

    The ability to manage and control the design process in order to ensure its effectiveness.

- Marketing
  - Viability

    Knowledge of marketing to understand what efforts are needed to ensure the commercial or economic viability of a design.

  - Promotion and documentation

    The ability to be involved or design the packaging of a thing.

The pedagogical knowledge necessary to author user guides and technical manuals.

As may be expected, the above list of design abilities runs somewhat parallel to the contents of this book. The ability to design must necessarily be knowledge and ability of those concepts and methods of which design is made and with which making is done.

It will also be noted that the list is quite long and demanding. Although it might be desirable, not everyone who concerns themselves with design will be in possession of all these traits. Important as they may be, it is equally important that the designer be aware of whatever abilities may be lacking and to have sufficient knowledge of that aspect to call on the help and advice of a colleague. While this may sound like a homily, one has only to look at the numerous designs of quite superior solutions over time that have been rejected or ignored for reasons mostly related to the designer's unwillingness to admit inability in one or more of the practical abilities listed above.

Many of the points may seem scantily described or subordinate in importance. Virtually all the subjects that these skills, traits and abilities embody are described in greater depth elsewhere in this book. Above all, it is a common preconception that designers spend most of their time at the exalted endeavor of creating drawings, models or mock-ups of beautiful things. Nothing could be further from the truth. In order that an idea be brought to fruition, the greater part of a designers efforts are expended on all but the aesthetics of making a solution work.

On creativity and preconception In one way or another designers are employed to come to solve problems in the form of needs because they are expected to arrive at unexpected, creative or innovative solutions. Not because the required solution is meant to be different from the expected, but simply because the solution is unknown. As mentioned before, it is this indeterminacy that most characterizes design.

Creative thinking as a means of generating alternate proposals is probably the most elusive trait or ability. Although there is no doubt that talent is a natural trait it needs stimulation to survive and grow, while capability can be trained to a much greater degree. The greatest impediments to bringing talent to fruition and training the capability of innovative thinking are preconceptions and taboos. In his *Conceptual blockbusting : a guide to better ideas* James Adams describes these as "Cultural and Environmental Blocks" [4, p.57] listing them as:

- Taboos
- Fantasy and reflection are a waste of time, lazy, even crazy.
- Playfulness is for children only.
- Problem-solving is a serious business and humor is out of place.
- Reason, logic, numbers, utility, practicality are good; feeling, intuition, qualitative judgments, pleasure are bad.
- Any problem can be solved by scientific thinking and lots of money.
- Everyone should be like me.
- Cyber is better.
- Tradition is preferable to change.

Reflective members of any society will recognize many of these comments as classical of the conservative vs. liberal, free-thinking vs. conformist and so on. In creative thinking, overcoming any of these preconceptions is essential to the release of thought that allows for iterative analysis of a problem to arrive at the series of ideas, one or more of which might be the inception of the process towards a successful solution.

Taboos top the list as the hardest blocks to overcome. Taboos in any environment be they cultural or otherwise. Even though a

taboo might be overcome and provide an astoundingly imaginative solution to a problem, the cultural or environmental nature of the taboo will often prevent its practical implementation. As an example, early installations of bathrooms with tub, toilet and running water were met with general consternation especially in rural areas of norther Europe. The act of washing ones person in a separate room by totally nude immersion in water was considered somehow indecent and the idea of evacuating bodily effluents in a contraption *inside* the house positively unsanitary[24].

Victorian engineers were often confronted by similar preconceptions from colleagues, the general public and authorities. As a particularly innovative engineer of the era Isambard Kingdom Brunel was the victim of constant criticism for breaking such taboos. Of course the various mishaps resulting from his experimenting at moving the boundaries of contemporary knowledge were no little help in reinforcing the critique. His first tunnel under the Thames, a project inherited from his father, collapsed several times during construction as a consequence of not having sufficient cover of river bed. Built of iron in an age of wooden sailing ships, the *Great Eastern* was the worlds largest ship for over 50 years. Its innovation sideways launch into the Thames was particularly stubborn and its role as a passenger ship a failure, being plagued by exploding boilers and other accidents. Finally achieving success as at Trans-Atlantic cable laying, it played a significant role in the tremendous growth of the telegraph net.

Similarly the Swiss engineer Robert Malliart was bitterly criticized for his elegantly slim bridges of reinforced concrete beginning in the 1920's. Although strong and above all economic, they were termed "cream cake structures" in a time where stone stacked on each and kept in place by properly visible keystones had been the only trusted way of spanning rivers and valleys since Ro-

[24]The personal experience of my great uncle when he announced that he intended to install a bathroom as part of renovating his farm house in the late 1920's. The bathroom was properly equipped many years later and only after others, considered to be of a higher class in the community had done so.

man times. That particular preconception had such strong adherence that bridges well into the 1940s were built of concrete clad with natural stone to retain their appearance of "natural" strength[25].

Four of Adams's points touch on traits and attitudes such as playfulness, humor, intuition, fantasy, reflection and pleasure as prerequisites for open, creative thinking. To many these are obvious, to others the seriousness of the endeavor reflects more often than not, the magnitude of the numbers involved. Those traits and abilities are founded in the simple pleasure of satisfying curiosity, investigation and experimentation. This is reflected in one of the expressions often used in one of the most successful design practices of our time, the Office of Charles and Ray Eames; *Take your pleasure seriously*[26]. The lives and production of the office often demonstrated the please that both Charles and Ray Eames derived from collecting and playing with toys, experimenting - often irreverently - materials and always investigating alternatives both in solution and presentation.

The fear of change and preference of tradition and conformity are points that doesn't need much elucidation. Most design solutions build on tradition, and success very often depends strongly on the understanding of the traditions behind the evolution of a design. However, it is the need for change to meet new challenges that gives rise to design in the first place and willingness to challenge conformity that dislodges preconceptions and spurs creative thinking.

The example of the front wheel drive automobile is an apt one illustrating the conflicts of change, tradition and conformity. When first developed it was alternately marketed as an innovative departure from the norm and as adhering to traditional conformity. It was sold as a car that gave better road holding and control,

[25]The bridge over Svinesund on the southern border between Norway and Sweden was completed in 1946.

[26][16, p.122]

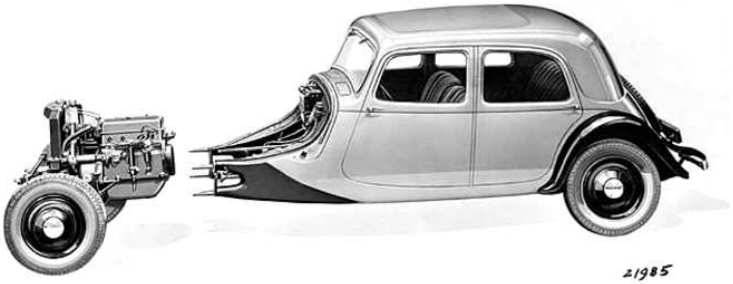

Figure 1.12: Innovation: Citroën front wheel drive, 1934. One of a series of illustrations meant to convince the customer of the advantages of front-wheel drive through visual logic. [13]

with the benefits of a roomier interior free of the bulky drive shaft traversing the length of the vehicle. (It was also cheaper to produce with fewer part to the advantage of both producer and consumer.) In parallel to its apparent modernity, it was also portrayed as a vehicle in the tradition of the horse-drawn carriage with propulsion at the front with a chassis that did not depart much in form from most of its competitors. (Fig. 1.12)

While his other points are reasonably robust attitudes towards overcoming "cultural and environmental blocks" to creative thinking, his remark on "cyber is better" seems somewhat petulant. Our recent history is littered with examples of new technologies being adopted indiscriminately. But such usage is part and parcel of the investigation and experimentation allows experience to accumulate and technologies to mature. Granted that technologies in development are sometimes brought to application too early, especially in fields where standards for interoperability are not yet adopted. This often results in rejection of solutions that are

well suited to their tasks only to be abandoned for more traditional technologies. Vannevar Bush's suggestion of using instant film in his *Memex* machine was an overly enthusiastic application of photography after Edwin Land's invention of Polaroid film.[27] The application by several Scandinavian banks of the smart card in the 1980's is another example of digital technology applied too early as it came before the adoption of common inter-bank standards of information interchange. While it is prudent to be mindful of excessive use of immature technologies to solve problems unsuited to their application, that itself is in many ways reminiscent of the fear of change derided in several points on the list of blocks. It all appears in many ways to be a generational resistance to the adoption of methods and technologies that seem to threaten some of the traditional ways of experimenting and playing which also alluded to by Victor Papanek in his remarks on creative thinking.

In his widely used *Design for the real word.* Papanek discusses ways of thinking and touches on the truly difficult subject of inspiration:

> Our ways of thinking can be divided into various modes. There is analytical thinking (How long will it take me to drive for lunch?). We engage in judgmental thinking (Which of for lunch?). We engage in fudgmental thinking (Which of these three steaks looks rarest?) and routine thinking (Given a specific temperature for the tempering of a steel alloy, what thickness is required to hold up a bridge?). In this last thinking mode we are encouraged to look up the correct answer at the back of some technical manual.
>
> And finally there is creative thinking. This seems to occur in three different ways. There is the sudden, momentary insight-the "spark of genius" - that some-

[27] Although the *Memex* project vividly anticipated both the personal computer and the Internet. [11]

> times comes to us in a blinding flash of revelation. Neither psychologists nor the innovators themselves have a clear explanation of this process. We have a good deal of documentation for the second way of finding a new solution: the discovery that comes to us in a dream. Scientific literature is filled with descriptions of this process: a researcher trying hard to develop a new insight, going to sleep and awakening with a lucid solution clear in his mind. This mechanism too is not understood, my own conviction is that such revelations are intuitive, that is: a marshalling of facts awaiting synthesis on a subconscious or preconscious level.[28]

He then goes on to describe a situation that does not seem to have changed much over the last 20 years in spite of the various teaching programs on creativity and innovation being marketed in higher education.

> We live in a society that penalizes highly creative individuals for their nonconformist autonomy. This makes the teaching, of problem-solving discouraging and difficult. A twentytwo-year-old student arrives at school with massive bloc against new ways of thinking, engendered by some sixteen years of miseducation, a heritage of childhood and pubescence of being "molded," "adjusted," "shaped." Meanwhile our society continuously evolves new social patterns that promise a slight departure from the mainstream but without ever endangering the patchwork of marginal groups that make up society as a whole.[29]

It appears that society in general and not excluding academia set very precise, but [purposely?] vaguely defined boundaries for what sort of individualism in thinking that is acceptable at any

[28] [34, p.152-153]
[29] [34, p. 156-157]

point in time. These boundaries are set by current norms of "political correctness", the use of accepted jargon within the bounds of a given field of inquiry, and degrees of familiarity with the works of [or personal acquaintance with] the current luminaries in the field.

On innovation and inspiration Assuming that inspiration is essential for a successful design, what is inspiration, and how does it relate to creative thinking and innovation? Although innovation has to some extent been discussed as a consequence of creative thinking above, what is innovation and why is the concept in such vogue that it be considered the subject of courses of academic study?

Is innovation simply the creation of something "new" and radically different from the known? Is it a new and radically different way of solving a known problem with known solutions, or is it simply the political acceptable deviation from the norm that Papnek refers to? Adams's "blocks" would suggest that it be the first, but when the concept becomes institutionalized, it is surely the last.

Even though the mechanisms of inspirational and innovative thinking are poorly understood, there are undoubtedly some prerequisites that are clear. One is the clear need for a solution to a particular problem, which may or may not set off a chain of thought (or intuitive flash of thought) that might lead to a particularly brilliant solution.[30]

The other is the intellectual challenge of the problem itself. But the challenge alone is not sufficient to trigger the train of thought that might lead to a solution. Furthermore there seems to be no single *method* that be used in the absence of the flash of inspiration to elicit the correct solution to the required deadline. There are,

[30] Although the solution might not be pertinent to the problem at hand, but an answer to some other, even quite unrelated challenge.

however, a series of actions that can be taken to aid in the organization of the investigation and forethought necessary to arrive at a solution. (See p.106)

The third prerequisite might, quite reasonably, elicit an innovative solution a change in the state of boundaries in the complexity of the system or thing being designed. It is at the transitional boundaries of complexity that the order and structure of the design matter have to take on new or different forms in order to succeed. (See pp.71 and 118)

Although it might seem that innovation in design is an individual and personal thing, the supportive environment is not only helpful, but an almost essential prerequisite for the existence of any form of fruitful investigatory rhetoric on the part of the designer. The list of the sort of environments where this obviously has happened and still goes on is long, but for those interested they might want to investigate the work of Raymond Lowey, the Office of Charles and Ray Eames, Bell Labs, Xerox PARC and Apple Computer. The first two being renown US industrial and graphic design firms, the latter responsible for more than 3 decades of continuous innovation in the development of computer science and personal computers.

Application of design

Design is not exclusively Western Designing in its widest sense takes place in the area of transition where theory is applied to the making of objects or systems that are to be used by living beings or their machines. The idea that design is the application of theory to practice is alluded to by Richard Buchanan thus:

> The relation between rhetoric and the arts of making, whether in words or things, is one of the most complex themes in Western culture.[31]

[31] [10, p.32]

As we consider the idea of design and its application as discourse, making and practice, we often frame it as a uniquely Western[32] phenomenon. Although it would be wrong to accuse contemporary writers of applying themselves indiscriminately to that exclusivity, it is worth wondering what our thinking on the relationship between design as we understand it to spring from the belle and beaux's arts of the Renaissance and an evident striving to rationalize its results in the realm of the natural sciences would have been had they taken into consideration more closely the works of earlier designers outside the *West*. While the earliest written recorded thought appears to be found in Classical Greece, the experience of design is well documented not very much further to the east long before the European reawakening to Classicism. Neither does it require great flights of the imagination to understand that a great deal of forethought and design must have gone into the planning and building of the enormous monuments of pharaonic Egypt or the much later and more extensive Angkor Wat in Cambodia. (See fig. 1.1)

It is in the design of much smaller things that we have some records of the design experience. In the 9th century A.D. the brothers Banū Mūsā bin Shakir of Baghdad were designing and constructing water driven machines such as clocks and entertainment devices called Ḥiyāl. These were perfected in the work of al-Jazarī at the opening of the 13th century:

> In his encyclopedic work, The Keys to the Sciences, Al-Khawārizmī (d.997) divides theoretical philosophy into three categories: (1) the lower science or the study of the nature, (2) the upper science or theology, and (3) the intermediate science or the study of the things that are not matter, but present in matter (size, shape, movement)19. Ḥiyāl, by virtue of its studying the movement of matter is elevated into an intermediate sci-

[32] And where it is not Western, at least pertaining to the industrial mainstream.

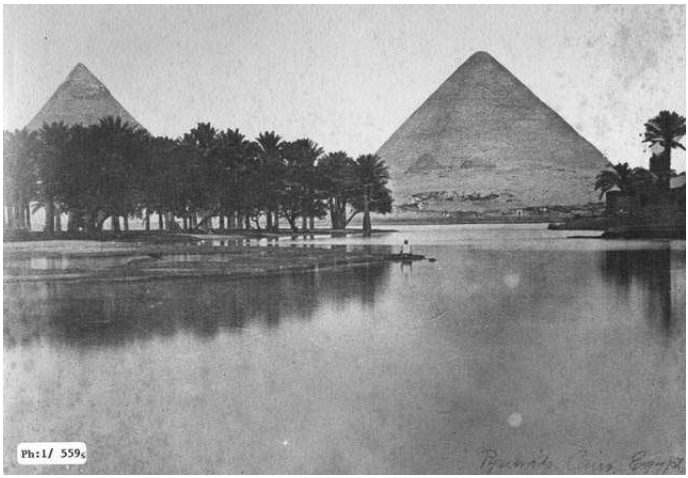

Figure 1.13: It should not take much imagination to realize that the building of the Great Pyramids at Gizeh required quite extensive and complex design. Photo courtesy of the Blatchford collection at the American University of Beirut. (Photographer unknown)

ence, ranking next to arithmetic, geometry, astronomy, and music.[33]

Although they were well aware of the previous Greek, especially Alexandrian work on pneumatics, the Arabic writings on these devices are almost devoid of any mention of scientific theory as to how the devices worked. However, the experience of design in overcoming the technical problems presented are framed in succinct terms of creative thought.

Al-Jazarī's *Compendium on the Theory and Practice of the Mechanical Arts* was written two centuries after this time of feverish assimilation of knowledge. Com-

[33] [3]

pleted on the 16th of January 1206, fifty-two years before the fall of the Abbasid empire, the Compendium represents the apex of Arabic fine technology. The Ten chapters comprising 40 per cent of al-Jazarī's book dedicated to detailed instructions on water-clock construction testify to this fact. In the introduction to the book, al-Jazarī states that after looking into the work of his predecessors and "contemplating the emptiness and fullness of things", he sought to put together these works introducing his own improvements. Al-Jazarī's improvements were based on ceaseless experimentation with existing methods to reach longer time spans for self functioning machines. Concerning the clock mentioned in the first section of this essay, for example, he explains how he tried Archimedes' model and was displeased with it because it only functioned for one day, the first day of Cancer. He then used another model of unknown origin, which also did not work. So, he "focused thought" and came up with his own design. It takes this final focusing of thought to make the leap from the rational faculty to intuitive inspiration. The method of experimentation is meant to perform the act of purifying in order to allow that higher faculty to function. At this higher level of empirical experience the soul of the experimenter himself is at stake; "what is now to be sought and dominated is the animal nature within him".[34]

An important aspect of these machines of entertainment is that they were that time's technological playthings, much as the camera, phonograph, radio, television and more recently the computer serve as the technological playthings of our time. Arab designers such as Al-Jazari were also responsible for the professional application of their technological accomplishments such as various forms of pumps for raising water from rivers and wells.

[34][3]

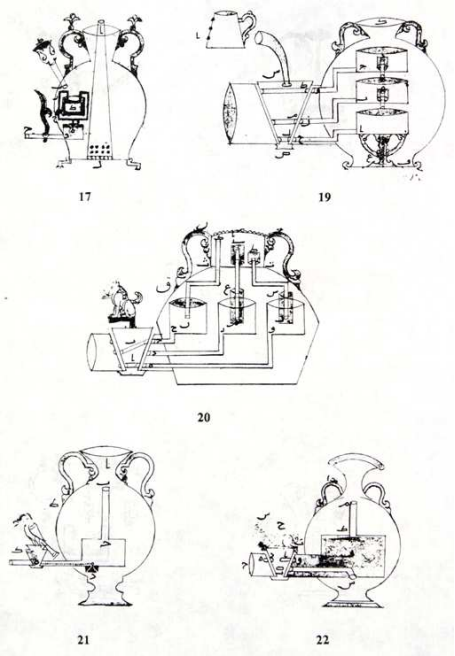

Figure 1.14: Some of the Banū Mūsā's drinking devices.(From the *Kitab al Ḫiyāl* in the Library of Topkapi Palace Museum.[6])

However, it is in the design of self-contained automata that they moved into the area where the experience of design couples with the user's fascination with an object that challenges the understanding of the real that must have given the same sense of accomplishment that we feel when we come close to mastering our own technological objects of desire.[35]

[35] *MuslimHeritage.com* at `http://www.muslimheritage.com/` also has a series of articles about Ḫiyāl, including diagrams and models that explain their workings.

Areas of design Placing itself in a specifically predictive area of applying theory to practice, design is often quite difficult to place in the great scheme of arts and sciences.

While design can be construed to apply to making in it's widest meaning, it is normally understood not to apply to the "fine arts" or "letters". A common enumeration of the arts would include: Literature, music, graphic arts, dance, drama, sculpture, architecture. In that scheme design is placed somewhat to the side in the applied, or utilitarian arts.

In modern terms design is commonly understood to fall into these categories:

- Industrial design

  The design of utilitarian objects of daily use, of practical necessity or items of luxury.

- Graphic design

  The design of all those 2-dimensional forms of iconography including signs, symbols and writing that convey visual meaning on flat surfaces. Graphic design is mainly representative in nature and includes such media as paper, wall graffiti, photography, film and of course digital media.

- Communication design

  Communication design is primarily presentational in nature concentration on the authoring of narratives and the roles they play in our daily lives as carriers of knowledge, arenas of entertainment, arbiters of cultural identity and political influence.

- Interaction design

  Interaction design is not as modern as one would be led to believe. The instruments of Ḥiyāl often required interaction with the user as do our modern computers, both as mechan-

ical devices and software systems. The design of complex machines such as automobiles also fall into this category.

- Organizational design

  The need for design becomes obvious as systems increase in complexity beyond familiar comprehension and transgresses quantitative thresholds of simultaneous understanding. Such design becomes obvious in forming the environments in which objects and systems reside, survive and develop such as institutions of learning, repositories of information, political institutions, instruments of government, organization of trade and industry, and the like.

Figure 1.15: The Akbil iButton digital ticket holder is about the size of an ordinary latch key.

All these areas of design, willingly or not, are deeply grounded in the social and political aspects of the making and dissemination of their results and meaning, the implications of which to be discussed later.

Quite often several areas of design come into play in solving a single general problem. Ticketing systems in public transportation are good examples of the application of multifaceted design. The Akbil ticket for public transportation in Istamboul in Turkey is one such system. It includes a comprehensive network of buses, trams, metro and ferries serving a population of around 10 million people. The ticket itself is a Dallas Semiconductor iButton (Fig. 1.15) which is touched to a fare-point on entry to the vehi-

cle. The reader emits a double beep tone indicating that the button has been read and the appropriate fare deducted. The button can be charged against cash or credit card at an Akbil recharger kiosk at bus stations or automatic recharging machines at the metro stations. iButtons are small, uniquely identifiable computers with encrypted memory. The complete ticketing system has involved all of the above areas of design covering the design of the buttons, readers and rechargers, graphics and communication for instruction and marketing, interaction for user, conductors and ticketing personnel and finally the organization of the whole system.[36]

Ways of designing

Almost every aspect of urban and agrarian environments in the populated world have in some manner received their present form by human design. Even those areas of protected natural habitat that we are led to believe to be truly ancient and "untouched" are designated as such by design and subsequently suffer modification by their use as objects of tourism and indirectly by the vast changes in the greater environment of which they are a symbiotic part. By way of evidence it is extremely rare to find pine trees today of sufficient age and girth to make the log chairs that were quite common in central areas of Scandinavia only a century ago. What then is the nature of the various ways of designing that span from making the barely noticeable to the *New Covetables*?[37]?

[36] For more on Akbil see: `www.akbil.com` and `http://www.turkeytravelplanner.com/WhereToGo/Istanbul/Transport/Akbil.html`

[37] A concept formalized by Charles and Ray Eames with certain characteristics described thus: "It can't be too easy to get them. You must be able to have them. You must not be able to have them without first wanting them. The price must really have a price. It must be a real price, but ... the coin in which that price is listed must be available to everyone."[16, p. 126]

Design by use The most common for of design is that by with a thing evolves in form and function by continuous adaptation resulting from user feedback. It is an intuitive and evolutionary form of design where objects and systems evolve by experience from use. Occasionally significant changes in technology, social or commercial circumstances will cause abrupt changes or accelerated modifications, even collapse, but generally, the pace of change will be somewhat akin to glacial. The vast majority of objects and systems of common utility about us are of such a nature.

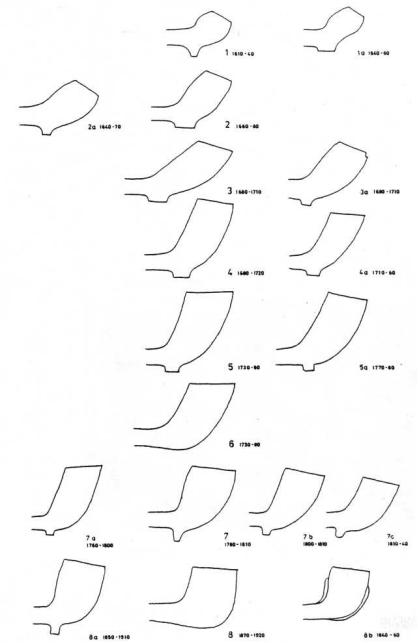

Figure 1.16: Simplified typology of English type clay tobacco pipes found in Norway.[28]

The white kaolin clay tobacco pipe, which was a common household item in northern Europe, the British Isles and North America from the early 17^{th} century until the middle of the 1800's, is an object typical of a slow, evolutionary design development. The illustrations 1.16 on page 62 show a typical evolutionary development of a large selection of pipes both of British production and the English type produced in Norway. (The typology was developed on the basis of finds by the author.) The use of tobacco was controversial from the outset. King James I opens his "Counterblaste to Tobacco" by characterizing the users of the leafy drug:

> And now good Countrey men let us (I pray you) consider, what honour or policie can moove us to imitate the barbarous and beastly maners of the wilde, godlesse, and slavish Indians, especially in so vile and stinking a custome? Shall wee that disdaine to imitate the maners of our neighbour France (having the stile of the first Christian Kingdom) and that cannot endure the spirit of the Spaniards (their King being now comparable in largenes of Dominions, to the great Emperor of Turkie) Shall wee, I say, that have bene so long civill and wealthy in Peace, famous and invincible in Warre, fortunate in both, we that have bene ever able to aide any of our neighbours (but never deafed any of their eares with any of our supplications for assistance) shall we, I say, without blushing, abase our selves so farre, as to imitate these beastly Indians, slaves to the Spaniards, refuse to the world, and as yet aliens from the holy Covenant of God? Why doe we not as well imitate them in walking naked as they doe? in preferring glasses, feathers, and such toyes, to golde and precious stones, as they do? Yea why do we not denie God and adore the Devill, as they doe?

It would seem that James' objections to tobacco were not solely on grounds of health.:

> It is not so long since the first entry of this abuse amongst us here, as this present age cannot yet very well remember, both the first Author, and the forme of the first introduction of it amongst us. It was neither brought in by King, great Conquerour, nor learned Doctor of Phisicke.[38]

The King's short-lived ban on the use of tobacco and manufacture of associate paraphernalia resulted only in the emigration of a number of pipe makers to Holland and the establishment of that country's own industry centered in the town of Gouda. Early Dutch pipes were virtually identical to the English, often including the Tudor Rose decoration on both sides of the head. It's addictive properties entrenched in the population, the use of tobacco proved impossible to eradicate. The ban was soon repealed and the industry proceeded to flourish both in the British Isles and in other countries of northern Europe. Clay pipes were the common means of smoking, tobacco having been introduced after contact with the natives of North America.[39]

The earliest pipes were entirely hand-made with small, thick-walled, bulb-shaped heads and relatively thick stems with large (up to 2mm) internal stem bore diameters. As tobacco fell in price with the growth of slavery and plantations in the New World, production was organized into separate processes for each step of manufacture. The volume of the bowl grew, the shapes changed and stems became longer. As the Industrial Revolution took hold the production of clay pipes was soon mechanized resulting in thinner walls, thinner stems and smaller bore. With the introduction of iron molds for whole pipes, various forms of ornate decorations were used. By the middle of the 1800's the development of

[38] [21]

[39] Their earliest contact with the western hemisphere being the Caribbean and South America, the Spaniards smoked tobacco in rolled leaves. The French initially used it as snuff. Later, the clay pipe factories of northern France and Wallonia in Belgium were of the most productive ever, with single factories making upwards of 4 million pipes annually.

the (wooden) Briar pipe, all but demolished the clay pipe industry. The manufacture of clay pipes had never been a very lucrative trade and by the middle of the 18thth century, low quality pipes were distributed free of charge with the rather more costly tobacco in the taverns of London. And by the late 1800's feeble attempts at survival are evident in pipes shaped to resemble the more popular wooden pipes of the day.

As evident from the evolution of shapes in the typology, the design of the pipes changed gradually reflecting developments in production technology, market demand, the price of tobacco and changing fashions.

On the general level of basic form and function this form of anonymous, evolutionary design applies to the vast majority of objects, systems and organizations of daily use such as cutlery, furniture and housing or schools, libraries and government especially where the users are themselves the designers. However, on the specific level, these things have almost always been given individual attention for special purposes by craftsmen or designers producing samples that depart from the general norm, either as items of luxury or for special - often of culturally specific - functions.

Design by "making" Although "making" is used by many as the essence of the process of design, the actual application of inquiry and "forethought" - it can be more specifically applied to that intuitive form of design that is applied when something is made. It is the design process that is used when an implement is crafted, used and then adjusted until it functions satisfactorily with little or nothing in the form of pre-production plans, drawings or models. Most people know it as the process they go through when furnishing a new home. Previous experience comes to application along with intuitive understanding of form and function of space and objects.

Unfortunately "design by making" is the most frequently used method of solving a whole host of complex design problems in-

cluding computer software. Often the inexperienced designer will recognize a familiar aspect of the problem at hand and immediately apply knowledge from some previous solution in the hope that will be a viable solution. The greatest danger is that recognizing a small part of the problem and its solution will imply that the overall structure and functionality will also fall into place. Discovering that the partial solution has brought with it assumptions that are not valid often comes too late and the rest of the process becomes mired in attempts at recovery or design more partial solutions to get around obstacles.

An excellent way of designing simple solutions to simple problems, intuitive design by making the actual object or system needed, it is almost invariably doomed to failure when the complexity exceeds that which can be easily grasped in a single set of simultaneously recognizable concepts.

Design by invention It is often the concept of invention that is cited as that which distinguishes design from other disciplines of inquiry. That design by definition is a process whereby knowledge, inquiry, experimentation are utilized to make a solution for a specific problem which solution is by its nature unknown and must be made. Thus each new invention is arrived at an materialized by design. What is at stake is not the success or viability of the invention, but rather the way at which its solution is achieved.

Inventors' notes show how sketches, or imagined solutions figure in their thinking about solutions. They often consist of numbers of notes and sketches of separate components or observations of similar ideas, proposals and resources, but the most striking is how, when asked how they arrive at solutions, ideas are born almost spontaneously when thinking freely around the subject to be solved or a pivotal idea may come to mind when actually thinking of something quit different.

Design by production Apart from the actual feasibility of function, the main constraint to the viability of a designed thing is production. The process and technology of production become a major determining factor in the design process itself, not only in bringing the object or system into general use.

In almost all objects except those of ostentatious luxury, where cost appears to enhance desirability, efficiency in production is that factor which above all makes the design a commercial success. It is the mechanization of production into the mass production of the industrial age that has brought design into the common marketplace.

When the afore-mentioned clay tobacco pipes developed from individually hand made pipes assembled from the two components of sculpted head and hand rolled stem with stamped markings to a single piece crafted in an iron mold, the price dropped dramatically becoming consumer products produced by the million.

Similarly, when computer software migrated from an ordered configuration of switches on a main frame's front panel or punching of cards, to compiled programs reproducible in infinite numbers on digital media, it suddenly moved from virtual handcraft to consumer products for both professional and lay.

Problem solving - design by design The most commonly understood notion of design is that where a problem is presented to be solved by a professional designer in a field of the design arts. Architects, industrial designers and system engineers are those that most usually spring to mind. Designers are commissioned to design simply because the client cannot solve the problem and wants a solution that is somehow different or exceptional. The expectation of "difference" might be that the solution would be similar to something that the particular designer has done previously with some success, or in some other way answer the clients needs.

In some cases the professional design process might arrive at a design solution by spontaneous ingenuity. More often than not, designs are arrived at through a more or less methodical application of knowledge and resources. In the 1950's and 60's there arose a vigorous movement of thought and development of design methods. Over the years, the enthusiasm for stringent design methods have been tempered, in some cases to the point where the authors of some methods have disavowed their previous work.[40] However, it seems inconceivable today that some form of methodical approach should not be applied to solving the design of even quite simple things.

The concept of "methodical approach" is an interesting one because of the great variations involved from field to field. Bearing in mind the way production process mentioned above influence the final design, the design of the tools used to arrive at a design solution are often the greatest determinant. This is especially evident in software production, generations of software development tool kits are used to simplify the development of a final product. Such tools have the potential of saving time spent programming common modules of functionality and data structures, but because a number of design decisions have been made with regard to the behavior of that software, severe constraints are imposed on the programmer. Notice how *design* and *designer* are interchangeable with *development*, *programming* and *programmer* in the above, bringing with them demands for design ability and a greater knowledge of design resources.

Design by "fumbling" It may be that most things that are designed by intent achieve their form in some methodical fashion and that there is a form of generic evolution in the way that designs develop over time. However, it is also regrettably true that the overwhelming majority of designs are arrived at through the haphazard assembling of component solutions that appear to work

[40] See p.106

in similar situations. This way of designing should not be confused with *brainstorming* as a design method where related or unrelated ideas are thrown up spontaneously, but rather akin to the adage "if it works, don't fix it". One need only envision some of the more arcane bureaucracies of this world to understand how bad initially simple and workable designs can become when subjected to haphazard and poorly thought through modifications are made. The same can be said for many common objects and environments, particularly architecture. Buildings, towns and cities are normally permanent constructions meant to last beyond the lifespan of common consumer objects. Even temporary buildings are often used far beyond their intended life, with or without appropriate modifications. It is exactly that subjection to constant modification that exposes the built environment to design and changes in the original design by others than the initial designer, if there ever was one. And it is that form of design which more often than not, applies modifications and additions unrelated to the original design considerations. While modifications may in some cases be necessary to correct mistakes or adapt the structure to changes not originally foreseen, in most cases, such design by "fumbling" is not particularly successful.

The range of examples spans from the mildly amusing to the outright catastrophic. While the attempts to make station wagons (or "estate" cars) of the Citroen DS or SAAB 96 were simply helpless atrophies of a quite successful achievement in industrial design, the haphazard growth of many of the mega-cities of the world, where planners have been overruled by political power, are nothing short of disastrous. Similarly, software that at the outset was simple, straight forward and quite user-friendly is often modified and added on to the point where it becomes bloated, unmanageable and down right unusable.

Design by individual, committee, and group Design at the level of comprehensible complexity by lone individuals some times result in works of astounding success. And at greater levels of com-

plexity collaborative design under the guidance of an individual with the necessary oversight is often cited as the best formula for success.

However, aimless design by committees, groups and loosely organized cooperation almost inevitably results in dismal failure, even if individuals within the group deliver successful contributions at a lower scale of complexity.

When design by committee actually works, it is often because the members have had the sense to allow one gifted individual get on with the matter at hand and have assisted in criticism and identification of oversights. The rule however almost invariably dictates that work in committee is governed by compromise and reduction to the point where all colors are mixed and become grey.

Design by group is an interesting, relatively modern phenomenon which has best been developed by the Internet. The Net's various forms of more or less instantaneous communication allow for a form of collaboration previous difficult to implement. It has best been shown to work in large, almost unimaginably complex projects such as the Linux operation system.[41]

Basically, one person designs a fundamental framework and then invites collaborators to contribute solutions to various parts of the framework within set constrains.

The peculiar kind of communications that makes this form of collaboration possible (mailing lists, USEnet News, CVS, etc.) also allows for an ongoing rhetorical discussion at all levels of though over the design at hand.

The design of the various components are tested by anyone interested in participating in the design process and by virtue of numbers, design evaluations can very quickly indicate success of failure.

[41] For more on Linux see http://www.linux.org/.

Linux is not the first example of designing a complex digital environment by group collaboration. The Internet itself is the result and an ongoing project in collaborative group design. New solutions to problems and new challenges are designed and developed in separate groups, then tested and finally approved and instituted as Internet standards at the plenary "town meetings" of the IETF (Internet Engineering Task Force).

Cognition

On the very close relationship between cognition and design. On understanding an interpreting the needs, functions and culture of other fields beings designed for.

Reading: Levin (Thinking and Seeing) [25]

Representing complexity

On symbols and theory as a way of representing to be able to think about complexity.

See the theory chapter on where this goes.

Some reasonably straightforward stuff on complexity. However, complexity is one of the most important matters at hand because it determines what tools and aids that must be used to hand the problem.

Reading: Venturi [39]

Have a look at Minsky and how he simplifies things. (Maybe to be used in later chapters?)

Simplification

Partially to explain a series geometry problems for his pupils, the teacher Edwin Abbot (1838-1926) wrote the now famous book *Flatland: A Romance of Many Dimensions* in 1884. The book is a

saga of a land of 2 dimensions that in describing its inhabitants and their ways also explains geometrical problems. In the process it becomes a biting criticism of the customs and ways of his contemporary Victorian society. (In his time, *Flatland* was not the book by which Abbott was know. It was only in the last half of the 20^{th} century that it became the cult book it is today.) Here is how he describes the inhabitants of Flatland [1]:

> *Concerning the Inhabitants of Flatland*
>
> THE GREATEST length or breadth of a full grown inhabitant of Flatland may be estimated at about eleven of your inches. Twelve inches may be regarded as a maximum.
>
> Our Women are Straight Lines.
>
> Our Soldiers and Lowest Class of Workmen are Triangles with two equal sides, each about eleven inches long, and a base or third side so short (often not exceeding half an inch) that they form at their vertices a very sharp and formidable angle. Indeed when their bases are of the most degraded type (not more than the eighth part of an inch in size), they can hardly be distinguished from Straight lines or Women; so extremely pointed are their vertices. With us, as with you, these Triangles are distinguished from others by being called Isosceles; and by this name I shall refer to them in the following pages.
>
> Our Middle Class consists of Equilateral or Equal-Sided Triangles.
>
> Our Professional Men and Gentlemen are Squares (to which class I myself belong) and Five-Sided Figures or Pentagons.
>
> Next above these come the Nobility, of whom there are several degrees, beginning at Six-Sided Figures, or Hexagons, and from thence rising in the number of their sides till they receive the honourable title of Polygonal, or many-Sided. Finally when the number

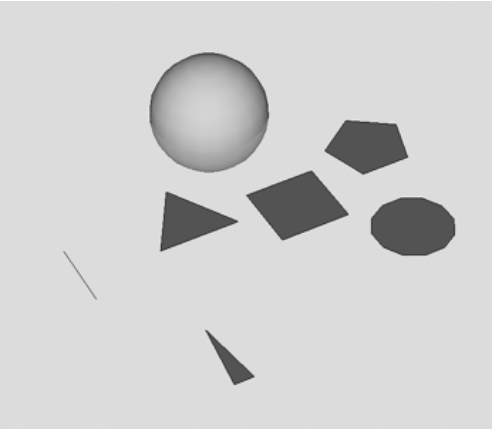

Figure 1.17: Inhabitants of Flatland. From left to right: a woman (line), men of various orders; a soldier, a worker (triangles), two lower middle class men (square and pentagon) and a priest (circle). At the back hovers the sphere, having intruded from spaceland and appearing to flatlanders as a circle with mysterious ability to expand and contract at will. Rendering: Børre Ludvigsen

of the sides becomes so numerous, and the sides themselves so small, that the figure cannot be distinguished from a circle, he is included in the Circular or Priestly order; and this is the highest class of all.

It is a Law of Nature with us that a male child shall have one more side than his father, so that each generation shall rise (as a rule) one step in the scale of development and nobility. Thus the son of a Square is a Pentagon; the son of a Pentagon, a Hexagon; and so on.

But this rule applies not always to the Tradesman, and still less often to the Soldiers, and to the Workmen;

who indeed can hardly be said to deserve the name of human Figures, since they have not all their sides equal. With them therefore the Law of Nature does not hold; and the son of an Isosceles (i.e. a Triangle with two sides equal) remains Isosceles still. Nevertheless, all hope is not such out, even from the Isosceles, that his posterity may ultimately rise above his degraded condition. For, after a long series of military successes, or diligent and skillful labours, it is generally found that the more intelligent among the Artisan and Soldier classes manifest a slight increase of their third side or base, and a shrinkage of the two other sides. Intermarriages (arranged by the Priests) between the sons and daughters of these more intellectual members of the lower classes generally result in an offspring approximating still more to the type of the Equal-Sided Triangle.

Rarely - in proportion to the vast numbers of Isosceles births - is a genuine and certifiable Equal-Sided Triangle produced from Isosceles parents [footnote 1]. Such a birth requires, as its antecedents, not only a series of carefully arranged intermarriages, but also a long-continued exercise of frugality and self-control on the part of the would-be ancestors of the coming Equilateral, and a patient, systematic, and continuous development of the Isosceles intellect through many generations.

The birth of a True Equilateral Triangle from Isosceles parents is the subject of rejoicing in our country for many furlongs round. After a strict examination conducted by the Sanitary and Social Board, the infant, if certified as Regular, is with solemn ceremonial admitted into the class of Equilaterals. He is then immediately taken from his proud yet sorrowing parents and adopted by some childless Equilateral, who is bound by oath never to permit the child henceforth to enter

his former home or so much as to look upon his relations again, for fear lest the freshly developed organism may, by force of unconscious imitation, fall back again into his hereditary level.

The occasional emergence of an Equilateral from the ranks of his serf-born ancestors is welcomed, not only by the poor serfs themselves, as a gleam of light and hope shed upon the monotonous squalor of their existence, but also by the Aristocracy at large; for all the higher classes are well aware that these rare phenomena, while they do little or nothing to vulgarize their own privileges, serve as almost useful barrier against revolution from below.

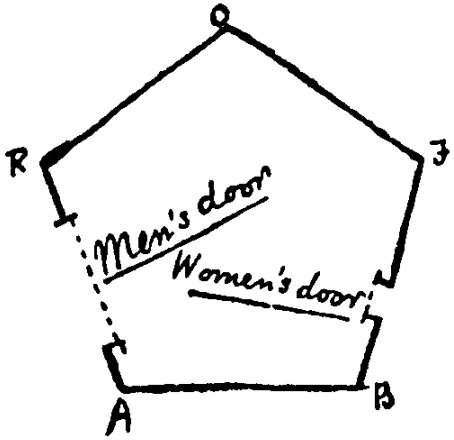

Figure 1.18: A house in Flatland. The men's door is wider than the women's door, because med are polygons and women are only line segments.

Had the acute-angled rabble been all, without exception, absolutely destitute of hope and of ambition,

they might have found leaders in some of their many seditious outbreaks, so able as to render their superior numbers and strength too much even for the wisdom of the Circles. But a wise ordinance of Nature has decreed that, in proportion as the working-classes increase in intelligence, knowledge, and all virtue, in that same proportion their acute angle (which makes them physically terrible) shall increase also and approximate to their comparatively harmless angle of the Equilateral Triangle. Thus, in the most brutal and formidable off the soldier class–creatures almost on a level with women in their lack of intelligence–it is found that, as they wax in the mental ability necessary to employ their tremendous penetrating power to advantage, so do they wane in the power of penetration itself.

How admirable is the Law of Compensation! And how perfect a proof of the natural fitness and, I may almost say, the divine origin of the aristocratic constitution of the States of Flatland! By a juidicious use of this Law of Nature, the Polygons and Circles are almost always able to stifle sedition in its very cradle, taking advantage of the irrepressible and boundless hopefulness of the human mind. Art also comes to the aid of Law and Order. It is generally found possible–by a little artificial compression or expansion on the part of the State physicians–to make some of the more intelligent leaders of a rebellion perfectly Regular, and to admit them at once into the privileged classes; a much larger number, who are still below the standard, allured by the prospect of being ultimately ennobled, are induced to enter the State Hospitals, where they are kept in honourable confinement for life; one or two alone of the most obstinate, foolish, and hopelessly irregular are led to execution.

Then the wretched rabble of the Isosceles, planless and leaderless, are ether transfixed without resis-

> tance by the small body of their brethren whom the Chief Circle keeps in pay for emergencies of this kind; or else more often, by means of jealousies and suspicious skillfully fomented among them by the Circular party, they are stirred to mutual warfare, and perish by one another's angles. No less than one hundred and twenty rebellions are recorded in our annals, besides minor outbreaks numbered at two hundred and thirty-five; and they have all ended thus.
>
> [Footnote 1]. "What need of a certificate?" a Spaceland critic may ask: "Is not the procreation of a Square Son a certificate from Nature herself, proving the Equal-sidedness of the Father?" I reply that no Lady of any position will marry an uncertified Triangle. Square offspring has sometimes resulted from a slightly Irregular Triangle; but in almost every such case the Irregularity of the first generation is visited on the third; which either fails to attain the Pentagonal rank, or relapses to the Triangular.

Prehistoric rock carvings (or *petroglyphs* are found on almost all continents and span from recent history to the bronze and rock ages. In the Nordic countries the richest petroglyphs in terms of pictorial content are usually from the bronze and late stone age. Stylistically, they are usually divided into the hunting types and agrarian types. The former considered to be the earliest form depicting hunting scenes and prey of various species both on land and sea. They are found from the waters edge on the west coast to altitudes approaching he tree line.

Agrarian carvings, on the other hand, are usually in the protected, agricultural regions of today, but at levels corresponding to the rate of the rise in sea level since the last ice age.[42] The prevalent themes are human figures (mainly male), vehicles of trans-

[42] In Østfold county in south-eastern Norway this is about 20 - 25 m. above present sea level.

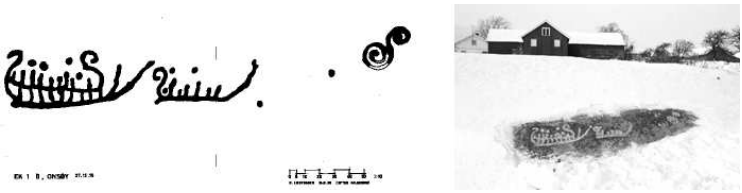

Figure 1.19: Rock carving at Ek, Norway. Ca. 3000 years old agrarian type carved in granite. Photo: Børre Ludvigsen

port (predominantly boats), beasts of burden, trees, and various circular symbols. (Fig. 1.19)

In this context these petroglyphs are very early, consciously designed representations of far more complex concepts and structures of thought. It would be fair to assume that the carvings may have been used in conjunction with spiritual rites or celebrations. However, as simplifications of higher complexities, they are too far back in time and unaccompanied by other evidence that might aid us to reconstruct their meaning or than by conjecture.

When NASA launched the space probes Pioneer 10 and Pioneer 11 in the 1970's, an attempt was made to design illustrations inscribed on small metal plaques carried on the spacecraft that represent us and our solar system. (Fig.1.20)

NASA's explanation of the design is this:

> The Pioneer 10 spacecraft, destined to be the first man-made object to escape our solar system, carries this plaque. It is designed to show scientifically educated inhabitants of some other star system-who might intercept it millions of years from now-when Pioneer was launched, from where, and by what kind of beings. The design is engraved into a gold-anodized aluminum plate, 152 by 229 millimeters (6 by 9 inches), attached to the spacecraft's antenna support struts in

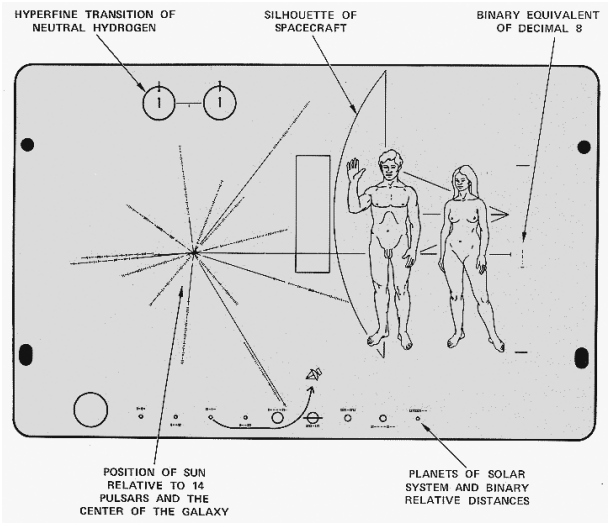

Figure 1.20: The plaques carried by Pioneer 10 and 11.

a position to help shield it from erosion by interstellar dust.

At the far right, the bracketing bars (1) show the height of the woman compared to the spacecraft. The figure indicated by (2) represents a reverse in the direction of spin of the electron in a hydrogen atom. This transition puts out a characteristic radio wave 21 cm long, so we are indicating that 21 cm is our base length. The horizontal and vertical ticks (3) are a representation of the number 8 in binary form. Therefore, the woman is 8 x 21 cm = 168 cm, or about 5'5" tall. The human figures represent the type of creature that created Pioneer. The man's hand is raised in a gesture of good will.

The radial pattern (4) will help other scientists locate our solar system in the galaxy. The solid bars in-

dicate distance, with the horizontal bar (5), denoting the distance from the Sun to the galactic center. The shorter solid bars represent directions and distances to various pulsars from our Sun, and the ticks following them are the periods of the pulsars in binary form. Pulsars are known to be slowing down and if the rate of slowing is constant, an other-world scientist should be able to roughly deduce the time Pioneer was launched. Thus, we have placed ourselves approximately in both space and time. The drawing at the bottom (6) indicates our solar system. The ticks accompanying each planet are the relative distance in binary form of that planet to the Sun. Pioneer's trajectory is shown as starting from the third planet, Earth.[43]

The problems of scale

Our perception of scale and magnitude are crucial to our comprehension of a design.

Size and magnitude When things become large but not necessarily complex and when they become both large and complex.

Relative scale This is where the discussion on why humans are a certain size goes. Or why any organic structure is the size it is.

The size of things relative to a human being or whatever creature is mean to interact with it.

[43] [32]

Designing for context

Designing for context. Designing for a specific context (something that almost always is a major constraint).

Designing in context Designing in a specific context also puts constraint on a design. Political, social, professional.

(Does this go here or under the activity part?)

The way things change

All things change, also designed things. How well do they survive change and what is the influence of design on that change. (The role of intellectual property rights in the process.)

How Buildings Change [8]

Everything is connected

How everything is connected. Look at Eames.

1.2 Digital Environments

A short introductory text explaining why understanding what digital environmnets are is important. . This section and the next has Licklider[44], Rheingold[36] and others as reference material.

But this section has to do with what DE are and how they relate to design as concept, not making or activity. That comes in a separate major part on DE.

[44] Of ARPA fame and much else.

Definitions (?)

Go through an explanation of the buildup of digital environments and how they become progressivly more complicated, requiring ever more organization by design.

Say something about the difference between design as a specification or checklist and design as a creative process in which resources are assembled and alternatives investigated.

The separation of parts and how design affects all

On how the right "fundamentals" in a design process can provide the glue through which the various parts may successfully be brought together.

Indivisibility of container and content

Why it is that the way a structure to contain knowledge (or anything else) is important for the successful manipulation, gathering, storage, retrieval or communication of the contents.

And how the character of the content can influence the structure.

1.3 History

The introduction here should probably say something about the significance of history. Inescapable, but on the other hand necessary as this [computer science] is negligent in its ignorance of the history of its own field. Most often left to the reminiscences of retired professors.

Design History

Design history being the history of how design has developed as a discipline and the history of design as the recording of how the form of objects and systems has evolved through the ages.

On how design history is a very western oriented phenomenon based on the interpretation of surviving writings, how these writings have been interpreted and “refined” in “our” societies and how the rest are virtually ignored.

On how the evidence of extant objects and systems are not taken into account other than by archaeologists and historians and how supposed interdisciplinary studies don’t work.

Ancient world:

> "For Aristotle, the differences among the various literary and constructive arts depend on a fundamental understanding of the human capacity to make, considered to be independent from the specialization of a particular art. All making is an integrative, synthetic activity.It is what he describes as an intellectual virtue: a reasoned state of the capacity to make, different from, but loosely related to, the intellectual virtue that stands behind the theoretical sciences and the moral virtues that stand behind action. However, Aristotle also found it important to distinguish the element of forethought from the specific considerations and activities that are relevant to each kind of making. Forethought in making is a kind of universal art, in the sense that it is independent of any particular art of making and, therefore, able to range over all potential considerations and subjects that may enter into the making of this or that kind of product. Forethought is an "architectonic" or "master" art, concerned with discovery and invention, ar-

gument and planning, and the purposes or ends that guide the activities of the subordinate arts and crafts."[45]

"The element of forethought in making is what subsequently came to be known as design, although no distinct discipline of design emerged in the ancient world, perhaps because forethought nd making were most often combined in the same person, the master builder or craftsman. . However, one exception was in the diverse arts of language and literature. A core art of rhetoric provided the basis for systematic forethought in all of the distinct forms of making in words: history, drama, poetry, political and legal speeches, prayers, and religious sermons.6 Rhetoric served IS the design art of literature; it provided the organization of thought in narrative and argument as well as the composition and arrangement of words in style. Yet rhetoric was not conceived by Aristotle as an art of words. It was an art of thought and argu ment whose product found embodiment in words as a vehicle of presentation."[46]

Renaissance:

In "rediscovering" and rereading the classical Greek and Roman philosophers, the artists of the Renaissance came to consider the highest form of making rhetoric an poetry thus creating the liberal art of *belle lettres*. The *beaux's arts* followed closely as literary thought branched out into the practical arts, and contemporary concepts of what was ideal, noble and beautiful was made to be seen.

The great achievement of the Renaissance was the creation of belles lettres and beaux's arts, along with a rebirth of rhetorical thought. This influenced all areas of culture and all arts of making, yielding a secularized humanism which influenced the sciences, as well.[47]

[45] [10, p.30]
[46] [10, p.31]
[47] [10, p.33]

Making in the Renaissance was not limited to the beautiful arts, it also "rediscovered" design in the application of visual representation to those functional devices wherewith they sought to solve the challenges of a growing and increasingly complex society. Leonardo's sketches of machines and other mechanical devices were among the earliest European evidence of design.

Twentieth century:

> Efforts to reunite design with the arts of making began in the nineteenth century, when Ruskin, Morris, and othcrs attempted to elevate the status of craft production as an alternative to mass production by machines. However, the most significant efforts to rejoin design and making came with the cultural and philosophic revolution at the beginning of the twentieth century. The origins of design are reasonably traced to the early decades of the twentieth century because it was in this period that individuals began to formulate new disciplines of design thinking that would combine theoretical knowledge with practical action for new productive purposes.[48]

The consensus seems to be that *real design* was born at the Bauhaus from whence it migrated across the Atlantic to Chicago where László Moholy-Nagy attempted to develop a "new liberal art of design" at the New Bauhaus [49], but with mixed success. Another branch of the Bauhaus movement settled in Ulm, Germany, where Max Bill founded the *Hochschule für Gestaltung*. In broad terms, the modern movement of design is seen to base its rationale on the belief that industry is culture.

The very idea that industry should not be culture or that somehow the two terms are incompatible is symptomatic of the pervading elitist approach to design that dominates modern design

[48][10, p.35]
[49][10, p.39]

discourse. The idea that "culture" is something that encompasses thinking and making in the "fine arts" and their contingent disciplines alone is at the heart of the conflicts that have pervaded western design.

These conflicts started with industrialization of crafts and have continued into the beginning of the 21st century where the case is still being made for design as a field of higher study and research on it own.

Master and apprentice

It is a fallacy that design has ever been the exclusive domain of one person alone. That design and subsequent making by one person is something good and the separation of the process is inherently bad.

There are and always have been methods for conveying the instructions for the making of a design from the designer to the maker. Sketches and drawings being the most obvious.

The separation of design and production

Separating design and production does not necessarily mean that the result of the design or the making is unsuccessful, it is the ultimate purpose of the design that determines its success or otherwise. The industrial production process more often than not, is the result of political aims focused on the successful practice of greed.

Industrialization

On how industrialization required design and how industrial standardization revolutionized warfare, politics and design.

The standard screw - metric, whitworth, etc.

Standard caliber arms, etc.

(See 118)

Proportion, as dimensions of the human body relative to each other, the "golden section" A = B + C, A:B = B:C

Mention Modulor, but put it in the section on standardization (handling complexity)

The designers of the arts and crafts movement ("Jugend" "Art Nouveau")

The Luddites, Morris and the efforts at anchoring nature in the humanism of the forms and embellishments of the physical environment (and intellectual thought?)

The reaction of functionalism

The modern movement, industrial materials and production, Bauhaus, Corbusier, Maillart and functionalism.

How it has colonized the built environment and the ignoring of environment and ecology.

Design in the Twentieth Century

[?]

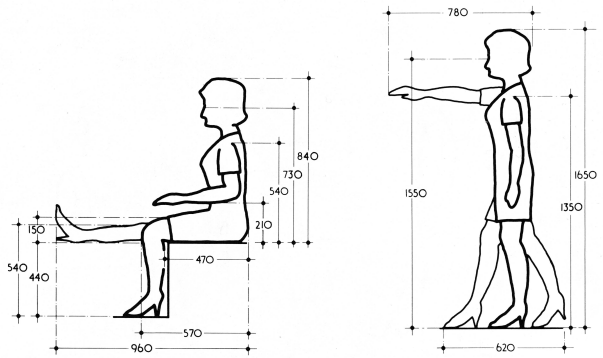

Figure 1.21: Anthropometric data. Mean average (50th percentile) dimensions of adult British female. (From Selwyn Goldsmith: Anthropometric data in [38, p.24]

The Machine Age in America (and the Soviet Union)

Romanticizing the machine and industrial production as the excuse for capitalism and the liberation of the masses. Constructivism, Tatlin, Geddes, Raymond Loewy.

2275 Reading: The Machine Age in America 1918-1941 [42]

How the machine age has continued and how it lives in the military fighting machines.

Scandinavian design and the labour movement

A short description and explanation of the roots of the Scandina-
2280 vian design movement.

Point to Ivar Lo-Johansson's writing, the labor movements in Scandinavia, establishment in the 1930's out of the socialist movements in Europe.

Ergonomics, the workplace and working environment. (Arbeidsmiljøloven).

An early user centered approach to design rooted in politics.

Art and architecture's role in providing a better environment for all the people.

Alvar Aalto, Arne Jacobsen, Poul Henningsen.

Design outside the west

Design in Japan; packaging, utensils, architecture, warfare, modern architecture, design by enhancement.

Why has Japanese design followed industry and the industrial processes so unquestioning?

Design in the Middle East. Historically, the Hiyal, the water wheels, geometry (platonic solids, patternism). [Dome, cube, pyramid and hyperbolic vaults.]

Design without designers

Bring *Architecture Without Architects*, *The Design of Everyday Things*

The point here is that design without designers has in it some very special qualities of design. This is evolutionary design, not design by fumbling, but eminently successful designs. A kayak for instance.

Commercialization and creation of markets

The voter as consumer, commercializing the presidency. "The West Wing" as commercial backdrop to the 2004 election on MSNBC. The presentation of the results as high-pace circus.

Consumerism and products for sloth

The marginalization of women (The Vibrator Book), the elevation during war, the subsequent marginalization to the home. The sustainment of a market for useless "need-to-have" products.

"The Whole Earth Catalog" - making consumerism cool by calling them tools for living.[7]

The "Sears catalog" and the growth of mail order consumerism bringing products to the farthest corners of the market.

Get an illustration from an old Sears catalog. Causey[12]

Design for the separation of the sexes by forces of nationalism

Designing for the separation of the sexes, commercialization of sex and the sexes.

Illustration?

State, capitalism and the industrial capitalist establishment.

(To work during war, home after war and to work for consumerism.)

Designing for political ends. Designing systems that work for the politics of the state.

From designing finance and trade systems and organizations for conquering colonies, imposing new production, importing the raw materials, manufacturing products and re-exporting them, to designing objects for and of production to sustain the process.

2 Theory

Design is concerned not with how things are, but with what they might be.[1]

(Here goes the discussion on knowledge, language and order as interactive support of our cognitive abilities and using the resulting inquiry in the whole process of making.)

Rhetoric, forethought, inquiry, experimentation.

2.1 Indeterminacy of subject matter

> There is a tendency among theorists to reduce design to a form of science, as if there is a fundamental predictive quality in designing that has eluded practicing designers. The assumption is that design has fixed or determinate subject matter that is given to the designer in the same way that the subject matter of nature is given to the scientist. However, the subject matter of design is not given. It is created through the activities of invention and planning, or through whatever other methodology or procedures a designer finds helpful in characterizing his or her work. Of course, one may argue that the subject matter of the

[1] Herbert Simon as quoted by Buchanan[10, p.42]

sciences is not entirely given; it must be discovered in the activities of scientific inquiry. But discovery and invention are essentially different. Discovery implies that there is something constantly available, waiting passively to be uncovered, and that the discovery will yield only one result, which may be confirmed by other experimental techniques for questioning nature. In other words, there is a determinacy in natural science, and the goal of inquiry is knowledge of properties and predictability of processes.

There is no similar determinacy in the activity of designing. The subject matter of design is radically indeterminate, open to alternative resolutions *even with the same methodology*. One may speak of "discovering design" because one is concerned with determining what design and the products of design are, or have been, in the twentieth century. The issue is a question of fact, and observations may be verified if someone else examines the evidence from the perspective of the claim. But of the designer, one speaks most often of creation and invention, and only casually or mistakenly of discovery. The scientist *discovers* a natural process or a natural law, but the engineer or designer invents a possible application or a new use suited to a particular product. There are many determinate constraints on the work of the designer, but the consideration of constraints is only a background for the invention or conception of a new product.[2]

2.2 Understanding design

Underpinnings in language, learning and communication.

[2] [10, p.24]

2.3 Historic notes on the understanding of design

On how design history is almost exclusively eurocentric and when it does take into consideration other cultures, it is invariable in a european perspective. (Japan for instance.)

Point to bits on design history "ancient world, Renaissance, modern movement".

> Al-Jazari's *Compendium on the Theory and Practice of the Mechanical Arts* was written two centuries after this time of feverish assimilation of kowledge. Completed on the 16^{th} of January 1206, fifty-two years before the fall of the Abbasid empire, the Compendium represents the apex of Arabic fine technology. The Ten chapters comprising 40 per cent of al-JazarI's book dedicated to detailed instructions on water-clock construction testify to this fact. In the introduction to the book, al-Jazari states that looking into the work of his predecessors and "contemplating the fullness of things", he sought to put together these works introducing his improvements. AI-Jazari's improvements were based on ceaseless experimentation with existing methods to reach longer time spans for self functioning machines. Concerning the clock mentioned in the first section of this essay, for example, he explains how he tried Archimedes' model and was displeased with it because it only functioned for one day, the first day of Cancer. He then used another model of unknown origin, which also did not work. So, he "focused thought" and came up with his own design. It takes this final focusing of thought to make the leap from the rational faculty to intuitive inspiration. The method of experimentation is meant to perform the act of purifying in order to allow that higher faculty to function. At this higher

level of empirical experience the soul of the experimenter himself is at stake; "what is now to be sought and dominated is the animal nature within him".[3]

2.4 Rhetoric, inquiry, exploration, and forethought.

The divisions of "the new rhetoric of 20^{th} century design" into *inventing, judging, deciding* and *evaluating* on the one side and *communication, construction, strategic planning* and *systematic integration* on the other are strikingly reminiscent of the standard approach to carrying out a conventional design project. Hovering over the points at which these divisions might intersect is the fifth division of rhetoric *expression and styling*. (See [10, p.45]

The mapping that Buchanan does of the subjects of rhetoric is wrong. The sequence of thought and application of rhetoric cannot be split to cover particular areas of design at the intersections leaving some isolated and not exposed to particular areas of exploration. The exposition of *expression and styling* to the whole sequence is correct but this division of thought into space becomes extremely difficult to understand or see.

Lay out the divisions sequentially or even randomly, but add the areas of application 3-dimensionally. We think, not only in 1 or 2 dimensional maps, but 3 and 4.

The sequence of divisions is reasonably straightforward.

- Inception, inventing
- Sketching ideas, construction
- Strategic planning
- Testing viability, judging

[3] [3]

	Communi-cation	Construc-tion	Strategic Planning	Systematic Integration
Inventing	**Signs & Images**			
Judging		**Physical Objects**		
Deciding			**Action & Services**	
Evaluation				**Ideas & Systems**

Table 2.1: Matrix of abilities and disciplines in design [10, p.45]

- Deciding
- Systematic integration
- Evaluating

Communication follows parallel as division that concerns all the others as does **expression and styling**.

Develop and argument and model for multi-dimensional rhetorical inquiry HERE:

That area of thinking in which thought becomes making.

On the predictive nature of design. That design is concerned not with how things are, but with how things *can be*.

What is *forethought* and what is prediction and the necessity of anticipating the future with a certain degree of robustness if not accuracy.

On design and its role in manifesting how we think of ourselves and how we behave socially and individually.

On rhetoric and its fundamental role in making design a discipline of *inquiry*, *exploration*, and *experimentation*.

> Considering the relation between rhetoric and making which has been an ongoing source of innovation in Western culture, it is easonable to suggest that what the Bauhaus lacked was a revolutionary vision of rhetoric to match its revolutionary vision of making. [4]

Is it design by questioning, rhetoric and discourse that has made Western design so successful? Is "Western" design successful in the sense that it is successful in its intended [westernized] markets or is it successful in itself, in the way it works?

There can be no doubt that free and unfettered inquiry is the fundamental prerequisite for innovation. Leaving aside the inevitability of post-capitalist cynicism and assuming that the purpose of innovation is the betterment of the long term situation of the passengers of planet Earth, it might be worth examining a few examples of situations where innovation by way of inquiry is stifled.

Powers in control and on top of the political "food chain" are inevitably conservative in the interest of retaining control and if possible increasing it. It is that latter aspect of growth, lest control be lost to someone growing faster, that provides the paradox and the hope for change. In order that power be retained, things must changes as little as possible, but by the same token, innovative ways of retaining that power must be developed. And so it remains only to institute some form of control that ensures that only designs that contribute toward the retention of power are developed, and nothing else.

[4] [10, p.38]

For some reason best left to the minds inclined to inquire into the history of thought, making and interaction of cultures to uncover, the improbable marriage of capital and relatively unfettered rhetoric

2.5 Inseparability of time and place / word and product

(See footnote.[5])

2.6 On visual analogy - things that look like other things

Because of its inherently predictive nature, the act of designing relies to a great extent on representations of that which it proposes to make. Somehow, all designs have to be represented in some way both in the process of assembly and in communicating the intent.

Why things are expected to look like what they are and when they are allowed not to. The need for visual and functional integrity.

Reading: Barbara Stafford[37]

Examples: Houses that have faces protecting attics and cellars, straw basket - porcelain basket - plastic basket, editor/pencil - text-processor/typewriter - Boeing / Lockheed fighter.

[5] I can't imagine what came over me to write this, but it must have been something smart, so I suppose it should come back. If it doesn't, it won't have been that smart after all.

2.7 Thresholds in resolution and [understanding?] complexity

When problems become increasingly complex, they cross thresholds of resolution and complexity where the need for other forms of representation than simple overview manifest themselves.

Patterns as a means of organizing and comprehending complexity. Visual patterns and symbolic patterns, induced both by nature and in design.

Problems or structures of components of knowledge will at first be of a degree of complexity simple enough to keep in mind simultaneously as they are evaluated and adjusted against each other in an effort to arrive at a resolution of the inherent challenge. But as complexity increases, some means of representation must be found to reduce the components being simultaneously handled to a manageable number.

Representations of complexity are formalized in many ways both in the arts and sciences. The graphic arts, cartography, mathematics, theorems of physics, standards represented literally, numerically and semiotically, are but a few of the ways complex information and knowledge is simplified to manageable levels.

2.8 Aesthetics

The place of art in design. How we have common cultural understandings of what is beautiful. How we perceive efficient things to be beautiful, and how the history of an objects or its rarity influences on the way we form common opinions on standards of beauty.

Expression and style bringing out positive emotions (graphics, words, sound) such as familiarity, confidence, etc.

Figure 2.1: Hierarchy that accommodates instability.

Figure 2.2: Grid that ascertains stability.

How there is a common understanding that natural forms are esthetically pleasing.

Reading: *Digital Aesthetics* [15]

2.9 Ethics and class structures

Discuss the problem of arrogant designers. The separation of the classes in design. The arrogance of "design without designers" - Donald Norman doesn't make it any better. Brochmann and the arrogance of "kraftsosialisme", but his informal way of presenting design. Erik Hesselberg's book on the Kon-Tiki expedition. What about design for children? ("KonTiki and I" was a children's book.)

There is nothing wrong in designing for the upper classes, but there appears to be an attitude that *design* is for the upper classes alone.

Can there be "good" kitsch? Is it that which makes us feel that popular design in foreign cultures is kitsch. Is it kitsch to them or only to us? Why is it that the western view of design is the only valid one?

This is not a matter of aesthetics, but ethics. Is there something quantifiable or qualitative about design that allows it to be characterized as "good" irrespective of the cultural in which it is made?

- Respect
- Handling taboos
- Fulfilling needs
- Justice
- Material quality
- Cultural belonging

- General usefulness

3 **Activity**

It is the activity of design, the foregoing inquiry, the application of inventiveness and analysis to physical objects - often quite complex amalgamations of objects, to organizations and to systems that in themselves can very well be inanimate to the point where they can be argued to be abstract, that places it ...

It is customary to divide the concept of design in the 20^{th} century into four broad areas:

- Industrial design of objects and products.
- Graphic design which appears to also to intersect with some of the visual arts.
- Communication design which in many ways border on graphic design.
- Interaction design of real-time feedback systems.
- Design of organizations.

However, it seems that these divisions are important for designers involved in each or several of them. In complex and highly multi-disciplinary fields such as architecture, where design comes to involve a whole conglomerate of categories included in (or in addition to) the above, these distinction come to have less significance.

I have placed design methods here rather than with theory, because it is about methodologies of making rather than thinking or discourse. Transforming design methods (examples usedin in other fields) is a problem

How designs scale in complexity is a determining factor in their success. This part examines a series of objects and systems showing how their size and complexity impend on the way they are designed and produced.

The first are simple objects that are often part of larger, more complex structures and organization in their production and distribution. It goes on to discuss such objects in terms of digital environments, then to examine large, complex systems that increasingly rely on digital environments to function. Finally a discussion on how digital environmnets are created.

3.1 Who designs

We are often confronted by statements in the media characterizing someone "The *architect* of the Oslo Accords"[1] or phrases like *designer tomatoes*. Although neither the writer nor the reader may have much knowledge of what design actually involves, in reality they come quite close to voicing what abilities and skills they expect a designer to have.

To anyone consciously concerned with design there comes at one time or other the acknowledgment that virtually everything around them is in some way designed to some end. There are vague traces in the ground of animal traps used by stone age hunters in the high mountains, where the unaware trekker expects to find an environment untouched except maybe by trekkers before him. The map of the USA, barring the mountain ranges in the hinterlands of both seaboards, is one great grid of roads running north - south

[1] Attributed to just about every person involved in that misadventure.

and east - west. Where there are greater densities of population the grid simply becomes denser until the resolution is down to that of the city block with main streets and back alleys. Although the layout might not be as rigidly Euclidean[2], most other places on the face of the Earth show some trace, not just incidental, but of change planned by human endeavor. The only major areas of the planet that do not bear overbearing marks of planned change are the some of the Arctic and Antarctic expanses and much of that last frontier the ocean floor.

It follows that design is a major part of that human social activity carried out both by professionals and others who make design decisions aimed at foreseeing how a thing can be. There are principally two kinds of person most intimately involved in the design of a thing. The designer, professional or otherwise, entrusted with forming the proposed solution to the design problem and those who come, though various responsibilities, to make design decisions. On the level of industrial or software design, for example of an object of utility such as a coffee cup or billing software, the decision makers are principally the software designers and marketers. In the case of a municipal park, it would be the landscape architects, politicians and bureaucrats.

About increasing specialization that works against comprehensive curiosity. See B. Fuller.

The conflict between design theorists and designers in everyday practice

As much as theorists in the field would like there to be a "sound intellectual foundation"[3] for the application of practical design, it would appear that the overwhelming bulk of design work - es-

[2] It is not by accident that as of January 2005 there were 60,000 hits on Google for "Euclid Street".

[3] [10]

pecially that realized outside of the academically trained design community - is carried out on no such foundations.

What is even more alarming it also appears that there is serious doubts about the success or viability of the last 3 - 4 decades of work on design methodology.[4] Is there a parallel between our everyday designers and the generic designs of previous, more sustainable societies?

Are there criteria for judging the success and failures in these designs when they are held up against each other? "artistic beauty"? functionality, integrity of materials and expression?

3.2 Design methods

A description of design methods. A couple of examples and short descriptions. Illustrated with some of the sketches from students' work?

Transforming design methods (examples usedin in other fields) is a problem

Reading: John Chris Jones *Design methods* [22], Bryan Lawson *How designers Think: The Design Process Demystified* [24].

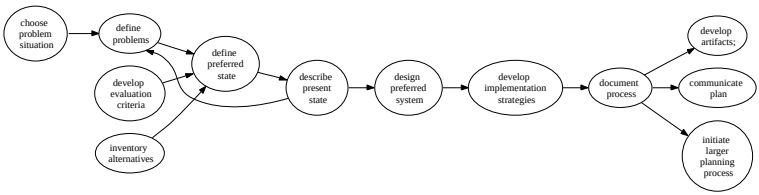

Figure 3.1: Buckminster Fuller's Design Science Planning Process

Buckminster Fuller's "Design Science Planning Process" [19]

[4] [20]

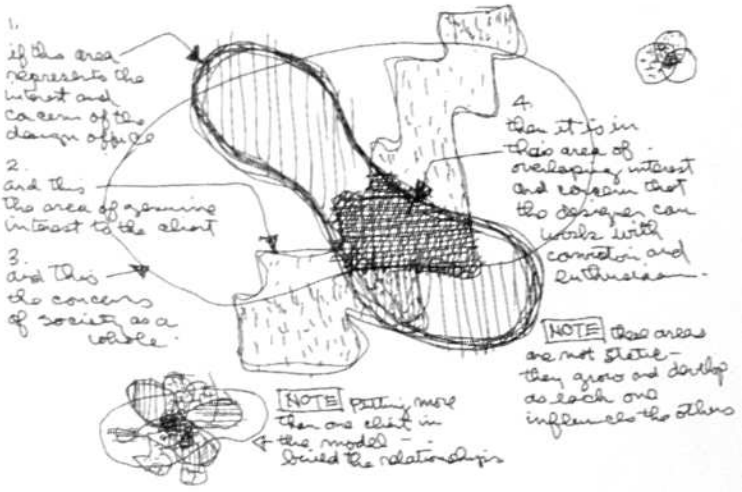

Figure 3.2: Charles Eames's *Design Diagram*

The Eames *Design Diagram*:

1. If this area represents the interest and concern of the design office
2. and this the area of genuine interest to the client
3. and this concerns society as a whole
4. then it is in this area of overlapping interest and concern that the designer can work with conviction and enthusiasm.

Note: These areas are not static - they grow and develop - as each one influences the others.

Note: Putting one or more client in the model builds the relationship - in a positive and constructive way. [16, p. 177]

On the conflict between design theory, design methods and the everyday practice of design.

Reading: Gedenryd [20]

3.3 The Design Process

The design process itself is a sequence of activities that need to be organized in some fashion in order for the process to be accomplished in a timely and economic manner.

Planning

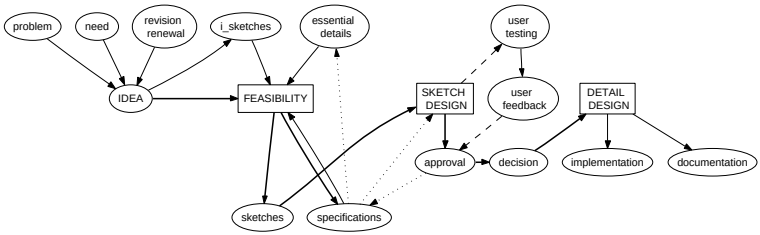

Figure 3.3: The planning process

Time plans

Economy

3.4 The User

The user is surprisingly often the most neglected aspect of design. Not that the end user of a particular design (object or system) for human use is thought to be anything other than a human being. The surprising lies in how many aspects of the end users human needs are often neglected to the advantage of

other motivating factors such as profit or power. In the realm of environmental systems such as town planning and architecture, the stated ideals as they are observed by historians have shifted considerably over time since planning was first implemented as a discipline by military officers of the 17^{th} century. The three major concerns of planners were ease of defense, fire prevention and sanitary conditions in that order.[5]

These three functions were the driving ideals of town and home planning up into the industrial age when modern forms of warfare rendered redundant the traditional needs for defense against a land-borne invader. The population explosion that came in the wake of industrialization and violent urbanization of industrialized countries shifted focus to more sophisticated forms of sanitary infrastructure to support larger populations, transportation of supplies, products, and people, low-cost mass housing for workers, and planning for new common technological infrastructures. The latter were special in that they were low visibility systems for transporting energy or signaling that in their potential energy or power of communication far exceeded the visual magnitude of the physical structure of their carriers. These were the new distribution systems for water, gas and later electricity and of course the real time communications networks such as the optical telegraph and then the electric telegraph.

The first half of the 20^{th} century saw major shifts in the direction of environmental design and planning. Attention slowly began to focus on the individual in some aspects. At least the individual as member of an idealized group. Social criticism in the latter half of the 19^{th} century, which drew attention to the social conditions of factory workers, the social upheavals of the first world war, the great depression and finally the second world war, all

[5]Leading to the frequent use of the water-filled moat where possible. The main function of which was defense of the structure or town within, a service that might well be enhanced by its secondary use as cesspool. A third function would be that of reservoir for fire-extinguishing purposes.

brought about a greater awareness of the necessity of reforming both working and living conditions of the "masses".

Particularly the socially disastrous effects of both wars and the intervening depression turned the attention of planners and designers to remedies that might alleviate the general suffering of the lower classes and the financial losses of the upper. Keynsian economics[6] and Marxist theory clashed as planners focused on economic growth and full employment. Two other aspects of design and planning also became apparent; attempts to mitigate the effects of industrial pollution and the application of industrial production to working and living space. Economic planning and functionalist design was characteristic of the western world as it was polarized by the "Cold War".

It has been the latter half of the 20^{th} century and particularly the time after 1968 that has brought the user as individual with individual needs to the attention of planning and design. Environmental issues both on the macro and micro levels have become important issues for planning of economic sustainability.[7] Such issues have become understood to affect not only the global society but individual, personal health and survival.

The individual as user has become the focus of planning efforts as various target groups in an increasingly consumer oriented society are identified. Groups with special needs voice their wants and ambitions, as other groups are singled out as potential customers. Thus women, children, the disabled, elderly, ethnic minorities, young voters, and so on become gatherings of individuals that can be identified as a particular kind of user with specific, classifiable traits.

[6] John Maynard Keynes, 1883 - 1946

[7] "Sustainability" is interpreted by some as balanced, zero-growth systems and as sustained growth by others.

Who is the user

Although it may seem obvious, identifying the user of a particular design may not be easy. And once the user is thought to be known, attempting to identify with the user is essential to understanding the problem at hand.

The user is not always the client, however, the client may feel that her needs and demands as the one paying for the design are more important than those of the end user.

Depending on the aims of a design finding a user and understand what that user's needs and preferences are often become a circular question.

Identifying the user. The user doesn't know what to choose before she knows what's possible and doesn't know what's possible before she has used.

User tests and surveys.

Things that are easy to learn aren't always easiest to use.

User centered design

Various methods and systems for engaging the user in the design. Donald A. Norman on user-centered design. [17]

3.5 Design for designers

On who we design for and where the concern for the user ends.

> I have been increasingly bothered by the lack of realitv in academic search. University-based research can be clever, profound, deep, but surprisingly often

> it has little or no impact either upon scientific knowledge or upon society at large. University-based science is meant to impress one's colleagues: What matters is precision, rigor, and reproducibility, even if the result bears little relevance to the phenomena under study. Whether the work has any relevance to broader issues is seldom addressed. This is a common problem in the human and social sciences, where the phenomena are especially complex, variable, and heavily influenced by context. Most academic study is designed to answer questions raised by previous academic studies. This propensity tends to make the studies ever more specialized, ever more esoteric, thereby removed even further from concerns and issues of the world. [33, p.xii]

Elitism in design, does it therefore follow that **that form of** design is bad?

Popular design or design that is popular is not necessarily good either.

How to resolve the paradox?

3.6 The Sketch (and drawing)

On the importance of sketching as a tool, as an extension of mind. What is it about the sketch be it graphic or written that makes it such an indispensable aid to design? 3.4

Drawing as documentation? Oslo ATCC?

Consider the sketch as a way of thinking and expressing thought, while the drawing as one of presentation of a set idea.

The ability to sketch is an inherent part of designing. Cross considers the use of *nonverbal, graphic/spatial modeling media* to be one of the four core abilities of the designer[8].

To "sketch" need not necessarily mean the making of a two-dimensional drawing with pencil and paper. It also encompasses

Method of observation

The sketch as method of observation and recording was probably made most famous with the anatomical studies of Leonardo da Vinci. The apparent object of the sketches was to record that which was observed during dissection. However, some of the are da Vinci's earlier representations of how he understood parts of the human anatomy to work were after the writings of Avicenna[9]. As such the experimental drawing becomes a way of exploring thought and as a language of thought, a way of thought in itself. Later the sketches document quite clearly how his knowledge of the human body and (to some degree) its functions changed drastically as his dissection work progressed and he quite accurately and assertively recorded the body's parts as they appeared. In this role the sketch becomes a method of observation and documentation, but its quality of reflection does not entirely disappear.

Sketch and photo - focus and simplification

Method of exploration

Method of communication

USE A SKETCH OF SOMETHING TO BE.

[8] [14]

[9] Ibn Sina 980-1037 CE `http://almashriq.hiof.no/ddc/projects/saab/avicenna/`

Figure 3.4: Sketch from lecture.

3.7 Making Things

2820 Small objects and little things. A short introduction about little things that look like what they are and objects that some times don't look like what they are. And why that is.

The design of everyday objects.

Use clay tobacco pipes as subject.

Figure 3.5: Christopher Bocklum's white caolin clay pipe type 2. (Drawing by Kristin Thorrud)[29]

Very short history on the nature of an object that has been burdened with moral and ethical doubt.[10]

Description of how they are made and the distribution of labor in their production.

A discussion on the evolution of the form over time and geography.

On production, distribution, regulation of trade and distribution.

Something on the object as a subject of emerging consumerism.

A conclusion on why the design and production of small objects is a manageable endeavor.

Small applications

Commandline programs

Small, simple commendline apps like ls -lR and combined ones like injectxml. Single and batch

Complex ones like LaTeX

GUI applets

Apple

Things that are not

On things that appear to be something they are not.

See page 97

The small basket, porcelain basket and plastic porcelain basket.

[10](From `http://www.ludvigsen.hiof.no/webdoc/bocklum`)

Why is it that things mutate?

The recognizable or the endearing?

Are there such digital things yet? Or is the whole WWW populated with such.

3.8 Design, technology, production, product, use

On the interdependency of design, technology, product, use. How it works and how we think about it.

On romanticizing manufacturing and production.

Ergonomics

3.9 Organizing systems that grow

On complexity and thresholds applied. Say something about Google here? Is this where you want to discuss it at length? No see **??**

Information systems

Collected, collated information

Catalogs

How lists of the right information (white pages) become tools (yellow pages) - Moholy Nagy.

The new web-based catalogs and maps. Google?

Libraries

Private book collections (cite Pepys)

Public libraries and archives.

On the net and the systems growing up around them. Bibtex, RSS, RDF. Google?

Knowledge systems

Control systems based on knowledge to organize complex tasks.

Public finance

Census, public registries, tax collection, budgets and public spending.

Planned economies and free markets.

Air Traffic Control

Very short history, some diagrams and explanation.

Emphasis on standards and international cooperation.

Some remarks on the political power of AT controllers.

Google

Where catalogs and libraries come together to become powerful tools. Is this just a little bit more powerful yellow pages?

Handling complexity

Systems and subsystems, standardization, classification, common means of communication.

Reading: Complexity and Contradiction in Architecture[39] and Waldrop [40]

Proportion, as dimensions of the human body relative to each other, the "golden section" A = B + C, A:B = B:C Mention Modulor, but put it in the section on standardization (handling complexity)

Some concluding remarks on complexity and how it is imperative that it can be handled to accommodate for the design of systems and organizations that are more complicated than 7 and 13.

Draw some analogies to illustrate. Systems for financing activities of state.

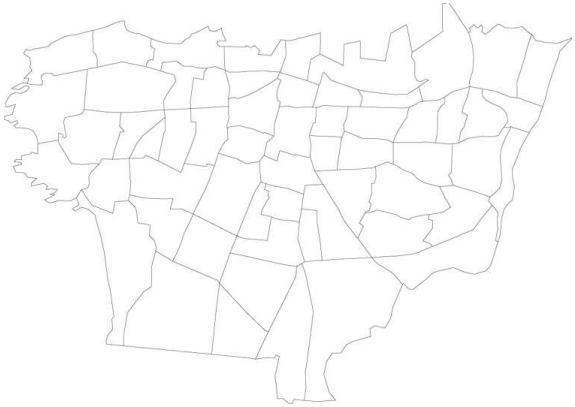

Figure 3.6: Municipalities, the simplest breakdown of the plan of a city. (The municipalities of Beirut, Lebanon.[2]

Various standards for physical street addresses.

Figure 3.7: Beirut' street plan, a somewhat more complex delineation of the city plan.[2]

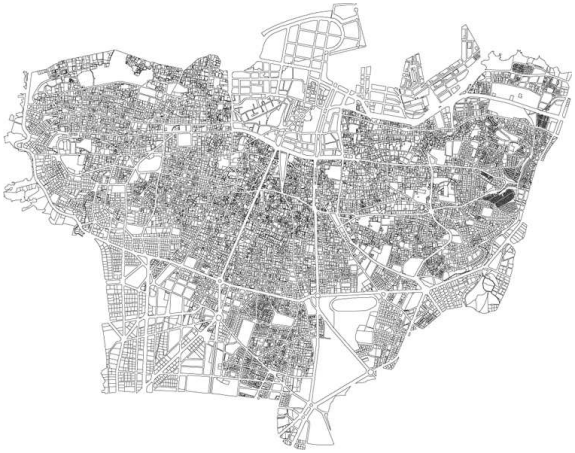

Figure 3.8: Plan of land ownership parcels, the next step in subdivision making the plan of a complex city comprehensible to planners. Beirut, Lebanon.[2]

Figure 3.9: The buildings of Beirut. The most complex level at which the entire city (within the municipal borders) can be comprehended in plan.[2]

- No number (by name - Loshavn)
- Gamlebyen in Fredrikstad
- Main street (odds and evens)
- Beirut (both and with numbered streets)
- Chicago

3.10 Creating environments

Architecture as a solution. Do some modicum of friendliness between architecture and engineering as disciplines where design in some form is essential for success.

Robert Maillart, illustration of bridges, Corb and something new. Explain why you stick to our time instead of getting lost in the

vast expanses of history. Show a small simple and a vast complex building. Pictures and plans.

Bring in digital environments as examples here.

Architecture as a seat of design

How design comes together in architecture and how the relationship between physical and information architecture can be mapped out and used.

From small to large

grep / a GUI clock or calendar

Operating systems, programs, and large systems.

Vast complexity

Huge systems and why they fail.

WWW

Internet

Managing vast complexity as a voluntary effort.

3.11 Environmentalism

Ecology, sustainable development, total energy use, environmental concerns, regulation of the working environment, ergonomics, noise abatement (insert a SID) are all rather recent concerns of design.

Concerns, many of which are being challenged by "popular" governments questioning the science in support of capital, even using religion as an aid.

3.12 Commercialization and consumerism

Keep this part limited to the way it works and not the ethics. Commerce and consumer are obviously necessary, they are the purveyors and users. Talk about transportation, distribution, (net distribution), packaging, advertisement?

4 Value and responsibility

Write some stuff on what sort of responsibility the designer has. There is in some way a taste of elitism in this idea too. As if designers have some sort of special responsibility that ordinary people don't have?

> To do science is to be political if only because it is a political decision to spend some amount of limited human energy and social resources on a particular question. Most scientists are, at a minimum, liberals, although it is by no means obvious why this should be so. Despite the fact that all of the molecular biologists of my acquaintance are shareholders in or advisers to biotechnology firms, the chief political controversy in the scientific community seems to be whether it is wise to vote for Ralph Nader this time. We might expect, then, that the actions of an administration strongly protective of the interests. of the owners of capital and identifying itself culturally with religious fundamentalism should be the cause of protest.
>
> If knowledge about the natural world is to rationally influence the decisions of an informed electorate, then people must believe that scientists tell the truth about nature insofar as they know it. While we might agree that prior political commitment could lead us to ask one question rather than another, or to put more

> weight on the result of a study that conforms to our prejudice rather than one that refutes it, every scientist must agree that outright fraud is beyond the pale. Putting aside the issue of morality, scientific investigation would be destroyed as a useful human endeavor and scientists would lose any claim on social resources if deliberate falsifications were not exposed. So scientists must be on the alert, ready to detect lies arising from within their institution. But this leads to a contradiction. To survive, science must expose dishonesty, but every such public exposure produces cynicism about the purity and disinterestedness of the institution and provides fuel for ideological anti-rationalism. The revelation that the paradoxical Piltdown Man fossil skull was, in fact, a hoax was a great relief to perplexed paleontologists but a cause of great exultation in Texas tabernacles.[1]

4.1 Creating

(I'm not sure what I meant by this when I made the outline, but I suppose it was clear at the time. I suppose it was an enumeration of the stages a designed thing goes through and the involvement of design at the various stages.)

The ethics involved in creating something. Is it really needed, it is an object of luxury, but undeniable beauty, or is it an object of truly questionable ethics?

Also take into account the pleasure of creating something. Surely there is a correlation between the satisfaction of creating something and its usefulness.

[1] [26, p.39]

In this part I want to discuss the process of creating and address the quandary of talent.

The WingedVictory of Samothrace, in spite of its connotations of supremacy in war, can only be considered – ***TRY TO FIND AN OVERWHELMINGLY BEUTIFUL AND BENIGN OBJECT OF INDUSTRIAL DESIGN.***

The AK47 (Fig. 4.1) is undoubtedly one of the most widely used and renown objects of cruelty and death in modern times. It has caused the death of more people than But as a pure object of engineering it has its own peculiar beauty, both in concept and production.

Figure 4.1: Kalashnikov AK47 assault rifle.

4.2 Production

On how the technology of production influences the design. Limitation and constraints that affect the form and function.

(Find an example from CS that is not "sliding shuttering".)

4.3 Marketing

Use a good example of good and ridiculous marketing that play on cultural factors and the "have to have" syndrome.

Figure 4.2: The Winged Victory of Samothrace.

4.4 Use

On everyday objects that are good to use. Maybe Engelbart's example of the pencil with the brick. On objects that show responsibility and value in their form for use.

4.5 Power and status

Doubtless; the automobile, the cool mobile phone, the Hasselblad camera, Swiss watches, atomic clock watches, "designer" things.

4.6 Sustainability

The bicycle.

4.7 Energy

The THINK car.

4.8 Reuse

European cars in Africa.

The idea that old battered up European cars are sold to West African republics to be resurrected in repair yards.

4.9 Social and capital manipulation of employment

Indian child workers.

Child camel jockeys in the Gulf. (See fig.4.3)

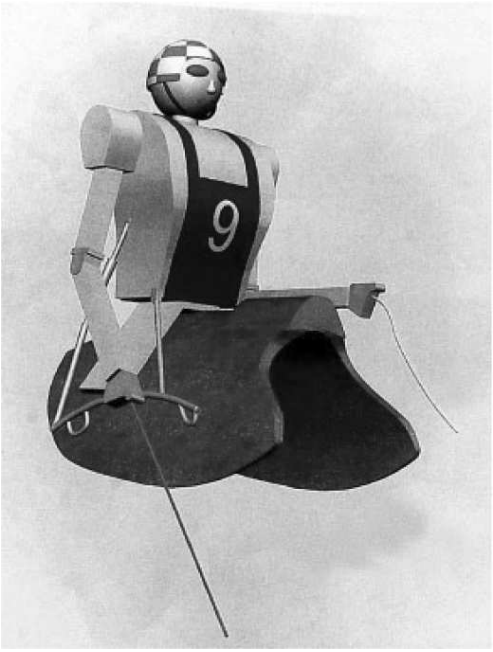

Figure 4.3: A Swiss company is designing a camel jockey robot for a client in the Arab Gulf as an alternative to the criticized use of child jockeys.

4.10 Maintenance

Military maintenance and operation manuals.

4.11 Documentation

CP/M manuals. The VCR manual.

4.12 Design and politics

Reading: Margolin *The Politics of the Artificial* [30]

- as a social activity
- political motivations

4.13 Patents and property rights

Government and industry pressures. The EU patent directive. Just limit the discussion here to straightforward information on patents and possible some development.

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