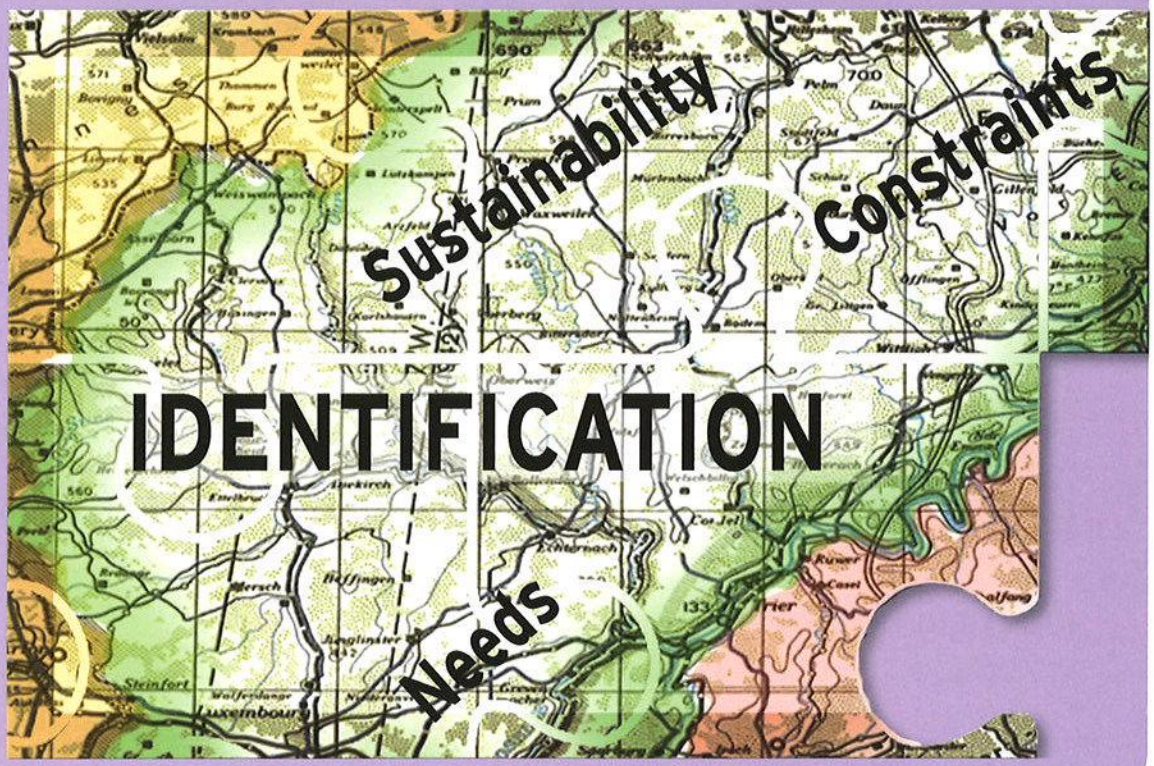
Stage 2



OBJECTIVE

This chapter covers the process of a designer identifying his or her idea and dealing with several steps that occur in this second stage, including reviewing constraints and coming up with solutions to the design problem within these constraints. Also covered is a designer's responsibility toward the community and society as a whole when faced with choices that can affect people's safety, health, and well-being.

KEY CONCEPTS

- A designer's main concerns are solving problems and making decisions.
- Design depends on recognizing and working within constraints.
- Every design has both inherent and imposed constraints.
- Designers must be aware of the larger, and often unintentional, consequences of their work.
- Sustainable practices and the protection of the environment are concerns that today's designers cannot ignore.

Figure 2.1 Identifying the problem is the first step to a new design solution. Here, two scientists check samples of treated leather for quality. The quality of the material will directly require design solutions that will influence the entire process and eventually the final product.

IDENTIFICATION

There are many ways to go about identifying a project. The project brief may arrive as a request from a client, it may be a self-directed new design, or it may be an improvement on an older design. Whatever the project's origin, designers need to identify what the design needs in a coherent way and what its limits are. A project's needs and limits are its constraints, and by identifying them, we understand what we need to engage with to create an effective design. We can then tap into our sources of inspiration and apply them to our projects.

CONSTRAINTS

Q. *Does the creation of design admit constraints?*
A. Design depends largely on constraints.
Q. *What constraints?*
A. The sum of all constraints. Here is one of the few effective keys to the design problem: the ability of the designer to recognize as many of the constraints as possible, his [or her] willingness and enthusiasm for working within these constraints—constraints of price, of size, of strength, of balance, of surface, of time, and so forth—each problem has its own peculiar list.
Q. *Does design obey laws?*
A. Aren't constraints enough? (Excerpt from *Design Q & A* by Charles and Ray Eames, 1967; appears in Volume 4 of the *Films of Charles and Ray Eames*)

A design project is a problem that needs to be solved and explained by a designer. The problem can be simple or complex, and the solution can be practical or whimsical—or even both at once.

Each problem has its own list of constraints, some more fixed than others. The constraints come up at different stages, and sometimes they are not completely apparent until after the

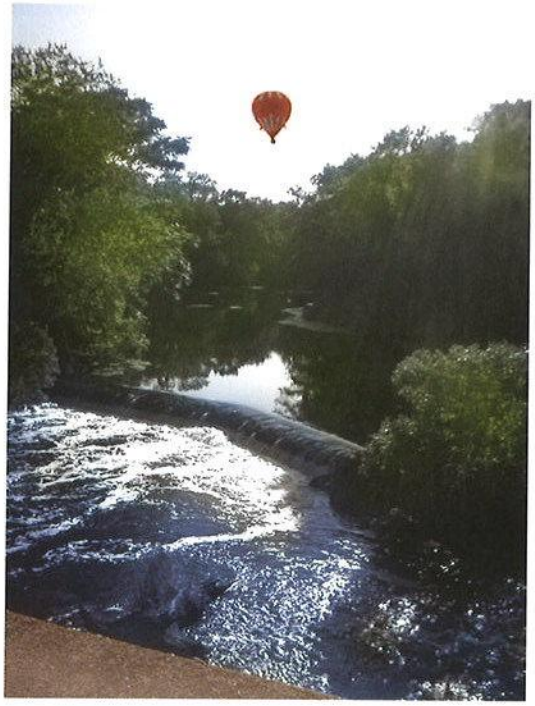


Figure 2.2 A design, like a river, has constraints that give it form and direction. You could even say that the constraints create it. A river without boundaries isn't a river. A design-concept without constraints has neither form nor identity.

final design is already in the hands of the end user. These constraints will, more than any other aspect, define the project as the idea or the solution, which begins to grow and evolve. It may seem at first that the design process will be more difficult if there are many constraints. However, the opposite is true, as long as the designer is willing to work within the constraints. Designers must not approach these constraints in a negative manner. "To constrain" seems like a negative action, but we must be aware of this as a frame and a guide that keep us from going into undesirable places. Think of a river, constrained within its banks. If designers ignore constraints, then the project may develop in an unwanted direction, which may require a designer to redesign or even cancel the project. Clients expect results as agreed, so if designers step outside the boundaries, they must do so with care.

Constraints can be either inherent or imposed. *Inherent constraints* are those directly contributing to the essential character of the object being designed. For example, a clock should have some way of measuring and displaying time, and a spoon should have a handle and a bowl. The best way to recognize a design's inherent constraint is by questioning whether the object would lose its essential nature if a certain aspect were to be removed. A clock that tells the wrong time is still a clock, but a clock that displays no time at all isn't really a clock. Therefore, an inherent constraint defines an object's identity (what it is in itself) and functionality (what it is meant to do). A raincoat should repel water, and a chair should hold its occupant in a sitting position. Conceptual artists and surrealists in the past century had a lot of fun ignoring or contradicting the inherent characteristics of objects and causing their audiences to question their perceptions and understandings of the world.

Imposed constraints are characteristics of an object's desired design that are not essential to its existence. The imposing of constraints usually (and ideally) involves choices that designers make at the beginning of a project when the desired result is defined. If designers move

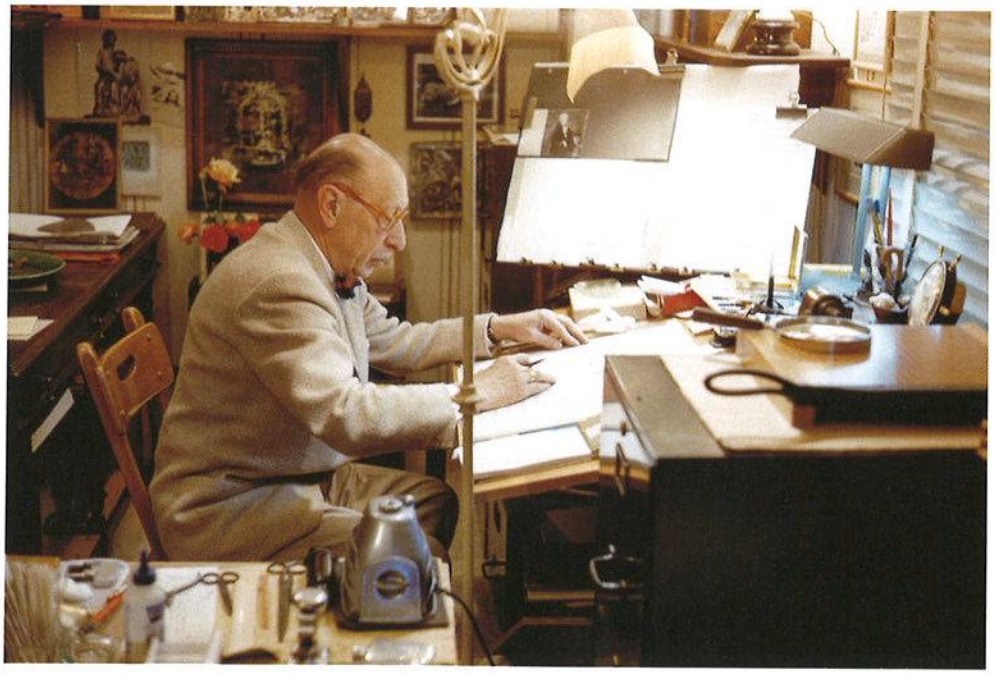


Figure 2.3 Igor Stravinsky felt that the imposing of constraints created a sense of creative freedom, as the worry of where the limits may be was now removed. The frame might be small, but within it you are completely free.

outside imposed constraints, they will still find that their designs are identifiable as objects of their class, but they aren't exactly the planned end result. For example, instead of designing a steel-encased clock, you design one with a ceramic shell. It is still a clock, but the qualities brought to it by virtue of its casing have changed.

Constraints can be imposed unexpectedly at any point during the design process, all the way through the manufacturing stage. For example, if you learn that a component needs to be a required size, it may affect and change the intended manufacturing technique, which may constrain the choice of materials, require specific coloring processes, or increase the budget, to name a few possibilities.

Figure 2.4 Man Ray created objects such as this "iron" to provoke questions about art and perception. By contradicting the object, making it not-itself, Man Ray invites thoughts on the nature of the thing itself as well as the interpretation we impose on objects to make them "art." Designers can play such games by "messing around" with inherent constraints.

Ideally, all constraints are evident at a project's start, but this is rarely the case. The specifics and budget may have arrived prepackaged from a client who was not aware of all the parameters of a project, or new developments may have unforeseen demands in tow. The designer must then realign the project, usually at a cost of time, money, or both. For this reason, it is very important to try to define all constraints at the beginning, keeping in mind that there is no shortage of possible constraints.

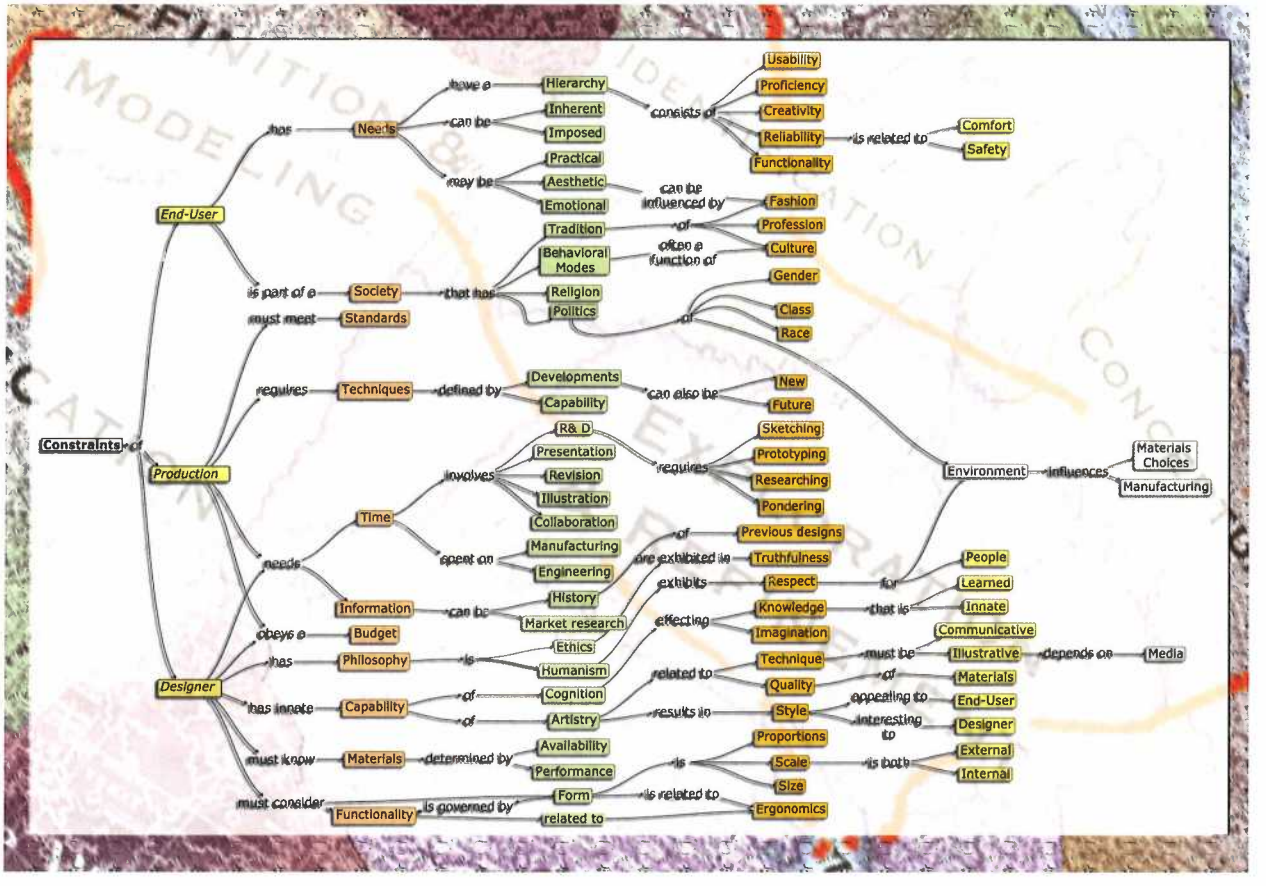


Figure 2.5 Look at any item in your own surroundings and think about how you can break down the nature of anything into a map such as this. Think about and realize the difference between imposed and inherent constraints that make the thing into what it is.

When identifying the constraints of a design problem, there are three main, largely overlapping areas in which designers should look. Constraints are determined by the needs or desires of the *end user*, *designer*, or *fabricator*. In addition, an ever-present constraint is *responsibility*, which applies to the other constraints in one way or another.

END USER CONSTRAINTS

The constraints that relate to the end user are usually the most obvious at the outset. Whatever the design, you have to deal with people. Whatever the client needs (inherent) or wishes for (imposed) is added to the list of characteristics the design must have. The client/end-user will inhabit, view, wear, use, build, or otherwise be affected by your work. Keeping the human factor in mind is absolutely necessary, whether it is directly, by working toward ergonomic solutions, or indirectly, by anticipating human interaction with your design. Ergonomic design is the art and science of working with human scale. It is a way of considering design options to ensure people's capabilities and physical limitations.

Functionality and Form

What an object does or how it should behave is determined by constraints, as previously mentioned. "Form follows function" is probably one of the most quoted maxims of modern design. It is generally taken to mean that an object's form should result from its function. The statements of any creed tend to lose their power when they are quoted excessively, usually out of context, and this particular maxim is no different. In its worst case, when it is treated as an article of faith, it has been responsible for many bad decisions. It has relieved designers of the responsibility for aesthetics. It was the architect Louis Henri Sullivan, in reference to the problem of designing tall buildings in the late 1890s, who said:

> Whether it be the sweeping eagle in his flight or the open apple-blossom, the toiling work-horse, the blithe swan, the branching oak, the winding stream at its base, the drifting clouds, over all the coursing sun, form ever follows function, and this is the law.[1]

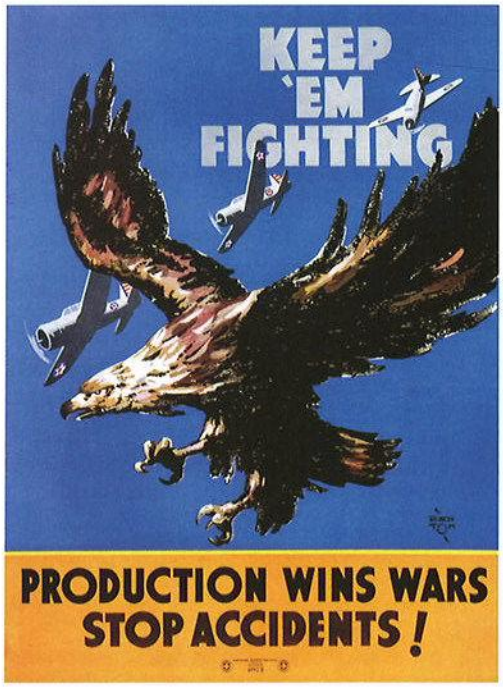


Figure 2.6 A natural system is not a design. The eagle doesn't fly because it is meant to; it flies because it can. Aircraft, however, are designed to fly and are built according to principles that allow flight.

In the late 19th century, people believed they had mastered all the laws of the universe and were excited about the industrialized future. It is understandable that such a period would generate the idea that process, or function, should determine the shape of things. Sullivan's statement, however, is a misreading of nature. Nature does not "decide" or make choices about its form *or* its function. A natural system functions *within* the capabilities of its form. A bird does not grow wings from a desire to fly; it flies because it has wings. Things in nature do what they can simply because they can. It can therefore be said with equal weight, if using nature as a model, that function ever follows form.

Strict functionalism also tends to ignore the possibility that aesthetic appeal or decoration may in itself be a design function to

consider. Essentially, the modernist/functionalist aesthetic was a response (and a refreshing one at the time) to the top-heaviness of Victorian design and an answer to the demands of industrialization. Think of form and function as joined. Let one inform and acknowledge the other in any order you like. Your main challenge is to make sure they do not conflict with each other and that both fulfill the end user's needs and desires.

Societal Constraints

Our world is increasingly globalized as far as business and communications go. It is also, at the same time, becoming increasingly fragmented culturally and politically. This highlights problems of marketing and manufacturing in other cultures. A huge portion of the world gets its imagery and ideas from the same entertainment media, while cultures that used to be under a multistate umbrella rally around their common heritage and language. To be aware of emergent trends, we must focus on the local and particular as well as the global and general and be careful not to assume anything about one or the other. Just because the whole world can watch the same television program does not mean that we have the same preferences in other fields. Religion, gender roles, and racial and class consciousness are all as intensely relevant as they are difficult to discuss. Don't presume to understand the needs and references of a culture unless you are of it, have studied it, or have a guide.

Human behavior is predictable only on a large scale and even then only very generally. But even more difficult than prediction is regulation. People will not behave in a certain way just because a designer or a planner wishes them to do so. Expecting common sense should never be a basic assumption in any design that involves public interaction.

An interesting example of a collision between design and "humanity" is a memorial fountain to the late Princess Diana Spencer, unveiled in London in 2004. Designed at a cost of $6.6 million, the memorial is a large oval stone channel set in a sloping landscaped

Figure 2.7 Human behavior becomes easier to predict as the number of people involved increases. But even then, unpredictable shifts can take place very quickly. These supporters partying after their club's victory are only predictable to a point. A random event may shift the crowd's mood and behavior.

Figure 2.8 Children at play in the Diana memorial fountain in London. The story of the fountain is one of many optimistic assumptions about human behavior.

site. Water runs through the oval, and the project was introduced with the idea that the waters were to be waded in. The whole thing was to "reflect the turbulence, excitement, and energy in Diana's life."

But water, children, dogs, and park pigeons make for a mean mix, and soon it was determined that the water was heavily contaminated with bacteria. To make things worse, waders who played on the wet granite began slipping on the stone and getting badly injured. There were further problems involving drains clogged by leaves falling off nearby trees and other debris. Three weeks after the memorial's grand opening, it was closed.

Fences were then erected around the memorial and fitted with gates so that staff could manage the number of visitors. The texture of the granite stone was roughened to prevent slip-and-fall accidents, and new guidelines were posted, instructing visitors to paddle their feet and dip their hands only if sitting on the edge of the fountain.

As part of a new safety plan, six "staff trained in crowd management and first aid" were to supervise the site during the summer. The heightened security raised the expected running costs of the memorial by more than $170,000 a year.

Safety

If safety is not a central concern right at the beginning of a design project, then it is usually the last thing on anybody's mind. There are indeed entire fields of design where safety concerns are minimal.

However, if there is even a hint of danger in a situation, it must be examined very carefully. The example of the memorial fountain for Princess Diana shows how common sense cannot always be expected and how unexpected consequences of straightforward decisions can sink a project. Marketers can (and do sometimes) go too far with their safety concerns, and a lawsuit-happy culture does not help matters any. This leads to warnings that bath sponges should not be flotation devices or that hot coffee is actually really, really hot. This is really an exercise in futility that only aims to prevent lawsuits.

Designers must be aware of the standards and laws governing materials, chemicals, and electricity. Building in redundant safety measures is always a good idea. If in doubt about the safety of your designs, research similar situations extensively and increase whatever safety factors you have already built in.

CONSTRAINTS OF PRODUCTION

The most immediate set of constraints is determined by matters related to production. The questions of materials, techniques, and capabilities are there from the start, and very few designers have the luxury of shooting out ideas first and asking production questions later.

With computer-aided-design (CAD) having taken over as the tool of choice in design studios, the line between designers, model makers, and engineers has become blurred. In architecture and industrial design, the line may never have been as clear as we are led to believe. The constraints of production are especially important to consider, now that CAD plays such a large role in every aspect, from rough sketching and modeling to printing construction diagrams.

Figure 2.9 When getting ready for production, it becomes very important to check the reality of your concept and solutions. Get outside eyes and opinions from as many sources as you can.

The software allows for the quick creation of any shape, texture, and configuration, and a regular reality check is necessary. Can what is being represented actually be constructed? Can the printer deal with the color nuances? Will the structure actually stand using this gauge of steel for support?

Reality checks are also necessary when working with nondigital media. It is just as easy (if not easier) to design an "impossible" design with a pencil and paper as with a computer and mouse. The danger involved in CAD is that the speed of execution, constant precision, and cleanliness of the output (printed or on-screen) lend "believability" to the image that a hand-drawn sketch will generally not be able to achieve. The image is therefore not questioned as intensely.

Computers aside, we must be aware of the processes involved in the manufacturing of our designs. However, we must not be so consumed with manufacturing issues that we are unable to experiment with our ideas and designs. If all that is to be done is what has already been done, then designing quickly deteriorates into simple bookkeeping. Working within constraints and using them to create something new is satisfying. The constraints of materials, engineering, and fabrication have, in the past century, been great sources of inspiration in all fields of design. For centuries, architects and builders have used the quirks of materials and construction to create rhythms and textures; the twentieth century took this to new extremes. The functionalist tendency took hold everywhere, allowing apparel designers to use seams and fasteners as visual elements and architects to highlight structural components and raw textures.

The true art of design lies in the collaboration between builders and makers and designers. Design is more than worrying about how the final product looks; how a product works is just as, if not more, important. Talk to the fabricators of your designs often and early in the process. Learn from them as much as you can and be respectful of their expertise. Strive to be well-informed and aware of the limitations of their methods, and keep track of new developments that can do away with the constraints of old technology.

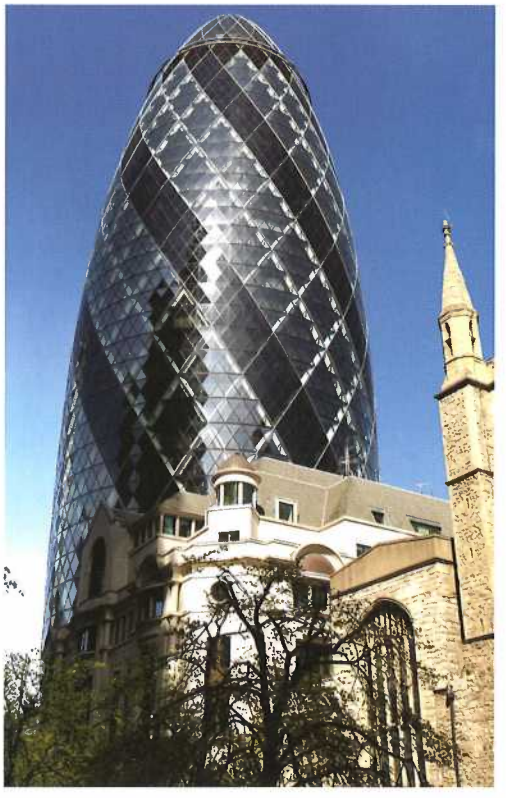


Figure 2.10 The 30 St. Mary Axe Tower in London (a.k.a., "The Gherkin"): Late Modernist architecture such as this is changing the image and skylines of cities worldwide.

Figure 2.11 Alexander McQueen RTW Fall 2008: The zipper, a most functional element, as a design statement.

CONSTRAINTS OF THE DESIGNER

Information

In designing, information is crucial; what you don't know usually does hurt you. My tutor at art school used to annoy me by saying that "designer" should read "decider." I later found that she was absolutely right, and the key to making a good decision is to have good information.

A designer must communicate well. In order for the end result of the project to be accurate, we must be sure that the information going in is clear. The lack of information about any aspect of the project may become a constraint. You may opt to design for a "best case" or "worst case" scenario.

One of the problems with decision-making in design is that designers need to make decisions well before they have all the information. The only way to deal with this is to create flexible plans that you can revise as you go. Make yourself and your clients aware of any uncertainties and update them whenever there is a revision. What may seem obvious to you may not be so clear to someone who encounters the project only intermittently.

Time

Designers have deadlines. Constraints of time are perhaps the most acute constraints of all. Time is distressingly difficult to make up once it's lost. We are often surprised and frustrated by the fact that every time we need to meet a deadline we work up until the last minute. This becomes easier to bear if you understand that last-minuteness is, in a way, part of the process. If a project has not come to a satisfactory conclusion or is still offering possibilities, we always take all the time given to us. The flip side is C. Northcote Parkinson's Law, which states, "All work expands to fill available time." Parkinson (who was being sarcastic about the British Civil Service) maintained that every job takes all the available time allotted to it because nobody works longer or harder than they need to. This principle is, unfortunately, often used by managers to justify tight schedules and is really not all that helpful in planning as it is often taken to mean that the job will get done in whatever time you allot to it. It is easy to see how that logic breaks down.

The Tailor's Rule: First, Do the Math

Solving the deadline-panic comes down to being a bit pedantic: Take the time available and divide it by the number of tasks that need to be done. Say you have a presentation due next week that includes 12 ideas mounted on boards. You have an entire week of 10-hour days. If you don't intend on working on the presentation day itself (never a good idea!), you have 6 days. So, you have half a day, say 5 hours, for each drawing in the presentation. However, there may also be other things that need to get done in this timeframe. You may have to get supplies and samples or do some research. Once you create the drawings, you also have to account for assembly of the presentation; you'll need time to do the following:

- mount them
- write captions
- assemble and mount any supporting material (color swatches, detail views, diagrams, samples, and so on)

Finally, let's say you need to have daily meetings to show your client or colleagues preliminary sketches. Suddenly, instead of just the initial 12 drawings you needed to do, you now have 3 additional tasks for each. Your task list is suddenly up to 55. It would seem you have, on average, a little more than an hour for each of the tasks you have to perform in the next 6 days. This also doesn't account for the fact that you may want to factor time for the following:

- redoing something
- dealing with unexpected problems
- leaving time for personal errands
- having a life

Applying the Tailor's Rule, or doing the math, is often a sobering exercise but allows people to see why we are so often scrambling at the last minute to finish projects and presentations.

The Tailor's Principle: Everything Takes at Least 15 Minutes

When you plan your time, you need to take into account that every significant action will probably take at least 15 minutes. In other words, you can't realistically fit more than 4 tasks, on average, into an hour. Regardless of whether it actually is 15 minutes or 10 or 20, the point is a good one because it keeps planning "real," if not entirely reasonable.

Let's say you had 60 hours to complete the 12 drawings. You decide you can finish the research and supply gathering in 1 day (10 hours), leaving you 50 hours in the 5 remaining

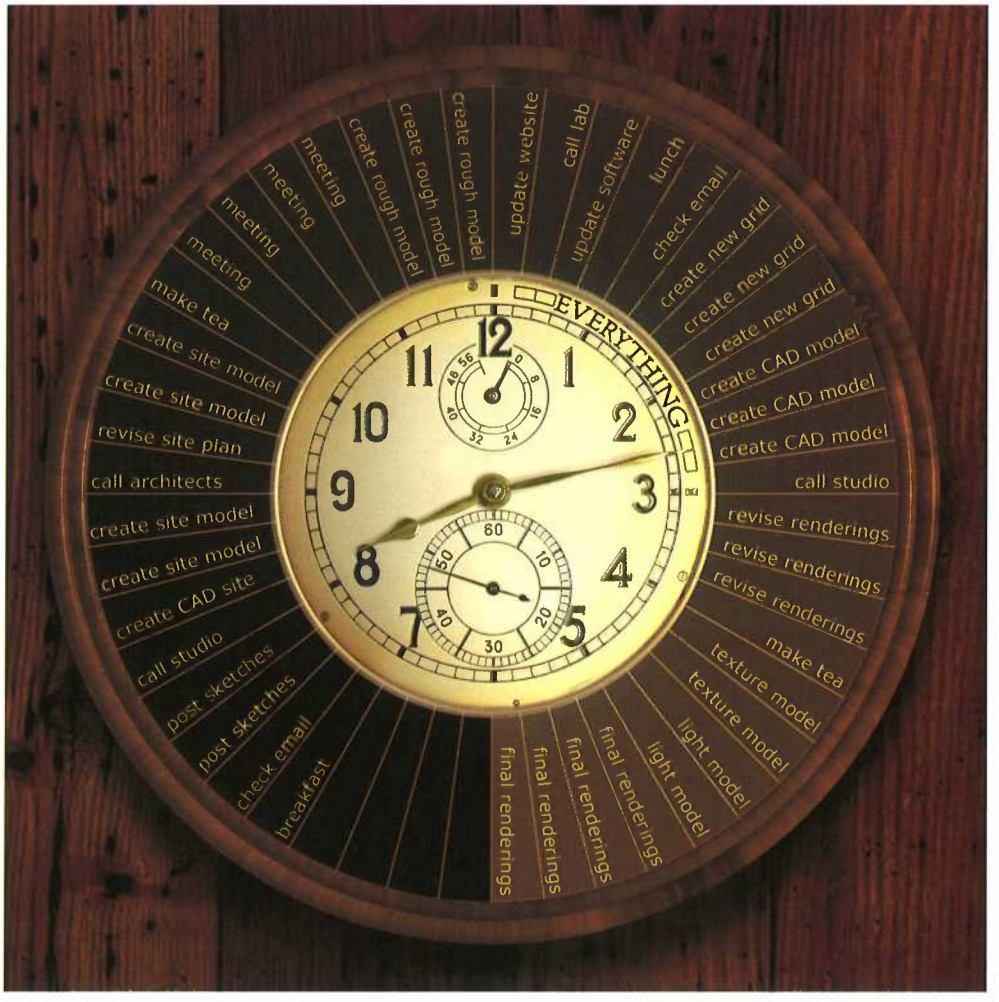


Figure 2.12 A day in the life of a designer. Note how a number of "little things" build up to take a large portion of the day. Another factor is the breaking up of the day. Long coherent spaces are rare.

days for the presentation boards. Put aside 1 hour a day for lunch and breaks. Now you have 45 left. You decide to allow 2 hours for each illustration—1 hour for sketching and drawing and 1 hour for finish and color—which takes 24 and leaves you with 21. Your daily meetings and other activities with clients, associates, and others will take about 90 minutes a day. You now have about 14 hours left to assemble support material, mount the drawings, and write captions for all 12 drawings. This leaves you with 14 hours ÷ 12 drawings = 70 minutes to create each drawing's presentation, and as each of these involves 3 tasks, you have just a little more than 20 minutes to complete the 3 tasks for each. Therefore, to create a presentation of 12 drawings, you must finish something every 20 minutes for the next 5 (10-hour) working days. Note that this doesn't allow time for any mistakes or downtime over the course of 1 week, which is neither normal nor healthy. This is where the greatest mistakes in planning creative time happen. We tend to assume that we can work flat out, at a constant rate, with no interruptions for days on end. However, most of us need to amend the Tailor's Principle to include downtime.

Amendment to the Tailor's Principle: Plan for Lag Time

One week of 10-hour days does not sound too bad. No matter how focused you are, unless you have a place to hide with your work, there will be interruptions. Life and its attending chaos intrude into the most carefully laid-out plans. You must therefore plan for the interruptions, such as the phone ringing, meetings not beginning or ending promptly on schedule, distractions of any kind, and so on. Planning time only to work is fine, but you have to realize that you need to be creative—not just busy—and as you saw in the Inspiration chapter, you must have time to refuel.

The solution is to factor "couch time" into your planning. This will help keep you sane in the long run. We decide to give ourselves 12-hour days instead of 10-hour days. The 2 extra hours a day are divided between extra assembly time and life's chaos. By adding 2 hours to each day, we have made sure that we won't have to add 12 hours to the last day. Without factoring the math, we may very well be in danger of showing up at our presentation without having slept and with unfinished or hurried-looking work. This is never good.

Time constraints are frustrating. We never feel there is enough time, and we usually feel that having a little more time will make things so much better. However, it is good to remember that the *best you can do* in a given timeframe is always the *best* you can do, whether it's the best you can do in three days or three years.

Materials

Materials must conform to both inherent and imposed constraints. You need to learn about materials, what they are and how they behave. The capabilities of the materials you choose will direct your project throughout. From the time you begin sketching, through preparing for production, to the eventual cost of shipping, the materials you choose will be a constant factor in your work and decision-making. If it is not immediately clear what materials are going to be involved in your project, research by considering both form and function and how each will be influenced by material choices. Strength, comfort, weight, and aesthetics should be considered, as well as production issues of standards, price, and availability. There may be color choices involved and often materials can carry an emotional, psychological, or political message, such as in the field of "green" or environmentally friendly design.

Many designs and CAD capabilities allow designers to use materials in a new or unconventional way, so be very careful that you understand the materials' capabilities. The constraints placed on you by your material choices should be in the back of your mind, even as you begin to sketch. You may not know what materials you intend to use until you see the forms you are designing, and the same is true for functionality. The materials may need to provide a function, such as strength, conductivity, or warmth, and environmental concerns should be in the front of your mind, right from the start. Production affects the choices as well. We must consider

Figure 2.13 Learn about materials. Engage with them hands-on, so that you know what they do and how they behave. The constraints of the materials are in the end the largest determining factor of the production and experience of your design.

techniques and capabilities and whether our choices are suited to them. If they aren't, we must search for a solution, often through modeling and experimentation.

Sometimes material choices are at odds with one another. The best-looking material may also be the least tolerant, and the lightest material may also be the most expensive. The most practical material may be the most damaging to the environment. You must be ready to compromise and revise your plans, but this is one of the more compelling reasons to be fully aware of the purpose of your designs and their constraints.

Budgets

The most difficult set of constraints has to do with money. Like other constraints, budget constraints can make the project less cumbersome, if not easier. It is a rare design project that has an open-ended budget, and that is a good thing. During my first years designing for theater, I was resident at a theater that had not implemented line-item budgeting for its productions. Every time I asked the question "How much can this cost?" I received the answer "As little as possible." This drove me—and other designers—to distraction, as the definition of "little" and "possible" was left entirely up to the designers. Needless to say, production costs tend to be high when there are no budget constraints. A good budget in design (just like anywhere else) must be clear and realistic.

If, for example, we know that we have only one dollar for fabric, we can begin to plan for scavenging and soliciting donations. Now the constraints contribute to the creativity. We eliminate a legion of problems and solutions right off the bat. This is much easier and more efficient than having to scramble to find fabric for one dollar. Time, in this case, is being wasted by questions of money.

In the same way as planning for time, budgeting should include contingency plans. It is not uncommon to routinely add 20 percent to budgets for "unknowns," and designers who do so generally base this on experience. This can also work in reverse. If you are handed a fixed budget to work with, estimate your numbers to 80 percent of its total and track your spending carefully. Look at your project, and try to spot which elements will be the most expensive and which carry an unknown price tag. Give the unknowns extra-careful consideration because odds are they will become larger figures than anyone expects.

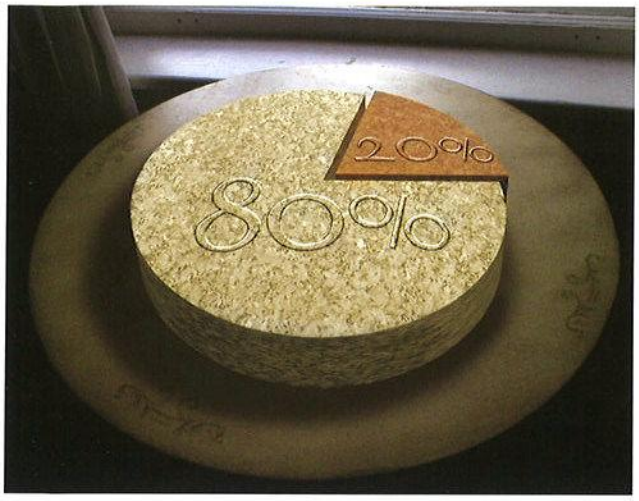


Figure 2.14 Pareto's Principle, also known as the "80/20 Rule," states that 80 percent of a project's resources will generally go toward 20 percent of a project's needs. This rather odd principle is surprisingly prevalent in a number of fields and disciplines.

Apply cost-benefit analysis to your decisions. Is a small detail worth a disproportionate amount of the budget? Yes, if the detail is what gives the design its character. It is good to keep in mind Pareto's Principle—also known as the 80/20 Rule—which states that 80 percent of a project's resources will generally go toward 20 percent of its needs. It is also good to remember that the budget is there for a reason and that it is very often high on your client's list of priorities. You may have the opportunity to reason with your clients about the wisdom of their budget decisions, but more often than not you have no other option but to go with what has been decided and work within the established budgetary constraints.

CONSTRAINTS OF RESPONSIBILITY: UNINTENDED CONSEQUENCES AND SUSTAINABILITY

The most basic design process will be multifaceted beyond expectations, and with that, things are bound to go wrong. In a case where complex systems go off the rails, someone will inevitably invoke Murphy's Law: Anything that can go wrong will. To most, Murphy's Law is just a wry comment, and its fatalistic overtones are not given much thought beyond the moment of their use. We allow this to affirm our belief that the universe's odds are stacked against us, and we move on. (Although O'Reilly's amendment to Murphy's Law—Murphy was an optimist—is apparently fictitious.)

Planning: Expecting the Unexpected

Murphy's Law was named after Captain Edward A. Murphy Jr., an engineer working at Edwards Air Force Base in 1949. One day, after finding that an experiment didn't work due to a mind-bogglingly wrong setup of equipment, he declared, "If there are two or more ways of doing something, and one of them can lead to catastrophe, then someone will do it."[2] Shortly afterward, Dr. John Paul Stapp, an air force doctor who took part in the experiment, said at a press conference that their good safety record on the project was due to a firm belief in Murphy's Law and in the necessity to try to circumvent it. In other words, Murphy's Law is not a fatalistic, defeatist principle, but rather a call for alertness and adaptation.[3] By vigilantly exploring the possibilities arising from our design's interaction with the world and adapting to the implied problems, we can reduce the "things that go wrong," if not eliminate them entirely.

Figure 2.15 Dr. Stapp coming out of the experiment in which the initial version of Murphy's Law was born: If there are two or more ways of doing something, and one of them can lead to catastrophe, then someone will do it.

Consider again Princess Diana's memorial fountain. It seems that everything that could go wrong did. People slipped on wet granite, leaves clogged the drains, and the water became contaminated. But the inevitability of the mishaps seems very clear. Foresight could not really have been that difficult. Walking observantly through the park would have alerted the designers to the fact that water in a green area collects leaves and debris. Creating a model made from the materials would have shown the designers that granite gets slippery when wet. To be fair, perhaps they did all this and thought, as the chairman of the memorial committee did, that "people would [show]

a little bit more respect given that it is a memorial."[4] This is what the sociologist Robert K. Merton called the "imperious immediacy of interest," referring to instances in which an individual wants the intended consequence of an action so much so that he or she is compelled to ignore other unintended effects.[5] It is precisely this kind of thinking that designers must avoid.

Sometimes the more stressed you are, the likelier you are to make mistakes and it may seem like the world is working against you. Joking aside, the universe *is* out to get you.[6] The natural world is one large system of order that fights entropy and loses continuously. The natural order of things is toward dissolution, and nature, through being overwhelming and relentless, always finds the chink in the armor. Besting that requires being alert and planning continually for entropy and chaos in any and every system. So, again: Murphy's Law is *not* a defeatist principle, but rather a call for vigilance.

A series of events required for making something happen (such as the creation of designs) can be viewed as a system, and systems have interdependent probabilities. Phase A must precede phase B, which must precede C and D, and so on. As with the Tailor's Rule earlier, a little math can be illuminating: Let's say you have 16 steps to take to complete a project. Let's also say that you have a 98 percent chance of succeeding in the first attempt at each step. Are these good odds? Not as much as one might think. Your total chance of overall success is 0.98 to the 16th power, which is 0.71, or 71 percent. Your odds are slightly less than 3 out of 4 for success.

More often than not complex systems are driven by probabilities, and the way to win is to create a system where the odds are heavily stacked in favor of success. You do this by being determined not to insert any actions or processes into your designs that may have an unacceptable outcome. If you must include undesirable possibilities, you have to alleviate the "bad" outcome by designing acceptable safeguards. Better to design out the unintended consequences altogether.

Unintended consequences is not only a phrase originally appropriated for specific use in sociology but also is now widely used in medicine, economics, civic planning, and politics. It can also be applied very effectively to the theory and planning of design. When testing a new design, it is important to keep in mind that not everything can be tested and planned for. No matter what the situation or design, the more complicated the world's interaction with it is, the likelier that there will be unanticipated, and sometimes unintended, consequences, which may not come to light until long after the design is finished. Oddly enough, people will put things to uses that the inventors never intended. The Internet, for example, has its origins in the 1960s system designed to keep the lines of command open during a nuclear attack. No one intended it to be used as it is today.

Figure 2.16 A 98 percent likelihood of success diminishes to 71 percent in 16 steps. Do the math! The odds are always stacked against you, so stop being surprised about it. Work with it. Murphy's law is not a defeatist principle, it is a call for vigilance!

Sometimes, new designs are developed in response to the problems inadvertently caused by other designs. For example, all the new handheld devices that have sprouted up in the past decade have produced a need to determine where to place them and how to store them. A demand for covers, pockets, speaker stands, car accessories, and so on has produced an entire industry devoted to designing and producing these accessories.

In Robert K. Merton's article, "The Unanticipated Consequences of Purposive Social Action," he identified five sources of unanticipated consequences. The first two—and the most pervasive—were inadequate knowledge and error. The third was "imperious immediate interest" wherein the focus on the immediate consequences prohibits any thought or examination of other results. Merton's fourth source of unintended consequences concerns when a person's fundamental values do not allow for the consideration of further consequences, and the fifth is when a prediction of the behavior of a system becomes part of the system, and as such, influences the outcome.

Merton's five sources of unintended consequences are a remarkably helpful set of guidelines for design because designing is, in the end, a social exercise. Merton provides us with a guide to expose where problems may inadvertently arise. Seeing that we cannot anticipate everything, we can at least try to identify the areas from which the trouble may arise, like old maps where unexplored areas were left blank and labeled "Here are monsters." If we know the areas from whence the monsters could arise, we can either avoid them or go in armed to the teeth. As we begin to plan for the production of our designs, we must be very aware of what we don't know, where we are in danger of error, and what could be our "blind spots." This awareness becomes our ammunition for the monster hunt.

First: Identify the gaps in your knowledge. Go through your designs, and find the areas where you need information or expertise beyond your own. (See for example Appendix 2: Resources for Design.) Be very honest with yourself about your knowledge or lack thereof. Make shopping lists of missing information, and find what you need. Is there technical information missing? Have you investigated issues relating to environmental concerns? What about budgets? It is very likely at this stage that you already have people around you who can help. Recognize other people's experience and expertise and get them involved. If you do not have experts at hand, make time for research or find experts. Get a brainstorming session going and *create* an expert. As long as you are not dealing with proprietary or classified information, people are always willing to help.

Figure 2.17 Often the only way to be sure that things are the way you want them to be is to go and look and touch and observe the design in person. If there's a way someone else can do it wrong, it will probably go that way at some point. Look at your design, use it, and put your hands on it.

Next you need to look for possible sources of error. One of the most common mistakes to make is to work under the assumption that because something worked in the past it will work again. This may be safe to assume most of the time, but you may find that you are doing things out of habit and neglect to notice that the circumstances are not *exactly* the same.[7] Another error is to assume that you have all the information (or that anyone else does, for that matter—issues relating to sustainability are especially demanding as the discourse is so polarized). The more links there are in your chain of information, the greater the danger that your information could be misinterpreted along the way. The information you disseminate about your designs needs to be extremely well-organized and accessible to its intended recipients. You simply cannot assume that people will understand. Murphy's Law is in full effect here: What they can misunderstand, misconstrue, misinterpret, mangle, fold, and mutilate, they will. Never rely on second-hand

information, and never assume anything. (Remember, you are not paranoid if the universe *really* is out to get you.)

Some serious introspection is in order. How large are your blinders? Are you so focused on the intended effect that you don't see the side effects? There is not necessarily anything wrong with desiring an outcome and being focused on it. Such focus may in fact be highly motivating to you and others. However, even when highly motivated, make a point of questioning the outcome of your designs. If you feel there is any doubt about the veracity of the picture as you see it, plan for a reality check. Look at similar designs and how they behave, and examine the environment your design will live in. Create a prototype and test it in as real an environment as you can. Look at the entire life cycle of your product—from gathering of materials to disposal and recycling—to determine its environmental effect, not just the narrow moment it is in the consumer's hands. Make sure your testing is also properly designed so it does not just give you the results you desire.

Relating Merton's fourth factor to design problems is less immediate, but it is found everywhere and therefore worth a look. It involves the fundamental values you live by and with which you approach the world. You have a set of beliefs and priorities according to which things are done, and these are not questioned on a day-to-day basis. The inherent danger is "the fact that when a system of basic values enjoins certain specific actions, adherents are not concerned with the objective consequences of these actions but only with the subjective satisfaction of duty well performed."[8] In other words, the *practice* becomes more important than the outcome of the actions involved. It becomes important to build something a certain way or communicate along certain channels, because *this is how it is done,* never questioning whether this is the best way to do it. Often this results in resistance to new, more efficient or interesting methods, but I have encountered this also when trying to get someone to go against the grain of their training; to do something that seems less well done than they can. I have asked scene-painters to paint sloppily, seamstresses to tack something clumsily together, and graphic designers to make their techniques and fixes clearly visible. They understood what I wanted, and usually why, but they still had to concentrate much harder on doing the job poorly.

Question your methods. Do you know how or why they work? Do they in fact *really* work? Are they the best methods? Are you stubbornly holding on to techniques and approaches that

Figure 2.18 Advocate a radical change strongly enough, and you may avert the situation that requires the change. The protesters of the first Earth Day in 1970 in Union Square Park in New York City may not have known that the dangers they were warning against would still exist 40 years later, but that the language of their protests would become commonplace and perhaps begin to avert the disaster.

are outdated and obsolete just because it's the way it's always been done? How do your personality and views play into your choices and decisions?

The concept of unintended consequences implies that "Public predictions of future social developments are frequently not sustained precisely because the prediction has become a new element in the concrete situation, thus tending to change the initial course."[9] This is the factor most tied to human behavior and points to the use of design as a force of social change. The designer is a member and often a leader of a team; a designer has responsibilities to the team as well as to society at large. The design goes out into the world and has an effect. Social interaction is a complex model of events and movements, and designers must be aware of the ripple effects they set in motion. Merton uses the example of how socialist proselytizing in the 19th century actually delayed or even hindered the revolution they prophesied and wished for. They called such attention to the plight of the working man and got labor so organized that the lot of workers actually improved. In this way they lessened or even negated the need for revolution.[10]

In a similar vein, designers can use their abilities and positions to avert disaster and perhaps bring about a revolution of their own. Designers can, for example, educate their colleagues and clients about the dangers our environment faces and advocate for sustainable practices in design, production, and marketing. In doing so, the raising of awareness may help hinder the most dire consequences currently predicted.

SUSTAINABILITY

The largest issue facing designers today is sustainability or "green" design. This type of design is more than a choice or constraint for a project. Sustainability is a philosophy that encourages all people to respect the planet, its resources, and the needs of future generations.

In the scheme of unintended consequences, the largest of all is the treatment that human development has had on the environment since the industrialization of Europe began in the 18th century. The human race has increasingly harvested resources from the planet at a rate way beyond its capacity to replace and renew. To design for sustainability means to reject the notion that we can take what we think we need from Earth and its ecosystems without regard for future inhabitants. The goal—in the words of a famous ecological analysis from the United Nations, the "Brundtland Report"—is "to meet the needs of the present without compromising the ability of future generations to meet their own needs."[11]

Figure 2.19 Earth seen from space. The Earth is a closed-loop ecosystem and currently the only one we have.

Earth is a closed system that has a finite amount of resources. The use and distribution of these resources has been highly wasteful and skewed and has inflicted irreversible changes to the environment.

Twenty percent of the world's people from countries with the highest incomes account for 86 percent of global consumption.[12] For example, if 10 people represent the world's population, then 2 of them represent the wealthiest segment. To illustrate, imagine dividing 30 cookies among 10 people. If the wealthiest are to have 86 percent of the cookies, the 2 high-income people will each get 13 cookies. Each of the remaining 8 gets half a cookie. Adding insult to this injury, note that the inhabitants of North America and the European Union also generate, on average, 3 to 11 times the amount of solid domestic waste as the inhabitants of developing countries.[13] The largest part of this waste is not being put to any

use. As a matter of fact, 93 percent of the manufacturing resources in the United States are turned to waste before the product even reaches the consumer.[14]

Global consumption expenditure has more than doubled in the past 40 years and is driving development the world over. The increase in consumption generally leads to economic growth, which is directly linked to an increased use of resources. While this has many positive effects, the inequalities remain and are in fact increasing, as the wealth generated from this increase in consumption, and the attendant production, does not get distributed evenly. Wastefulness is also on the rise. Even though the developed nations have in many cases managed to uncouple economic growth from an increase in resource consumption, this kind of efficiency is still relatively unknown in the developing world, and it is there that the growth is now greatest.[15]

The challenge is to take a step beyond simply limiting resource use. The more affluent countries need to adopt lifestyles that are within the planet's ecological means. In this way, they would limit the damage caused by their economic growth and become a model for developing nations on how to sustain growth without further harming our ecosystem. The idea that perpetual growth is the defining characteristic of a healthy society is no longer tenable.[16] It is also necessary to move away from the mindset of "fixing" and toward a philosophy of betterment.

At the Earth Summit in Rio de Janeiro in 1992, more than 178 governments (including the United States) adopted Agenda 21—a program of action for sustainable development worldwide. Its first principle reads as follows:

> Human beings are at the center of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.[17]

Since then, summit after summit has failed to produce any significant results, due to governments of large industrial nations resisting changes that impact their production and exports. Tackling these concerns, however, cannot be the responsibility of governments alone. As the tenth principle states, "Environmental issues are best handled with the participation of all concerned citizens."[18] Designers, whatever their discipline, are in a key position to participate in

Figure 2.20 Human beings are a part of nature but operate in a way that is often distant from natural rhythms and life cycles. There is a limit to what any living being can take from its environment. Humans seem to be slowly realizing this.

this effort and contribute toward its goals. As we have seen, a designer is the hub of communication for a project. The designer communicates with everyone involved—from colleagues to end users—and can inform, educate, and motivate them at every stage. Manufacturers and retailers have slowly begun to go along with sustainable practices and will continue to do so if and when it makes economic sense. The ability of a product to claim some measure of environmental sensitivity has begun to be seen as a selling point, especially in Europe, but also increasingly in the United States. Consider how much the products we design are, in fact, alike. To be able to add the incentive of environmental friendliness is "just good PR" in the words of one executive.[19] The number of people who will buy "green" products, even at a higher price, is steadily growing.

"Follow the money" is always a good maxim and, in this case, completely valid. In the past 300 years (if not longer), the marketplace has led to greater and swifter innovation than has altruism. Designers who are interested in promoting sustainability will be far more successful by working steadily for change inside the consumer culture than by protesting against it from the outside. By designing products that are less taxing on the environment, we can begin to raise consumer awareness and change deeply embedded patterns of consumption.

By educating ourselves and others about the benefits of sustainable practices and making choices based on these, we can become a force for global change. This is not a difficult task; all it requires is keeping the following points in mind when making choices for your designs:

- Sustainability is both a need and a constraint
- Using resources efficiently is key
- Increasing *durability*, *reuse*, and *reparability* may be the most effective direction for redesign
- It is increasingly important to eliminate toxic, persistent, and bioaccumulative substances
- Designers can create products that help devise new models of consumer–producer relationships
- As design and commerce becomes ever more a global concern, it is important to change the relationship between developed and developing countries

Sustainability: A Need and a Constraint

Design is, at its core, about fulfilling needs within given constraints. The demand for sustainable principles in designing and manufacturing *must* therefore have an effect on any project where it is taken seriously. Sustainability is, in itself, a need that is becoming clearer and more urgent with each passing year. There is a need for practices that leave the planet the way we found it, that minimize our effect on it, and that leave resources for future generations. The demand for such practices should erect constraints all around our design projects.

We must minimize energy usage, wasteful packaging, and unnecessary transportation of raw materials and finished products. We must design products that use minimal energy and resources during their lifetime, and then they must be reused, recycled, or biodegradable at the end of their life-cycle. All these guidelines create a set of constraints that makes the designing of anything at all doubly interesting and a far more exciting challenge than just designing more stuff to sell. For each stage of the design process, there is a set of constraints stemming from the need for design and manufacturing to avoid foisting unsustainable practices on us. When identifying the needs and constraints of a project from now on, consider that sustainability is *always* a need and that the constraints that grow out of this need are non-negotiable. The future well-being of our children, grandchildren, and their children is at stake.

Using Resources Efficiently

We need to use less to make more. This involves taking a look at the entire life cycle of a product: being aware of the product's development from the gathering, harvesting, or mining of resources to the manufacturing, packing, shipping, and distribution. We also need to look at

retailing, usage, and eventual disposal or recycling. Where is the waste? How can the waste be minimized or put to use? Clearly, designers do not have ultimate control over how their designs are used; but by designing the product in such a way that it has minimal environmental impact at each stage, you will assert whatever influence you can.

We are the only lifeform on the planet that creates waste that is not subsequently used in some other natural process. A sustainable society would eliminate the concept of waste. Waste is not simply an unwanted and sometimes harmful byproduct of life; it is a raw material that is out of place. Waste and pollution demonstrate a gross inefficiency in an economic system, since they represent resources that are no longer available for use, and that may cause harm for humans and other species.[20] We must look to nature to inspire us to design products that cycle their materials through the economy. The ultimate goal is that all waste will become fodder for another product, therefore minimizing the impact on the planet by keeping human consumption within a closed-loop system.

The impact we have on the planet is quantified in the ecological footprint. It is a measure of how much bioproductive land and water we utilize to produce all the resources we consume and to handle all the waste we make, much of which is made up of forests for absorption of carbon dioxide. According to the World Wildlife Fund's *2008 Living Planet Report*, the average world citizen has an ecological footprint of 6.7 acres, the average German's is 10.4 acres, and the average U.S. citizen's is a hefty 23.2 acres. The drain on Earth's resources will only increase as the developing regions increase their consumption (and who is to say they are not to do so?) and thereby expand their footprints.

Because there are only 5.2 acres of bioproductive land per person on the planet, we are currently running a deficit of 23 percent. The capacity decreases every year through the increase of the world's population, and the rate of decrease is accelerating through a worldwide increase in consumption.[21]

This deficit may be what accounts for the fact that in the last three decades of the 20th century populations of terrestrial and marine species dropped by 30 percent, while

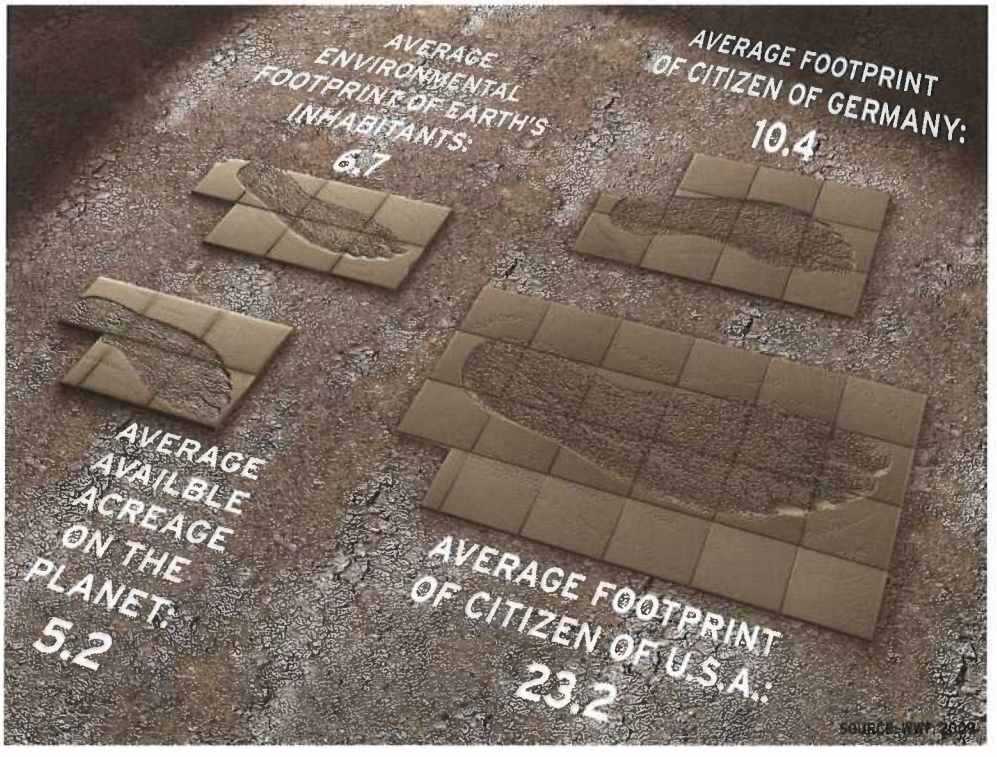


Figure 2.21 In 2008 there were 5.2 acres of bioproductive land per person on the planet. However, the average world citizen has an environmental footprint of 6.7 acres, the average German's is 10.4 acres, and the average US citizen's is 23.2.

freshwater populations plummeted by a stunning 50 percent. Equally alarming is our energy footprint, dominated by our use of fossil fuels such as coal, gas, and oil. This is the fastest growing component of the ecological footprint, increasing by 180 percent in those same decades. Fossil fuel dependence is unsustainable for more than a few decades hence. It took thousands of years for nature to create the fossil fuels that humans of the early 21st century consume in one day.[22] Designers would do well to focus on the energy requirements of their designs by making sure they are designed, manufactured, transported, marketed, and finally operated within the following three constraints:

1. A product's life cycle involves the greatest possible *conservation* of existing energies.
2. A product is designed so that its life cycle requires a greater *efficient* use of energy.
3. A product's manufacturing and use reflect an increased drive to switch over to cleaner, more *renewable sources* of energy.

Principle 3 of the UN's Agenda 21 states, "The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations."[23] Unless we begin to seriously redesign our products and methods, there will be less available for future generations. There is room for a lot of top-of-the-hierarchy creative thinking. A looming target is the 93-percent wastage that happens before products get to U.S. consumers. Study that for your product. Where does it happen? How can you design to eliminate it? How much can be solved by reducing transportation needs? Can you influence this with fewer components, fewer materials, and more localized production? Aim to design not only a product but also a life cycle that uses materials sensibly and highlights recycling and thrift. But in the end, what might be the most effective question is: Do we really need this product? Perhaps the best design solution is to design away the product itself altogether.

Eliminating Toxic, Persistent, and Bioaccumulative Substances

Our environment is clogged with pollutants. Our industries are throwing toxic substances into the biosphere faster than the natural systems can neutralize them. Compounds are accumulating in the food chain of which we are the top link. The list of chemicals to avoid in manufacturing is getting longer each year. Our life expectancies are increasing and so is the buildup of these substances, not just in the environment and food chain, but in us, ourselves. Longer life means the bioaccumulative substances in our bodies reach damaging levels more often, and more effects are coming to light. Allergies, cancers, retardation of fetal growth, and delays in children's mental development are just a few examples of these effects.

Figure 2.22 Our environment is clogged with polluting substances that are irritating, harmful, and downright poisonous. Our industries are throwing toxic substances into the biosphere faster than the natural systems can neutralize them. There is no excuse for pretending that our demand for a specific lifestyle and the goods to go with it are not at the root of this. It will, however, be easier to change the goods than to change the human desire for them. Designers can help avert this by designing the goods to have less impact.

First of all, make sure your designs' life cycles are free of the most toxic compounds. Your designs should be manufactured, marketed, used, and eventually recycled with the greatest possible avoidance of environmental contamination. This should include emissions produced in manufacturing and transportation, as well as secondary implications, such as the usage of batteries, or toxic cleaning compounds.

Educate yourself on these substances and their uses in production. There are a number of

governmental agencies as well as private foundations such as the National Center for Environmental Health[24] and the Children's Health Environmental Coalition[25] that have websites full of resources. You will be surprised how widespread toxic substances are in the manufacturing of literally *everything* around you.

Increasing Durability, Reuse, and Reparability

Increasingly, during the 20th century, consumers in the United States were habituated to the disposability of goods. Once something stops working, or even if we just stop using something, we don't get it repaired or give it to someone else. We throw it out. Most electronic goods are now so cheap to produce that they would cost more to repair than to replace—if you could even find someone who could repair them. All this contributes to an ever-growing mound of materials that have been designated as "waste" long before their lifetime is over. The economics of obsolescence have a strong hold on consumer economy, keeping the wheels turning, and new paradigms will not see the light without resistance. But again, economic politics will win if consumers as well as manufacturers can see the larger benefit of durable, reparable goods.

However, recycling of materials and components is gaining popularity in the 21st century. There are several large-scale initiatives taking place and more in the works. For example, a Dell "recycling tour" in 2004 took place in 17 U.S. cities, collecting nearly 1,000 tons of unwanted computer equipment. In its first 2 years, Operation Fonebak, a nationwide mobile phone recycling scheme in the United Kingdom, processed more than 3.5 million mobile phones for reuse and recycling. Wherever possible, phones are fully refurbished and sent to developing countries. Irreparable or older phones are recycled for their materials and parts. In the U.K. there are an estimated 45 million cell phones in use, with users replacing them every 18 months. The lifetime of the product, however, is about 8 years, so essentially the refurbished product has a longer lifetime in its new home than the original user gave it.

European automakers are redesigning their cars to be very efficient in terms of reuse, in response to European Union legislation that dictates that every vehicle scrapped must be taken back at no charge from the last owner. Volvo, for example, is aiming to be able to recycle 95 percent of the materials in its cars by 2015, and in 2007 Holland and Sweden were already recycling more than 85 percent of cars.

The common incentive for manufacturers is that there are recoverable valuable metals, such as gold, silver, copper, and platinum that are put back into use. Materials that cannot be reused find their ways into other products. Mixed plastics (those that contain metals and plastics) from cell phones are sent to a specialist recycler in Sweden who incinerates the plastic and uses the energy to heat the local village. Other plastics are sent for granulation and end up as traffic cones, among other things.[26]

In designing products for recycling, reusing, and reparability, you must think in terms of components and commonality of materials. What can be reused where and how? How much energy is involved? When dealing with plastics, consider how they would be recycled or whether they can be recycled at all.

What appears to be a technological question—how much of anything do we really need?—is actually a social one.[27] Do we really need everything to be new, colorful, and shiny? Can we be satisfied with something else? When is "enough" enough? Is there something missing in a user's interaction with an object? (How, for instance, would you redesign a cell phone so that its user keeps it for its entire lifetime? How about making a fashionable garment that is to be "worn out?")

It is a big misconception that green design has to be somehow "lesser" in quality. This is not the case at all. If everything becomes raw material for something else, then the stigma of "recycled equals old" will disappear through sheer redundancy.

Devising New Models of Consumer-Producer Relationships

Related to the issue of reparability is the possibility that if products become components and materials for replacing and reusing, then ownership of products may become a fluid concept.

In the United States, Interface—the leading manufacturer of commercial carpeting—runs a program called the Evergreen carpet lease. Customers lease the carpet and accompanying maintenance services. Interface retains ownership of the carpet and takes it back after use for additional uses or recycling, thus retaining the value of the carpet as an asset and controlling all liabilities of the carpet in landfills. They sell only the *services* of the carpet: color, design, texture, warmth, acoustics, comfort under foot, and cleanliness but *not* the carpet itself.

Here they have designed a process as well as a product: Ask whether the consumers really need to *own* the product or whether leasing is an alternative. Can a product's function be equally or better met by a service instead? If so, how does this change the nature of the product? Think about what would happen to it at the end of the lease term. It would obviously need to survive intact and be reparable or reuseable. What does that mean for its components? How will it be designed to meet the needs of care and maintenance *during* the lease term? One thing to consider in such a scheme would be where the maintenance will be most needed and design that part, area, or component so that it is easily swapped out.

Changing the Relationship Between Developed and Developing Countries

The exploitation of poorer nations' resources and populations for the enrichment and comfort of wealthy and more powerful nations is a paradigm that must change if we are to live in a truly global community. Our products cannot continue to require cheap labor and resources to the degree that they have so far. All ideas of justice and equality aside, it is simply inevitable that developing nations will reach a level of affluence where they will no longer be content to be the producers of other people's wealth. Where will we then go for our inexpensive labor and cheap materials? We have also learned in the past 30 years that environmental damage is not a local issue. Toxins tend to spread throughout the globe's ecosystem and the depletion of resources influences generations to come. The sad possibility is that nations that are now struggling to

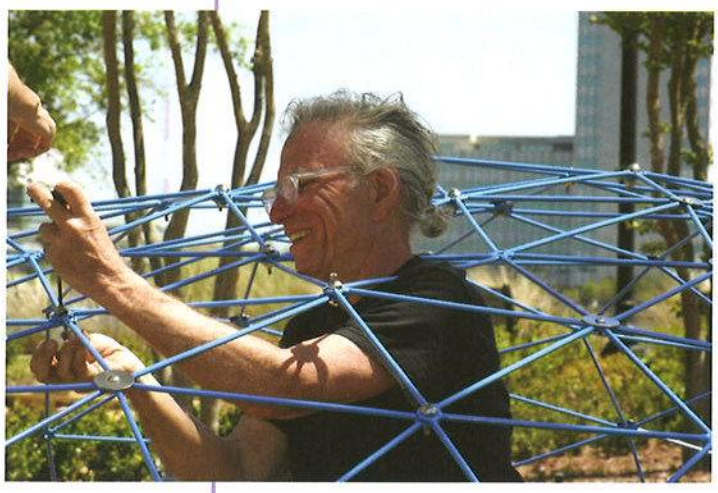
Figure 2.23 The Earth is a closed system. The substances released into the ecosphere during manufacturing have nowhere else to go but into the ecosystem. A damaged lake such as this, at Krasnoperekopsk in Crimea, contaminated by chemical waste, is not on another planet; it is here and part of the planet's system. Investigate the entire life-cycle of your product. How does it affect the environment in harvesting, manufacturing, treatment, packaging, shipping, use, reuse, recycling, and disposal?

achieve the level of prosperity enjoyed by those of us who live where the first wave of industrialization took place may never achieve it, as the resources will simply not be there. The same may apply to our immediate descendants.

The only way out of our current predicament is to do more with less. There is no excuse for up-and-coming designers not to participate in an attempt to make the world a better place for everyone, now and in the future. The Brundtland Report spells this out directly and dramatically:

> Many present efforts to guard and maintain human progress to meet human needs, and to realize human ambitions are simply unsustainable—in both rich and poor nations. They draw too heavily, too quickly, on already overdrawn environmental resource accounts to be affordable far into the future without bankrupting those accounts. They may show a profit on the balance sheets of our generation, but our children will inherit the losses. We borrow environmental capital from future generations with no intention of repaying. They may damn us for our spendthrift ways, but they can never collect on our debt to them. We act as we do because we can get away with it: future generations do not vote; they have no political or financial power; they cannot challenge our decisions.
>
> But the results of the present profligacy are rapidly closing the options for future generations. Most of today's decision-makers will be dead before the planet feels the heavier effects of acid precipitation, global warming, ozone depletion, or widespread desertification and species lost. Most of the young voters of today will still be alive. In the Commission's hearings it was the young, those who have the most to lose, who were the harshest critics of the planet's present management.[28]

Now: Which side of this discussion do you choose to be on?



BROWER HATCHER, ARTIST

Brower Hatcher's work ranges from gallery-scale artwork to large architectural designs. In a career of more than 30 years, he has consistently explored the notion of a "visual field" through the use of space-defining wire frame structures. Brower lives and works in Rhode Island, but his work can be found all over the United States. His recent work incorporates biomimetic principles: allowing sculptural forms to develop using principles of biological growth.

Conceptualizing is a distillation process, which I think I do indirectly. In the first step I sort of fill myself up—I become a sponge. I like to wander in books; it's a mental wandering where I fill myself up with reading and looking around. It doesn't really matter where I am. It's great if you can partake of the world, you know, go to great cities, but I don't think that's requisite. You just keep filling yourself up, and then when you have this problem in the back of your head and listen for solutions, the ideas just sort of come to you. But I think it's sometimes more like a hunt. You're looking for something; you come around the corner, and suddenly you see your quarry. Then you get your bow and arrow: "This is the big one."

I work at it all the time. I'm always ready. I like going back to nature. My wife is a ferocious gardener, and I like to watch all that unfold; I like watching things grow. I might be digging in the garden, and there's a worm, and I think, "Wow, look at that great-looking worm! Look how that worm's put together!" In my early days, I was hanging around with all these heavy modernists; they were all so deadly serious, which was fine—I learned an awful lot. But my first works were very rooted in nature. Somehow that made me feel really good. I guess I like things that have one foot in a pretty sophisticated cultural aspect but have the other foot in nature. I find that very intriguing.

If you've got a job scenario where you have to deliver, then you have to reach closure, some kind of summing up. There are always other things going on, so I can't keep the wandering up for long. In some ways that makes me more frantic; I don't want to lose half an hour. . . I need to be sure I'm using all the time I can. I'm reading; I'm thinking; I'm working. I'm working in an opening-up expanding way, before I have to close down. I know the time will come when I have to make decisions. I have to define things, draw the forms, model them, and make a spatial plot. Whatever it is I'm thinking about has to get done. . . . It has to come out of this dream state.

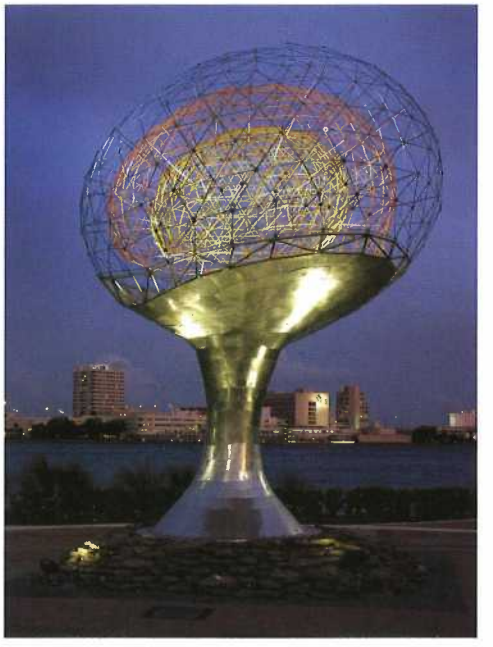
It's at work even on my downtime, when I can't absorb any more. I completely relax, and often in these times I can visualize, sometimes very effectively. There's that time just before you sleep when you can kind of see things. When you just wake up, something will click; things will come together. I think it's important after you've been actively filling yourself up that you take time to relax and let things process.

But also then it depends on what you're doing. Somehow, in the different stages, the manifestation is different, the medium changes. First you are absorbing; you're a sponge soaking up what you can. This becomes a dreamy manifestation, which then goes to a second level of manifestation where you're making models, and the piece keeps changing. There's a clarification, and there's also a creativity pumping in. There's something you thought up; maybe you had this vision. You thought it was the thing, but then it's really not the thing. Say you decide

you want to put a rhinoceros over there. You now have to deal with the specifics of that decision. Then maybe this allows you to see that the rhinoceros wasn't such a good idea anyway.

Finally, you get around to the stage of making the thing physically, and that's another kind of thought process, where I think you have to be very open to materials, let the stuff talk to you. You put it together; it creates certain situations and certain forms. Ideas come out of that. You're going along one way, but then you see that it would be better to go the other way.

Every time you do anything, it opens the door to something else. This is why I like to have work progressing on many different things and a number of people at the studio. Often there's work that I more or less know how to do. But I really like the edge, when you're out there doing stuff you didn't know how to do before.



The Tillie K. Fowler Memorial, Jacksonville, Florida

I used to do very solitary work, doing my own little thing. I found that kind of lonely and a little bit extreme. You want to do bigger and bigger things, but it's not just that. It's kind of being in the world; the art is interactive, taking place in the world. It's a very complicated process. You're involved with a lot of people. I guess I enjoy the society of the crowd and working with everybody's talent. I guess I'm also a major collaborator. I like having a team. I recognize that all these people have all these talents and abilities, and if you can bring them in on the larger picture, the potential is enormous—it goes way beyond me. I'm beginning to feel that I'm more just the muse or something. Well, I guess I'm the leader, the conductor—but you're not going to get much music if you don't have an orchestra.

I think it's all very fun, but there is also a fair amount of hardship. It's different from having a job where you are just providing a service and being compensated for it. You're often out there flapping in the breeze. By sheer willpower and some maniacal dream, you make it possible. Basically I imagine these things, and somehow I get myself into the position where people seem to become interested and find that I can provide them with something no one else can. And then I have this entire team pulling along with me, which makes it all possible. I suppose there's a symbiosis.

All the time you have to be aware that there's an audience out there. They are your clients, and they are also the ones with the expectations. They hired you because they believe that you can deliver on their expectations. They think you are going to create something absolutely amazing. I love the challenge that somebody is expecting me to come up with something amazing. In many ways that gives me a lot of license to do what I want to do or be the way I want to be. It's extremely liberating when people have those kinds of expectations. You do want to rise to the occasion, and it's very exciting to actually do that and then have somebody stand back and go "Wow, that's amazing." But by that time I've usually had enough of the piece in question. The creativity is over and what remains is to take it somewhere and install it. I mean, I've had my fun. . . . The installing of the work and then standing around while people say nice things, that's all very nice, but I don't find that particularly important. It's a courtesy, like going

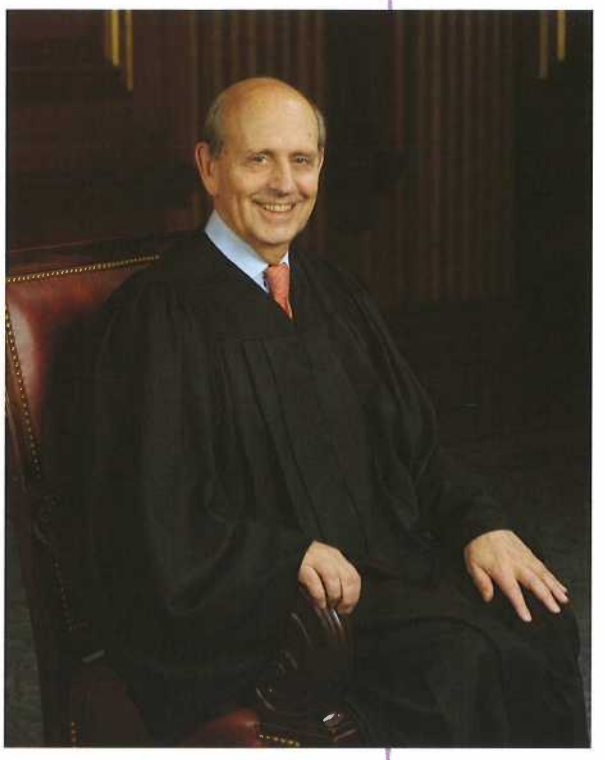
to an opening. It's part of the give and take of operating in this arena. I do like to stand back, to be a fly on the wall, and to listen to what people say. I find that very interesting, because ultimately the work is not complete until it enters the world. I may be personally done with it, but the work gets to a point where it has a life of its own. That life is bigger than I am, and beyond me, and in order for the creation to really be the thing we want it to be, I have to go away. I have to let go; it's not me anymore; it's out there in the world doing its work, which it does by itself, but I've infused it with all these little triggers. Then when it's done, I like to go home and putter around, dig in my garden, and become a sponge again.

It's become so now that there are so many gigs, and they sort of run right into one another. And they feed on one another. For everything you do, there are things you couldn't do. It's a garden of forking paths and you decide to go down this path and that path. But as you're going down your chosen path, you look to the side, and there's another path, and you look down that and think, "Oh, that's kind of neat," but you don't have time to explore it, so there's always the possibility to come back to one of those.

Unwinding is actually getting centered again, coming back to a core in your life, back to something that's really simple and basic. Actually, I like building stone walls. It's simple, it's hard work, and it's variable enough. Little by little I'm building a wall around the garden.

I'm lucky in that I have a lovely home, a lovely wife, lovely kids. . . . I live by the seashore. Sometimes it's just amazing to open the door and look outside.

JUSTICE STEPHEN G. BREYER, SUPREME COURT OF THE UNITED STATES



Stephen G. Breyer's career in law spans half a century since he graduated from Stanford, Oxford, and Harvard Law School. In 1994, Breyer was appointed a Supreme Court Justice by President Clinton. Justice Breyer taught law for many years at Harvard Law School and at the Harvard Kennedy School of Government. He is the author of *Making Democracy Work: A Judge's View*, a book about the U.S. Constitution. In the 1990s Justice Breyer, then an appellate judge in Boston, was an instrumental advisor on the design for the John J. Moakley federal courthouse in Boston. The design is considered a great success and a model for public architecture. He also wrote the foreword to a book called *Celebrating the Courthouse: A Guide for Architects, Their Clients, and the Public*. From 2011 to 2013 he served on the panel that awards architecture's greatest honor, the Pritzker Prize.

My interest in architecture began as a general interest. Probably the same as anyone in my generation who went to an exchange program in Europe when he was 18 years old in college. At that time that was really adventurous. I am from California. I had rarely been outside of California. I can remember now waking up after a boat trip in Paris and everyone in my group, family and friends, were dancing in the streets. We thought we were in a movie. We thought we must be Hollywood with the buildings, the streets, the lights, and everything. We saw Versailles… It was like a movie. For two years I behaved as a student behaves: I traveled a lot and I had been to Oxford. Anyone who does that begins to take in the surroundings. However, the more specific thing was my work with Judge Douglas Woodlock and Vincent Flanagan on the Boston courthouse. We did a search for architects, which required us to be credible to the architectural community, many of whom do not like working for the government.

Doug and I spent maybe a half a day a week for three years on this project. We would have meetings in our office every week to really push, pull and tug because even though we didn't really have authority to do anything, we tried to speed this thing along. It required us to find some money, to work with a budget; we read about it and we talked to people. It was a wonderful experience for me personally, but more importantly it led to the Harry Cobb building, which I think the public likes. It was meant for the public, and I think it works pretty well. That was a very positive experience for me because I saw all that goes into a building from the perspective of an architect, as well as from the perspective of the public, and how incredibly complex the job of architecture is. Architecture is a wonderful profession, but oh my it is hard! They are always trying to do ten things at once.

My role in the process was to listen to people and ask: "do you really want that?" I brought a point of view. I tried to speed things along, talking to the community groups, talking to Harry about his design. I got very far just asking questions. What we tried to do was produce a building for the public. It is the public's building and they can use for it different purposes. It helps to civilize the court when there is a park and a daycare center. Wherever you are in that building it's visually a conception of Harry Cobb and the artist Ellsworth Kelly. Wherever you

look, it's lovely. Wherever you look there is something to see. Wherever you look it's a form, it's colors that fit together, and your spirit is aroused from what you look at—and it's dignified. You are inside and outside the courtroom setting, and each location has an individual dignity. At the same time, there are many courtrooms and yet it doesn't look like an office building, it looks like a courthouse.

We all piled in a car and looked at buildings. We drove to New York and Princeton, and we went up to Canada. We asked people if they wanted their building designed by Cesar Pelli, designed by Harry Cobb, designed by somebody else. We had a final majority and a final selection, six or seven I think. It was all wonderful, wonderful art, but Harry did it. Harry showed us what the problem was when he showed us a picture, a courthouse from Virginia, a 17th-century building. He said, "Look at that building. There is a steeple: That means it is a public building. There is a porch: That means it is a community building where people can gather, and there is a room and in that room the public's business is done." That is architectural, functional, and symbolic of what a courthouse is.

I will show you what happens. In the 19th-century, we have Beaux Art and that still can live in the Virginian courthouse. It is a central dome over a public space (central gathering space) with four business rooms operating outside of the government building. Now he says, "What happens when you have 10, 15, or even 20 courtrooms?" Let me show you. He shows us the Los Angeles courthouse; something designed in the mid-20th century. "Is it an office building? Is it a prison? Is it a hospital?" He asked. Maybe it is somewhere between a prison and a hospital, because it was a building that looks like any other 40,000 commercial buildings. You should not have a courthouse that looks like an office building. He says, "How do we design a building that is a courthouse and has the same functions as the Virginia courthouse that has 20 courtrooms. That is a project. We don't have the money to build a dome. What can we do?"

Then he showed us some choices. We don't want the judge as a king. A judge is a public servant, not a king. So what you are focusing on are the lawyers. The lawyers are doing their clients' business. The courtroom is where their business, the public's business, will be done. It is far more attractive. Then Harry set to work trying to produce a building that will maintain the dignity of the individual courtroom, its business function, not make the judge a king, and serve as a place where the public will like to go, with a daycare center, a park, and a jury room that can serve also as a meeting place. It also includes a public room that can serve as a place for local artists to exhibit and a restaurant, so people will come in and it will serve as a public space.

Now I see that people are using it for public functions and I see that schoolchildren from the public schools in the area regularly come in, and there are programs to regularly bring them into the courthouse. So they learn about the judicial system. It is theirs after all, and it will be theirs. Harry Cobb has achieved in this building what we were trying to do.

One thing I got out of my experience with the courthouse is to not make global judgments about a particular period or about a particular way of architecture as being always good or always bad. I think it is interesting to see people throughout the world with the same idea about courthouses: Richard Rodgers' design for the courthouse in Bourdeaux, for example. Then there is a courthouse in South Africa and there is a courthouse in Melbourne, and in Jerusalem, and they all have the same idea. The message sent out is that this is a building that belongs to the public that serves a public function. They want you to come in. They want you to come in and see what is going on. They're all echoing each other consciously or unconsciously.

The one thing I am reasonably convinced about is that, even though it may vary from person to person, buildings in one way or another move every person. You just cannot escape emotional associations. You are in a place in space and time. Everyone knows something, and therefore there will be associations. I think an architect plays on those associations. If you are in Rome, you are in a place of history. That is also true if you are in Boston. It is true if you are

in the warehouse districts. It is true if you are building an addition to the National Gallery in London. There is a history, and that history is there to bestow, marvel, and show. Want to be a space cadet? OK! I can't stop you—and sometimes that works.

I think the courthouse in Boston is a successful modernist statement of openness and inclusion. It uses brick and connects with the brick in the warehouse area it is in. It is certainly a modernist style—a classically modern style. It brings people in. The question of bringing people in is the question of whether a human being, when in the vicinity of the building, will have an emotional reaction—that it is welcoming to be in that building. You can see skyscrapers that are designed so that when you are on the sidewalk your physical sense of space is much smaller. You think this is made for human beings. That's what you see now in the cities: architects trying to produce human scale events.

The things I would want to know are: "What is it I am building and what is going to go on there?" The more designers talk to people, the better. When Frank Gehry designed Symphony Hall in Los Angeles, he spent weeks and months not just talking to people that have positions involving the building, but sitting with the musicians while they were playing. He wanted to know what their experience was and what their life was like. The concert hall in LA is a fabulous room. Everybody is a part of this. The audience, the positions, and the music are all there and are all participants. Harry Cobb did just the same for his design. He spent six months listening to court cases and talking to judges.

To me that just pays off, because then it's a building that they can use—that they know how to use. I can't really give advice to architects, but a designed space, it has form, it has a program, and it's an object that will form people's lives. It will serve the functions of those people who use it. All of those have to be combined.

Suppose, in my role at the court for example, that I don't pay attention to what the underlying purpose is in the text when I'm trying to figure out what some words in a statute mean? If I don't pay attention to the purpose, I have lost more than half the battle, because I will produce something that is dry. It may serve some function, but it will not be related to the *human* functions that underlie it.

The John Joseph Moakley United States Courthouse in Boston, Massachusetts.

There are a number of special problems involved in public architecture. It's a terribly difficult program. The architect has to deal with all kinds of groups: the security, the budget, program, tenants, the regulations, the competitive process, the possibility of protest—an unbelievable number of complicated things. I spoke with a very famous architect who said he would never bid on a public building, it was just too much. I want to say: "It is hard, but it can be done!" Try to think about special problems. You can't just give in. If the security people say something like: "You have to have the first 20 floors as a blank wall," I think the correct response is: "No." Then you have to keep pushing it, to get someone in authority to a point where they have to make a choice. Have you seen? Take a look at our embassy in Chilé, for example. I think it's an example of everything that's bad. It looks like Fort Knox. Oh, there are beautiful American embassies. There have been and I'm sure there will be in the future, but that one is a perfect example of why somebody needs to be in authority that will not say "security, security" all the time. I understand that the security people are always overstated. They have to do that. That's their job: to think of everything that might happen. But somebody has to say no at some point.

It is a very complicated human process, and it's understandable that an architect doesn't want to go through some kind of boot camp. But, I think there is a reward, because you do help the public. You will feel better about it, if you try. You can't twist the architects' arms; you can just say I hope they will do it. I think that by doing this with their own motives, they will do it. The objective is so important. The objective is the shaping of the human mind. In today's world this is part of the democratic process, and there is no reason why the public cannot participate in the process.

STAGE 2: IDENTIFICATION

APPAREL: IDENTIFICATION (EXAMPLE DESIGN THESIS)

What do you need to design? (Product)
A highly fashionable ecologically sound garment

What is its nature? (Description)
It is a biker-style jacket that draws on post-punk fashions and is completely made of recyclable or recycled materials, with a low-impact production in a high-impact look.

Who is it for? (Audience)
A stylish flamboyant woman, of any age.

Why is it needed? (Problem)
High-profile high-fashion needs recyclable garments to "normalize" the trend. "Green" has not crossed that line yet. The only way to make that happen is to bring it in at high-fashion levels.

What are its benefits? (Solution)
By making ecologically impact-free high-fashion garments, one can make the trend not only mainstream, but also fashionable throughout the fashion spectrum.

Why is it interesting? (Challenge)
High fashion, when aimed at multiple-age demographics, tends toward the staid. It is very "safe." Ecologically sound fashionable clothing, likewise, has a less-than-exciting reputation. This design is therefore inspired by not just the client's individual needs, but by the needs of our culture. We must make it "cool" for designer fashion to be ecologically sound. The individual experience of wearing the garment must be fulfilling in function and style, just as any high-end design must be, but it should also carry the added benefit, fulfillment and "cool-factor" of leaving as small an environmental footprint as possible.

What will you bring to it? (Vision)
I will bring to it an aesthetic that takes from the years of my own developing fashion consciousness in the 1970s and 1980s as well as a determination (see above) to turn around the environmentally unsound nature of the fashion business.

How will you proceed? (Methods)
I will consider color schemes (see Appendix 1) and research materials from both aesthetic and ecological points of departure, historical trends (see Appendix 4), and the demographics of the possible consumers. I will then proceed to sketching and modeling.

FURNITURE: IDENTIFICATION (EXAMPLE DESIGN THESIS)

What do you need to design? (Product)
A "signature" handcrafted chair.

What is its nature? (Description)
The chair is designed to be a whimsical version of a "classic" style, with the added twist that it will be created entirely and obviously from recycled and repurposed materials without resorting to "gimmickry."

Who is it for? (Audience)
Style-conscious consumer on a budget, looking for an interesting piece that makes an eco-friendly statement

Why is it needed? (Problem)
Chairs are everywhere and therefore a perfect target for the application of "green designs" three R's: Recycle, Reuse, Repair. Chairs designed under these headings often tend to be rather lackluster when they are not "gimmicky," and therefore not interesting enough for this to become a mainstream approach in furniture design.

What are its benefits? (Solution)
Creating a stylish "upcycled" and recyclable chair has the possibility of making recycled materials in furniture design more mainstream.

Why is it interesting? (Challenge)
It will be interesting on more than one level. The look of the chair will be interesting in that it will be a twist on a classic style. The nature of the chair will also be interesting as the materials may be unexpected and the execution might be unorthodox. The inspiration comes from the game of putting together unexpected combinations. The "found object" approach can be both interesting and entertaining in having a "surprise" element (literally) built in. A visual joke becomes a dialogue with the user and over time the experience of the piece allows it to develop a character of its own.

What will you bring to it? (Vision)
I will bring a sense of playful theatricality and a studied irreverence toward history and tradition.

How will you proceed? (Methods)
I will consider the shapes, colors, and elements to use in a classic chair (see Appendix 1). I will then research materials that can be substituted for the classic materials of a specific historical style (see Appendix 4). I will examine these with an eye toward both aesthetic and ecological impact. I will then proceed to sketching and modeling and gathering parts and materials.

GUI: IDENTIFICATION (EXAMPLE DESIGN THESIS)

What do you need to design? (Product)
A graphic user-interface (GUI) for an app and website for a seller of used books, artworks, and antiquities.

What is its nature? (Description)
A site and an app that allow the presentation and sales of a varied selection of used and rare books, artworks and other items. It should emphasize the visual, but also allow easy presentation of levels of information about the items. The interfaces should not have an impactful design, but be a supportive structure for the visual material.

Who is it for? (Audience)
The client is a gallery and auction house that deals with antiquities, used and rare books, and artworks. The items sold vary considerably in size and scope and occasionally whole lots of different items need to be presented as a group.

Why is it needed? (Problem)
The gallery has a website that is difficult to navigate. This is a problem as its customers are invariably browsing and are doing so on multiple platforms and screen sizes. As the products are so variable, the search function does not make up for the inability to get an overview of available items.

What are its benefits? (Solution)
The interaction online will be all the more easy. The new interfaces will allow the items available for sale or auction to be easily found and viewed. The interfaces will be easily navigable and information will be easily accessible with increasing elaboration of information on different levels.

Why is it interesting? (Challenge)
It is interesting as it is an environment that is traditionally tactile and physical (see Appendix 1). Viewing antiquities, books, and artworks on screen must therefore feel very immediate, be easy and clear but with the same sense of intimacy that a physical presence in a gallery or bookshop would deliver. The inspiration for the design comes from wanting to create an experience that is both technically and visually fulfilling as well as creating a portal that serves the user as well as the owner of the business. The challenge of this puzzle is immensely exciting as a puzzle should be!

What will you bring to it? (Vision)
I will bring a sense of tactile presence and clear accessibility. I will bring a desire to view beautiful and interesting objects with clarity and good information.

How will you proceed? (Methods)
I will research the gallery and its products, talk to its customers and staff, and critically consider the web portals for similar companies. I will create a map of the site and list all its requirements, before considering the "look."

1: DESIGN THESIS

With your project in mind, answer the following questions with *as much visual material as possible*. (Suggestions are included as examples with the questions.) If you can't find a single image to back up your thinking, either create the same effect with more than one image or sketch what is missing. Create a collage of words *and* images (physical or digital) that addresses the following:

1.1: What will you design?

Describe the physical product as succinctly as you can.

Examples:

- I intend to design a chair for home-office use. (Find pictures of chairs, home offices.)
- I intend to design a jacket for bicycle messengers. (Find pictures of bicycle messengers, bicycle sports riders, jackets of a similar nature, motorcyclists, cavalry riders . . .)

1.2: What is its nature?

Describe its function and the components of the design: materials, colors, mechanics, and so on.

Examples:

- The chair will have the comfort and adjustability of an office chair and the styling and feel of a home environment. It will be made of materials that are easy to clean and that come in an array of colors and are adjustable to a range of body types and sizes. (Find pictures of surfaces and fabrics, offices and homes, colors, different-sized people sitting in different locations.)
- The jacket will be of a durable, easily cleaned, waterproof, and lightweight material. It will have multiple pockets in various sizes. It will have add-on options for different seasons and climates (e.g., hood, lining, and face mask). Colors will promote high visibility. Reflective materials will be incorporated. All fasteners, zipper-pulls, and so on will be large-scale to facilitate operation while wearing gloves. Styling will be led by the aesthetic of the bike messenger culture. (Find pictures of jackets and other garments showing all the details mentioned.)

1.3: Who is it for?

Describe an end user and the environment to which he or she belongs.

Examples:

- The end user is a professional, working from home, who needs to spend several hours a day at a desk located in a multiuse home environment. (Find pictures of people like this. Note the "type" and "lifestyle" involved.)
- The end user is a bicycle messenger in a large urban environment. This involves cycling in heavy traffic at fast speeds while carrying packages and envelopes in inclement weather conditions. (Find pictures of people like this—these may be the same as in 1.1)

1.4: Why is it needed?

Describe the problem that requires this design as a solution.

Examples:

- Desk chairs for office use are functional and often ergonomically designed but less than attractive and generally at odds with home furnishings. A home office that is in a family area requires furniture that belongs to that environment and that provides the comfort and functionality of office designs. (Here, pictures that show a chair and environment that work together and also others that don't.)

- The jacket must be more versatile than any standard jacket because of different demands placed on it by seasonal fluctuations in weather and different requirements of motion and effort when riding or on foot. There is a challenge in combining such a high level of functionality with a sense of style. (Find images of any garment that does this or for any design that is stylish yet highly functional. Sports car? Motorbike? Something more ancient?)

1.5: What are the benefits of it?

Describe the benefits this design will bring. These should be the answers to the problems posed in the previous question.

Examples:

- The designs will provide a choice for those with home offices, allowing them to furnish their work spaces with a chair that belongs to their homes' aesthetic. Conversely, offices can be furnished in a way that is counter to the traditional functional look. (Put together pictures that play with these ideas. Break some rules. Follow other rules rigidly. See what happens.)
- The jackets will benefit bicycle messengers, making their day-to-day existence more comfortable, functional, stylish, and safe. The pockets and fabrics will create a garment that is an essential tool for the messenger's workday. (Show these details. Sketch onto existing images to add pockets, straps, flaps, to an existing design. See what happens. Be spontaneous.)

1.6: Why is this interesting?

Explain why this project is interesting to you and how it could be interesting to a client.

Examples:

- Designing this chair is interesting to me as I am very interested in blending the aesthetics of "home" and "work." With new materials and CAD/CAM technologies, I believe that the functional can now be subservient to any desired style. I think clients would be interested in anything that increases the number of options they have for arranging and decorating their personal spaces. (Show pictures that blend "home" and "work," find elements that speak of both, and combine them into a layout.)
- I am very interested in designing a garment that answers such intensely functional needs, while addressing the very individual stylistic approach of the bicycle messenger. The clients will be interested by the ease of use, the increase in their comfort, and the specificity of the garment to their situations. (Find images of garments that are stylish, comfortable, and functional. Find images of things that are NOT garments, but exhibit those same qualities. How do they do that?)

1.7: How will you proceed?

Explain how you will proceed to begin the design process. What will you do next?

Examples:

- I will begin by researching the ergonomics involved and the issues related to the end users' comfort and desires for style. I will then examine my options for materials, taking care to acknowledge issues of sustainable design. I will visit several home offices and note their practical and aesthetic concerns. (Find pictures of good ergonomic designs. Create a collection—a grab-bag—of different offices and interiors.)
- I will begin by researching the ergonomics involved and the issues related to the end users' comfort, safety, and style. I will then examine my options for materials, taking care to acknowledge issues of sustainable design. I will interview messengers and examine

Figure 2.24 This concept board was created to illustrate a design thesis discussing fractured surfaces and broken lines.

their workdays and conditions, as well as the sizes and types of objects the pockets could contain. I will research bike-messenger styles and emblems. I will research safety issues and the related colors and fabrics. (Look for pictures of ergonomic clothing designs: uniforms, athletic gear, military, space exploration? Include pictures of the objects and gear that the pockets and straps need to accommodate. Do they fit? It's a puzzle: Does it work?)

2: IDENTIFYING CONSTRAINTS

Ideas are often best defined by what they should not be. By examining constraints that arise through the needs of a project and the problems that need solving, we outline what form (figuratively and otherwise) the idea will take. We define as much as possible and create as much information as we can.

2.1: What are the apparent or potential problems that need to be solved? (Why are you designing this?)

2.2: What do we need to know to begin? Is there research to be done? References to find? (What are the gaps in your knowledge? What do you need to know better than anyone in order to explain the designs?)

2.3: What are the constraints that define the possible solutions? (What keeps you from designing the best one there is? How are you going to work within and/or around those limits?)

2.4: As you begin designing, think of which of these may apply or which of these you would like to apply.

The willful application of constraints can also be helpful in that it creates support and challenges the designer to use solutions that may otherwise have never been considered. More constraints may actually be better. They will focus your creativity.

2.5: Consider as many constraints as you can for your project using some from the following list:

- Information
- Function
- Form
- Materials
- Budget
- Time
- Production
- Environmental impact

2.6: Rank them in order of relative importance.

2.7: Which are inherent, and which are imposed?

2.8: See Figure 2.5: Constraint Concept Map on page 42 and consider what other constraints, either inherent or imposed, may apply to your project.

3.1: How do products such as the ones you intend to design affect the environment? Consider the product's entire life cycle.

- Harvesting/Gathering/Creation of Materials: Remember that materials may be recycled as well as recyclable. Can you reuse something? Can you scavenge?
- Production: Consider the current production methods. What is the most harmful element in the production stage? Can it be removed?
- Packaging: Does your product require packaging? If so, can you design it in such a way as to be recyclable or ecologically less impactful? Can you design the product in such a way that doesn't require (so much) packaging?
- Transportation/Storage: Do the materials have to come from far away? Does your product have to be manufactured far away? Can you make design choices that minimize the shipping of things back and forth across the globe? Are there locally produced materials that will serve as well?
- Usage: How does the consumer's use of your product impact the environment? Energy use? Cleaning? Disposal? Can you design these impacts out of the cycle?
- Disposal/Reuse/Recycling: Can you design your product to be (more) recyclable/reusable/repairable? Can it be dismantled after use and its components reused?

3.2: In short: How could your designs minimize the environmental impact of the product? Which solutions can you implement by yourself in your designing, and which require larger cooperation with manufacturers, shippers, or retailers, for example? What is the biggest hindrance you face in this effort?

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20 Anthony D. Cortese, Education for Sustainability: The Need for a New Human Perspective (Boston: Second Nature, Inc., 1999), 4.
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23 DESA, 1992: Principle 3.
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27 Edward Tenner, *Why Things Bite Back: Technology and the Revenge of Unintended Consequences* (New York: Knopf, 1996), 275.
28 World Commission on Environment and Development (WCED): Document A/42/427: "Our Common Future," The Brundtland Report, 1987, p. 24.