

Elegant Solutions

by

Robert Leff

Bachelor of Science in Art and Design
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Signature of Author _____
MIT Sloan School of Management
May 16, 1997

Certified by _____
James Utterback
Professor of Management and Engineering
Thesis Supervisor

Accepted by _____
Rochelle Weichman
Director, Management of Technology Program

MASSACHUSETTS INSTITUTE
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Submitted to the Alfred P. Sloan School of Management
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ABSTRACT

An investigation into the notion of *elegant solutions* in the design realm was performed through interviews with a variety of designers and a study of academic literature on creativity. Various aspects of elegant product design solutions were identified, and the process leading to the creation of elegant solutions was identified and described. The study uncovered issues of balance, context recognition, communication, experience, problem definition, and synthesis in generating elegant design solutions.

Thesis Supervisor: James Utterback
Title: Professor of Management and Engineering

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I. Approach and Method

Sometimes a product fits its purpose so well and has a certain *je ne sais quoi* that makes it universally recognized as an *elegant solution* to the problem at hand. This thesis investigates the notion of the elegant solution.

According to the Oxford English Dictionary, elegant comes from the Latin *elegans*, meaning “graceful propriety.” Etymologically it means “choosing carefully or skillfully.” The definition goes on to provide the following:

- Characterized by refined grace of form. Graceful, free from awkwardness.
- Pleasing by minuter beauties.
- Tasteful correctness, harmonious simplicity.
- Of scientific processes, contrivances, etc.: “Neat,” pleasing by ingenious simplicity and effectiveness.

The origins of the phrase “elegant solution” are in mathematics, but it has been extended into the fields of software, product design, and negotiation. Another definition, from the world of hacker culture, comes via the *Jargon File* found on the Internet,

elegant: [from mathematical usage] adj. “Combining simplicity, power, and a certain ineffable grace of design.”

The French aviator, adventurer, and author Antoine de Saint-Exup'ery... gave us perhaps the best definition of engineering elegance when he said “A designer knows he has achieved perfection not when there is nothing left to add, but when there is nothing left to take away.”

By concentrating on the design realm, including architecture, product design, interior design, and furniture design, this study attempts to define elegance further by analyzing the qualities that viewers and users appreciate in elegant solutions as well as the qualities that designers strive to imbue them with. Then the creative process is analyzed in an attempt to reveal the design approaches that produce elegant solutions. Finally the phenomenon of pleasure experienced by the user or viewer of an elegant solution is examined.

Why look at design? According to Gianfranco Zaccai, founder of Design Continuum, “Corporate America is increasingly aware that better design represents a vast untapped gold mine for

increasing the corporation's value. Management guru Tom Peters refers to design as commoditization's antidote."¹ Woodie Flowers, a design professor at MIT, agrees, saying that the margin available in the world economy is informed, creative thought.

Method

Initially, I used articles in the media to get a sense of how the term "elegant solution" is used in common parlance. This investigation revealed certain aspects that viewers of elegant solutions see as key.

Then I began to interview designers in various fields about their view of elegance, the conditions under which elegant solutions can be achieved, the role that constraints play in producing elegant solutions, and the design process that leads to elegant solutions. These discussions revealed a view of elegance from the designer's viewpoint.

Finally, I turned to books on the subject of creativity, both from a psychological and philosophical point of view, in order to learn more about the creative process. These investigations revealed certain aspects of the creative process that play into creating elegance.

Interview Subjects

I attempted to find a variety of creative people from different design disciplines in order to generate a well-rounded view of the creative process, rather than focusing on only one profession. I interviewed three industrial designers, an architect, an interior designer, a furniture designer, a graphic designer, a professor of design, and a design engineer. I also interviewed a technical writer, since writers must look at product design from the user's point of view.

Sonya Pinkus, Industrial Designer. Sonya recently emigrated from Russia, where she worked on the construction side rather than the graphical side of a design team concentrating on technical products. She finds her experience as a designer in Russia to be quite different from the United

¹ Gianfranco Zaccai and Gerald Badler, "New Directions for Design", *Design Management Journal*, vol. 7, no. 2 (spring 1996).

States, because here products are driven by the needs of the user, and in the old Soviet system they were driven by the needs of the design client, which was often the state. In the United States she has been working with Shreve, Crump and Lowe developing custom jewelry designs to customer specifications.

Kymus Ginwala, Design Engineer. Kymus is the founder of Northern Research and Engineering (NREC), a business based on creating elegant engineering solutions. NREC specializes in designing and manufacturing parts and systems for fluid dynamics applications. NREC's business model has been to search for customer needs to develop products using NREC's technology and expertise in fluid dynamics. Kymus likes to engage in projects that solve technical problems for the first time. After several decades as an independent company, NREC became a fully owned subsidiary of Ingersoll-Rand, although the majority of their work is still for outside customers. Kymus currently serves NREC in a business development capacity.

Patrick Brennan, Interior Designer. Patrick specializes in interior design and custom furniture design for residential and commercial clients. In San Francisco he worked with Gary Hutton, and in Boston with Tradewinds and Laura Ashley. Patrick also works in theatrical design at the Mount, in Lenox, Massachusetts and at the Boston Center for the Arts. He is currently at Pierre Deux.

Rick von Turkovich, Industrial Designer. Rick is Vice President of Design Continuum, a Newton-based international design consultancy that performs a broad range of design tasks for clients including market research, product planning, industrial design, graphic design, product rollout, and corporate identity. Continuum serves its clients in a design role that is analogous to the role of a management consultant: they not only help clients design new products, they also help them figure out what new products to pursue. Continuum has developed a process that speeds up the design cycle and insures that designs truly meet the needs of both the client and the user.

Garret Wohl, Architect. Garret is an architect with a practice in Boston's South End. She works on a wide variety of projects including design and renovation of private homes, public housing, public buildings, and restaurants.

Nina Childs Johnson, Furniture Designer. Nina designs and constructs custom furniture in Vermont, where she is currently apprenticing with a master craftsman.

Paul Henninge, Industrial Designer. Paul runs his own small industrial design firm in Burlington, Vermont. He has worked on a wide variety of projects from wood stoves, to snowboards and ski

poles, to toilets and baby-changing stations. He received a prestigious design award while still a junior at Ohio State for his design of a recumbent exercise bicycle. Paul worked for Product Genesis, an industrial design firm in Boston, before striking out on his own.

Woodie Flowers, Design Professor. Woodie teaches design in the mechanical engineering department at M.I.T., and runs the M.I.T. Design Center. Woodie is currently concentrating on the process of fostering creativity in students and in the workplace through innovative approaches to teaching design.

Effie Chou, Graphic Designer. Effie works for Jon Roll, an environmental graphics design firm in Harvard Square on a variety of projects including signage, friezes, murals, exhibition displays, and corporate identity packages.

Hope Nilsson, writer. Hope is a technical writer who has worked on a variety of technology-based products. Technical writers often act as user advocates during the design process, since they must communicate to the user how a product works. If it is difficult to describe, it is probably not designed well. Hope is an aficionado of elegant product design. As a participant in a variety of sports, she is constantly searching for elegant solutions in products ranging from the perfect dry suit for cold weather kayaking to the quintessential articulated plastic boot for telemark skiing.

Organization of this Document

This thesis contains four main sections. The first section, Approach and Methods, describes the problem approach and research methods. The second section, Harmony of Purpose, discusses various traits that elegant solutions display. The third section, Authentically Viewing the Problem, discusses the conditions of possibility for creating elegant solutions. The fourth section, Transcendence, serves as a conclusion. An appendix, Opposing Viewpoints—The Behaviorist View, discusses findings that are odds with the findings in this thesis, namely an alternative, incrementalist view of problem solving. Finally a Bibliography cites the academic sources used to develop this thesis.

II. Harmony of Purpose

“ Great design is measured by the total experience of the user.” - Gianfranco Zaccai,
founder, Design Continuum

The Oxford English Dictionary definition of elegance speaks of harmony. An elegant design solution achieves harmony by balancing the forces inherent in any design project. Elegant solutions recognize their context and communicate their function.

Achieving Balance

Elegant designs seek to balance the constraints inherent in any design project in order to develop a unified whole that works on every level. Design is an exercise in symmetry, balancing the tensions of the various issues that pull on a designer’s attention.

The artist Ben Shahn speaks of “the long artistic tug-of-war between idea and image,” revealing a tension that must be resolved.²

Robert Grudin, in *The Grace of Great Things: Creativity and Innovation*, stresses the importance of recognizing the dichotomies that exist within a project. He says that the acts of inspiration and discovery involve the unification of polarities of experience transcending the past and weaving new strands into the future.³

² Vera John-Steiner, *Notebooks of the Mind: Explorations of Thinking* (Albuquerque: University of New Mexico Press, 1985) p. 8.

³ Robert Grudin, *The Grace of Great Things: Creativity and Innovation*, (New York: Ticknor and Fields 1990) p. 33.

According to Grudin, “Beautiful things are not only suitable to themselves but display fitness for the greater hierarchies that they inhabit.” Elegant designs have an inner coherence and contextual fitness. They display symmetries that imply a “natural justice.”⁴

Elegant solutions resolve the tension between details and unity of the whole.

A major aspect of design is a balance between attention to detail on a micro level and the unity of a design on a macro level. Grudin speaks of a sense of wholeness, where elements interact and participate in larger forms,⁵ and the importance of a patient regard for detail.⁶

Frank Lloyd Wright speaks of organic design as portraying a natural relationship of the part to the whole.⁷

According to Paul Henninge, for an industrial designer there is an interplay between attention to detail and stepping back to look at the larger picture. Paul’s father, was an engineer who worked only on the planning stages of design. In designing a bridge, he would sketch out the structure in broad strokes, and leave it to others to figure out the details of load and connections. He would link his thinking to a broad vision, talking about Indian trails and how they told you where to lay down the road.

While his father’s passion was for the big picture, Paul’s point of view as an industrial designer is that elegant design is when “a product is implemented with a sense of detail that fits like a glove to the situation.”

⁴ Op. cit. Grudin 1990 p. 59.

⁵ Op. cit. Grudin 1990 pp. 12-23.

⁶ Op. cit. Grudin 1990 pp. 12-23.

⁷ Op. cit. Grudin 1990 p. 36.

Nina Childs Johnson also talks of the unity between the detail level and the overall design. She describes the “hidden mechanical wonders in furniture joints” in her discussion of detail. From the furniture designer’s point of view, there can be elegance both in the overall design and in the details of the joinery.

Hope Nilsson enjoys designs that work well internally and within their context. She sports a tattoo on her ankle that is specifically designed to flow with the musculature and bone structure of that part of the body, creating an elegant design through its attention to detail.

According to Woodie Flowers our society does not celebrate detail creativity. He feels that detail creativity is as important as strategic creativity, but Board’s of Directors and CEO’s ignore the detail level for the most part.

In Japan, on the other hand, detail is celebrated. The elegance of Japanese design comes from its sense of unity and harmony. Each ikebana floral design is a self-contained microcosm arranged according to a prescribed order of earth, heaven and man. Traditional Japanese design appeals to a higher order symmetry than the geometrical symmetry of Western design. For the Japanese, design is a vehicle for the infinite development of one’s thinking, beyond mere function. The key values are integration, grace, elegance and harmony with nature. “Japanese designs let nature speak for man.”⁸

Elegant solutions seek to optimize by resolving tensions instead of making tradeoffs.

Garret Wohl says that her job as an architect is largely about finding elegant solutions to problems. She believes that the search for an optimum solution is often the path toward achieving an elegant solution.

⁸ Tanaka Ikko and Koike Kazuko, *Japan Design: The Four Seasons in Design* (San Francisco: Chronicle Books, 1984), pp. 10-11.



A lovely example of space optimization is the Japanese hakodan or hakohashigo: drawers and closets built into a staircase in order to maximize living space. They are found frequently in Kyoto.⁹

⁹ Op. cit. Ikko (1984), p. 26.

According to Kymus Ginwala, his firm, NREC, is very interested in solutions that optimize efficiency and performance. NREC has developed software to help engineers optimize the shape of turbine and blade designs for specific applications and constraints. NREC has also developed control software for 5-axis machine tools because their engineers recognize the constraints of production and work to optimize their designs for both operating efficiency and manufacturability. Kymus was an early adherent of design for manufacture, recognizing the value of placing engineers on the production floor as a first assignment, so they get a hands-on understanding of the constraints of the production environment.

In *The Power of Product Platforms*, Marc Meyer and Al Lehnerd propose a working definition for elegance in design:

An optimized system in which all subsystems, taken as a whole, create the greatest output performance for the least inputs.¹⁰

To this end, NREC is involved in development of an “inside-the-fence” cogeneration unit based on natural gas or oil that would generate heat, hot water and electricity efficiently from a single fuel source, optimizing and simplifying the solution to the user’s energy needs.

Optimization removes extraneous elements, making elegant solutions appear simple.

Meyer and Lehnerd speak of elegant design as “simplicity combined with a richness in features.”¹¹

Nina Childs Johnson suggests that “elegant design is simple, to the point, not overdesigned.” Robert

Grudin defines simplicity as “wholeness without repetition or digression.”¹²

¹⁰ Marc H. Meyer and Alvin P. Lehnerd, *The Power of Product Platforms: Building Value and Cost Leadership* (New York: Free Press, 1997).

¹¹ Op. cit. Meyer & Lehnerd 1997.

¹² Op. cit. Grudin 1990 p. 59.

Phenomenology identifies an intense desire human to understand our environment by oversimplifying and reducing the world to one fundamental or ultimate level.¹³ An elegant solution reduces a problem to its essence, but it does not oversimplify it. Perhaps, though, our appreciation for the simplicity of an elegant solution, the way it pleases the viewer, comes from this desire to simplify our environment.

A basic example is found in the simple, elegant design of a ski holder strap. The product consists of a strip of fabric with Velcro tabs on each end that can be wrapped around a pair of skis to hold them together for easy carrying. Older designs with rubber straps and a metal hook were dangerous, sometimes flying off in the user's face when being attached. Eventually the rubber would wear out from being repeatedly stretched under conditions ranging from subzero freezing to room temperature. The new design is simple, straightforward and powerful. It performs all the tasks of prior designs but contains none of the inherent drawbacks.

According to its brochure, Design Continuum strives to create elegant designs that provide "better, simpler, smarter ways of doing things...saving time, money and material."¹⁴

Sonya Pinkus suggests, however, that some designs can be too simple. In fashion for example, Calvin Klein's simple designs look wonderful on a perfect body, but do nothing for the masses of consumers with imperfect bodies, ignoring the needs of most consumers.

¹³Gian-Carlo Rota and Jeff Thompson, *The End of Objectivity: The Legacy of Phenomenology* (Unpublished Manuscript).

¹⁴ From Design Continuum marketing literature.

Elegant solutions balance the needs of the designer, client and user.

According to Paul Henninge, a design must please three audiences:

1. The end user (the public)
2. The client (usually a manufacturer)
3. The designer

When a design meets the needs of all three audiences at the same time, then elegance can be achieved.

Patrick Brennan agrees, remarking that some responsibility for the success of a project rests with the client. He describes the ideal design client as someone who:

- communicates their needs well
- is open-minded to new input
- is interested in the issues

While Patrick stresses the importance of the client's input, he admits that a design must please him first.

Effie Chou also believes that the client bears some responsibility. She says that if a graphic design client is involved in the process and would appreciate the effort and the result, then she is willing to take the time required to find the elegant solution to the problem. For run-of-the-mill projects that don't excite her, she sometimes finds it difficult to find the inspiration and motivation required to come up with an elegant solution.

Elegant solutions are non-discriminatory, encompassing the needs of all potential users.

Garret Wohl provides an example of an architectural solution in response to the American's with Disabilities Act (ADA). Garret believes that the essence of the ADA is non-discrimination, and therefore architectural modifications to buildings in order to comply with the act should also be non-discriminatory, which often calls for an elegant solution. A separate entrance around the rear, for

example, is not an elegant solution, and is discriminatory. Garret was working on the entrance to the West End Courthouse in Boston. The standard ADA solution is a 1 in 12 sloping ramp that doubles back on itself next to the main entry stairs. Unfortunately this solution is often unsightly, and can ruin the effect of an existing design. As she says, the solution is “clunky,” a word frequently used as the opposite of elegant. Her solution in this case was a gently sloping 1 in 20 ramp that replaced the steps entirely and serves as a common entranceway for all, regardless of motility. This solution took advantage of the existing empty space in front of the building and did not detract from the overall theme of the original design.

Another project related to the disabled was performed by Design Continuum for the research group of a furniture company. Herman Miller Research provided Continuum its data on the personal hygiene needs of the elderly. The idea was to address the needs of the elderly and disabled while finding areas where the needs of the elderly, the young and the caregivers converged. The result was the Metaform Personal Hygiene System. The prototype system’s features include:¹⁵

- A sink that can be mechanically raised or lowered with a simple switch to suit a standing or seated user’s needs.
 - A toilet, with optional arm rests, that flips down from the wall allowing a wheelchair to easily maneuver into position. The toilet height can also be adjusted mechanically by the user, allowing the wheelchair-bound to transfer themselves at one height, and then lower the seat to provide a squatting posture for optimum elimination. When the toilet is flipped back up into the wall recess, it is automatically cleaned.
-
- A shower module that requires no curtain or door to impede wheelchair access.

¹⁵ Op. Cit. Design Continuum.

- An innovative floor drain at the boundary of the shower enclosure that drains both the shower and the room (in case of flooding or spillage). The drain does not interfere with a wheelchair rolling over it.
- An integrated support rail with a non-slip surface in the shower that also serves as a towel rack and an accessory bar for a handicapped seat, soap dispenser, or bassinet.
- A shower head mounted on a column at the outer corner that also provides lighting and ventilation of water vapor at the source.

The shower configuration allows disabled users to shower in a seated position facing outward, rather than towards a wall. The whole system seeks to accommodate the disabled without stigmatizing them.

Recognizing the Context in Order to Communicate Sense

Elegant design must balance all of the constraints involved, but in order to communicate effectively, it must do so while recognizing the context in which the design will be viewed or used. According to Robert Grudin, “To analyze something in its full context, we need an understanding of the whole, a sense of goal and value.”¹⁶

The end user is the ultimate judge of a design’s success.

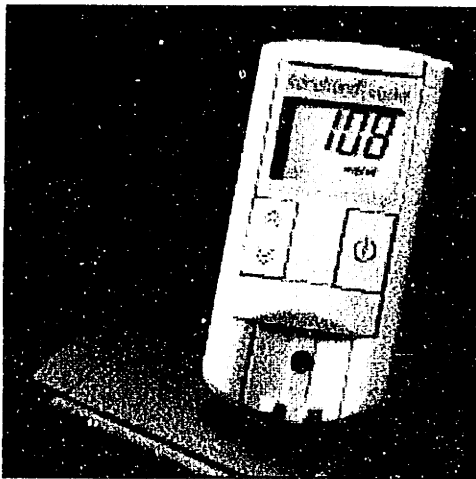
Paul Henning claims that character in design is controversial in the United States. There is pressure to fit in, to meld. For example, when designing fixtures or items for a bathroom, Americans prefer benign designs. Therefore designers for the American market must avoid controversy in the bathroom. European consumers, on the other hand, have more appreciation for character, and European designs often display more character than American designs.

¹⁶ Op. cit. Grudin 1990 p. 37.

Sonya Pinkus agrees, saying that the demands of European versus American consumers in the fashion realm are also quite different. For example, Europeans want tailored, fitted clothing, while Americans crave comfort.

According to Paul, architects have a difficult time innovating because of user acceptance. Their audience is extremely conscious of the constraint of history. If a structure does not have a clear foundation, vertical elements and a roof, it is rejected by users as a building. The geodesic dome is a wonderfully elegant solution, where the structural forces are represented in the design with a minimum of materials and weight. But with no foundation or vertical and horizontal elements, it is not accepted by people as a “building.” It lacks the mass that people associate with shelter. Most people don’t want to live or work in a geodesic dome. They don’t trust them as buildings.

At EuroDisney a hotel was built whose facade frightened visitors. People were literally afraid to enter the building. Because it did not look like a hotel tourists did not want to stay there. Eventually the hotel was closed down due to lack of guests.



The Accutrend Alpha Blood glucose measuring device. Design Continuum performed conjoint analysis on various aspects of the product in worldwide research with a variety of ages, abilities, and sexes in order to determine the design that would have greatest customer acceptance. They employed an approach that allowed users to articulate their preferences through visual and functional metaphors.¹⁷

¹⁷ Op. Cit. Design Continuum.

Elegant design is timely, it recognizes cultural cues.

According to Patrick Brennan, while math or science can be universally elegant, design is always viewed in the context of its time and culture.

Paul Henning concentrates on this cultural basis of design. He says that there are no designs out of time or out of context. While some designs, like the Acropolis have a timeless sense of proportion, any design that is celebrated is celebrated in the context of its own time. That is not to say that it will not be appreciated by generations to follow, but one of the constraints in design is to make something for the time you are in. This analysis agrees with one of the central tenets of existential phenomenology: that sense can only be grasped within a context.¹⁸

Paul says that, “Culture is where the strength is. You really have to provide a solution that is appropriate for our time... I think that product design is the art history of tomorrow.”¹⁹ Paul and his cronies speak about wonderful designs that capture the times we live in as having “groove pepper”—that intangible characteristic that balances and unifies emotion, utility, and form while communicating function in an especially timely manner.

Paul says that objects like the Ford Taurus or the Frisbee are a reflection of our culture. He sees the important issues for the 1990’s as mobility and hyperfunctionalism. People want products like laptops, cellular phones, pagers and palmtops that are small, light, portable and multifunctional. Paul sees a certain insecurity inherent in the culture as we approach the next millennium that is similar to the insecurity people felt at the turn of the last century. Instability abounds as family and community ties are becoming frayed. In the work environment, for many people job security is a thing of the past. Our information environment is also changing rapidly. It begins to feel unfamiliar if one doesn’t keep up. Paul also sees a growing tendency toward total self-reliance in our culture that is evidenced in films like Blade Runner and Road Warrior.

¹⁸ Op. cit. Rota & Thompson p. 6.

Woodie Flowers agrees with Paul that designers must have a cultural context in which to work. He feels that it is important for a designer to have an overview of what is happening in society and suggests that designers read the Wall Street Journal or an equivalent in order to stay informed.

Elegant design has a sense of history

Part of the cultural context is the past, recognizing historical cues. Sonya Pinkus points to modern designs that are simple, but that use cues from the past. For example, she enjoys seeing the history of furniture in the details of a modern design.

Nina Childs Johnson agrees. She points out that elegance in design requires an understanding of the relationship between the designer and history. For example a furniture designer needs a strong connection to the standard, historical way of doing joints.

“If innovators are bold and innocent, open and courteous, to present phenomena, they are equally so to things past,” says Robert Grudin, describing a “...quest to regain continuity with ancient forms of piety.” He says that, “Inspiration may be the revelation of something new, but it is also the rediscovery of something always true.”²⁰

Elegant design works in harmony with nature.

Woodie Flowers suggests that in order to create elegance, a designer must “have an affair with mother nature.” Sonya Pinkus agrees, positing that taking cues from nature is a pointer of elegance.

¹⁹ McKay Duncan and John Butterick, *Hardpacked*, Core Industrial Design Network (April 1997).

²⁰ Op. cit. Grudin 1990 pp. 12-23.

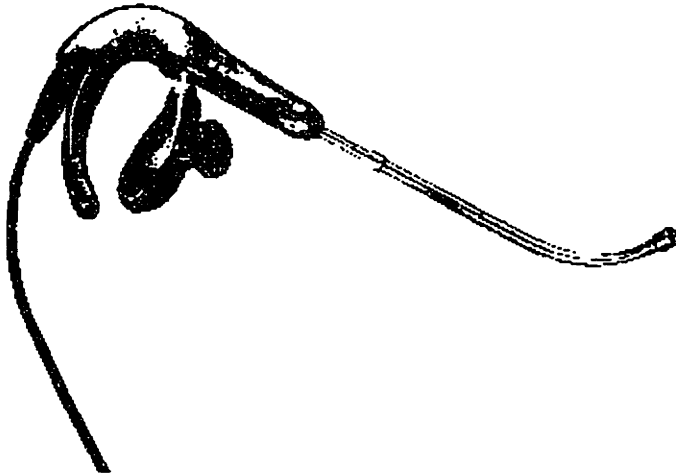
Robert Grudin says, “The creative mind chooses justice, moderation and simplicity...because these virtues are the closest possible parallels to nature.”²¹

In furniture design, according to Nina Childs Johnson, it is important to understand the materials and their character, like the grain of the wood, for example. She says,

The craftsmen must feel what a piece of wood wants to become. Wood is an organic material and you are transforming it. You don't want to violate the material. Wooden furniture must have a strong relationship to nature, a connection to where the materials come from. I prefer organic designs, curves, unpainted furniture, where the glow of the wood comes out. These things are elegant. Sometimes you have to work the materials a lot, but if the form comes from nature then it respects the material, even if you must work the material in a way that may seem to violate its structure.

Nina also talks of the relationship of furniture parts to body parts: arm, leg, foot—and on Queen Anne furniture—the ankle and knee as well.

²¹ Op. cit. Grudin 1990 pp. 12-23.



For Plantronics, Design Continuum developed the world's lightest telephone headsets, helping the company expand its market beyond desk-bound users. The line Continuum created offers three models: traditional headband, ultra-light over the ear, and a mini ear bud that rests in the concha of the ear. Because the ear bud model can be put on or taken off with only one hand, it has gained more acceptance by occasional users. Even though no user had expressed the two-handed limitation as a reason for not using a headset, Continuum surmised the need through market research, and verified it through simulations. The product's ergonomic design works with nature.²²

Elegant design is thoughtful, it allows the form to express the function.

In design, the form, shape, color and other attributes of the object all say something. Paul Henning cites the example of Mitsubishi. By looking at the design of their cars, which is very masculine, it is not surprising to him that their corporate culture fosters the kind of attitudes that led to the filing of a sexual harassment suit against the company by female employees.

Paul believes that product design is a form of communication. A good snowboard binding should let you know how it works. Form follows function and communicates the function. You can't separate aesthetics and function. Paul is against inauthenticity in design. If something looks clean, it should be clean. Otherwise it is deceptive, and unfair to the user. Similarly, if something looks sturdy, it ought to be sturdy. A sturdy-looking object that breaks easily frustrates the user.

²² Op. Cit. Design Continuum.

Well-designed objects are easy to interpret and understand. They contain visible clues to their operation. Poorly designed objects can be difficult and frustrating to use. They provide no clues—or sometimes false clues. They trap the user and thwart the normal process of interpretation and understanding.²³

Sonya Pinkus also likes to see the function of a product expressed in the design. She feels that particularly in technical products, it is crucial that form follow function and indicate how a product should be used.



Design Continuum developed a rack system for a massively parallel supercomputer. The open, modular rack design requires no special cooling for the components. The interconnections between racks are handled through overhead ductwork, rather than requiring a raised floor. Lighting is also provided in the ductwork. The effect feels like an environment out of Star Trek. The metaphor of neuron interconnections in the design expresses the idea of a massively parallel supercomputer.²⁴

Elegant design is evocative.

For Paul Henninge, a design with “character” is what pleases him most. An elegant design should evoke emotion on the part of the user or viewer. He contrasts the evocative Ducati with an everyday Honda. The Ducati makes him smile.

²³ Donald A. Norman, *The Psychology of Everyday Things* (New York: Basic Books, Inc., 1988).

²⁴ Op. Cit. Design Continuum.

Garret Wohl believes that a design with character has an uplifting effect on the viewer. It can bring the viewer up from the mundane, much like the elegance often ascribed to certain personalities, like Princess Diana, whose way of carrying herself has an uplifting effect on those around her.

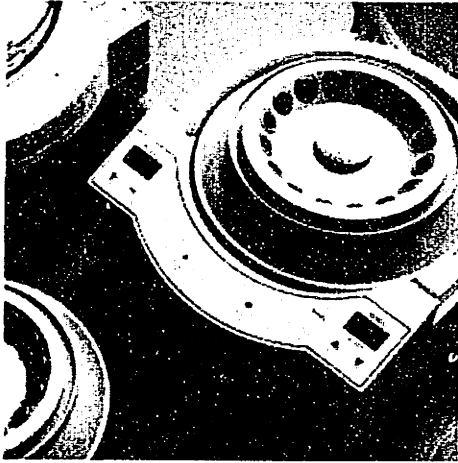
Choreographer Anna Sokolow said,

Anyone...can have a good idea for a dance. In itself that's not enough. There must be form as well as concept; both matter—what you feel and how you express it. First, the choreographer sees his idea in terms of movement, as the painter sees his in terms of color, line, mass. This happens spontaneously. Movements are not intellectually contrived but are evoked by emotional images. The only intellectual process is the one that puts these spontaneously conceived movements into a form that works as a whole.”²⁵

Elegant designs are imbued with this emotional input and express emotion in the design.

Design Continuum's marketing literature states that an elegant design “reveals itself over time, at every point of contact...it brings beauty and simplicity into our lives...it digs deep, looks around plans ahead.”

²⁵ Op cit. John-Steiner 1985 p. 164



The Micro V Personal Centrifuge from Design Continuum is a small portable unit that features removable, interchangeable, autoclavable rotors that minimize the possibility of contamination. This innovative design leapfrogged the competition. Continuum used rapid prototyping methods to produce several test shapes and then ran market tests to identify the ideal design from among the options. The friendly product design they settled on evokes R2D2 and the Sony Discman. According to Rick von Turkovich, when customers need a unit repaired, they often insist on getting back the same unit and not a replacement, because they have formed an emotional attachment with the device.²⁶

Elegance in design is a form of beauty beyond aesthetics.

Elegance is a form of beauty. Although many elegant solutions are aesthetically beautiful, the essence of an elegant solution is a beauty that appeals to intellect and emotion. There is often a connection between being pleased intellectually and being pleased emotionally. As Nina Childs Johnson says, “Elegant furniture design connects with the user in a gut way, on an emotional or intellectual level, beyond simple aesthetics.” Robert Grudin speaks of the importance of a designer having a sense of participation in beauty, whether that beauty is aesthetic or not.²⁷

Elegant solutions communicate sense.

Effective communication is the communication of meaning: making another understand the sense of something. Hope Nilsson believes that “viewing an elegant design is a sense-making experience.” As

²⁶ Op. Cit. Design Continuum.

²⁷ Op. cit. Grudin 1990 pp. 12-23.

such, the viewer who perceives elegance has the same *aha!* experience that the designer had when solving the original problem, providing a feeling of satisfaction. When the viewer grasps the function of a design, all of a sudden it reorganizes itself and makes *sense*. The true sense of the original problem the designer faced is revealed through its expression in the design, and the authenticity of the designer's solution is communicated as the function of the design leaps out from its facticity.²⁸ James Joyce describes it more eloquently as the epiphany achieved when "the whatness leaps to us from the vestments of its appearance."²⁹

Viewing an elegant solution casts the past in a different light for the viewer in the same way that solving a problem does for the designer. According to Robert Grudin, "The past self-destructs in creating the present. Our discoveries so reshape reality that we cannot remember what we were like before we had them."³⁰ The viewer of an elegant solution shares in "the pure joy of sudden insight."³¹

²⁸ Op. Cit. Rota & Thompson p. 35..

²⁹ Op. cit. Grudin 1990 p. 58.

³⁰ Op. cit. Grudin 1990 p. 4.

³¹ Op. cit. Grudin 1990 p. 9.

III. Authentically Viewing the Problem

“ The fundamental contribution of design is to solve problems, enhance experiences and simplify lives.” – Gianfranco Zaccai, founder, Design Continuum³²

“ The really creative act in science involves initially forming the correct questions rather than providing the answers.” – Albert Einstein³³

Now that we have seen how elegance expresses itself in design through a harmony of purpose, this section explores the conditions of possibility for creating elegant solutions by examining the role of constraints and problem definition in creative problem solving.

GianCarlo Rota, in *The End of Objectivity*, describes the process of solving a mathematics problem (paraphrased here):³⁴

In retrospect, the false avenues I pursued, in light of having solved the problem, were escapes. Once the problem is solved, I see that the failed attempts at a solution were really not attempts to face the problem directly. They were attempts to evade the problem.

A property of having seen the right solution is that it recasts the past in a different light, as an escape that I have been through. I see that the authentic solution was staring at me all the time, but I avoided facing it out of fear of the new, or laziness, or an unwillingness to face something new. Facing the new takes courage.

³² Op. Cit. Design Continuum.

³³ Robert W. Weisberg, *Creativity: Genius and Other Myths* (New York: W.H. Freeman and Company, 1986), p. 74.

³⁴ Op. cit. Rota & Thompson p. 9-10.

Until I have solved the problem, however, I don't know if any technique that I try is genuine or not.

What is revealed upon solving the problem is a total break with the past. "The ontological break with the past." The solution of the problem is the "moment of truth" where I view the past as something that is no longer part of myself, something from which I am freed: freedom from the shackles of the past. The solution comes from authentically viewing the problem at hand.

When I have grasped the sense of the context, the solution appears evident.

This view of problem solving serves as a backdrop for this section.

The Importance of Constraints

In order to solve a problem, the problem must be defined. Robert Weisberg, in *Creativity: Genius and Other Myths* speaks of "importance of knowing the criteria a solution must meet."³⁵ Constraints serve to frame problems for designers.

At Continuum, deliverables are always defined up front, properly setting customer expectations and framing the issues clearly. In addition, there is regular monitoring of progress and contact with the client to ensure sensitivity to evolving concerns.

Constraints give designers an angle of attack on the problem.

According to Paul Henning, constraints and elegance are intimately intertwined. A design project fraught with constraints is much more likely to produce elegance than one with few constraints. When there are no constraints, it is difficult to even define the problem in a useful way. Effie Chou agrees. She prefers to work in a situation of constraint because it helps her focus on the project at hand.

³⁵ Op. cit. Weisberg (1986) p. 66.

Constraints feed innovation.

In highly constrained environments like the space program or the aircraft industry, where there is constant need for trade-offs, elegant solutions are required, since they tend to minimize the negative aspects of trade-offs, generating win/win situations instead. George Schairer, a Boeing designer says of the industry,

The airplane is a working compromise of many interrelated factors. Nearly every item is arranged to accomplish more than one purpose, and there are many ways to put the components together to come up with a workable airplane.³⁶

In his senior design class at MIT, Woodie Flowers gives students a complex task, in a large group, with a tiny budget, and not enough time, in order to simulate the real pressures of the design world. One outcome of assigning 24 students to one project is that students are forced to break problems down and form task forces. They also learn that little work gets accomplished in meetings. According to Woodie, the constraint of pressure is fundamental to design. Woodie's suggestion for designers is to "make friends with the knot in your stomach." In other words, use the anxiety to propel you rather than allowing it to consume you.

Often in her practice, Garret finds that lighting provides opportunities for elegant solutions. For example, in a room with a cathedral ceiling, she wanted to use indirect lighting, rather than have an obtrusive fixture glaring light down upon the room. The solution was to lower the crown molding where the wall and ceiling meet in order to put recessed lighting above the molding, so the fixture would be invisible and the light would reflect off the ceiling. In this case, the constraints pointed to the solution.

³⁶ Jean Ford Brennan, *The Elegant Solution* (Princeton, NJ: D. Van Nostrand Company, Inc., 1967).

Elegant designs build on a theme.

Garret Wohl definitely prefers to design within constraints. She provides the example of work she did for a wealthy Texan who had too much money and no theme in mind. Under those conditions, the end-product also had no theme, and was not an example of her best work.

According to Patrick Brennan, some clients only buy a designer's name, saying, for example, "I'm going away for three months, and I want my home transformed while I'm away." Such clients are not a designer's dream come true, because they have not articulated a theme.

The idea of theme, and variations on the theme, came up in work Garret performed to develop renovation guidelines for the Georgian homes in the town of Bath, England. She and her partner discovered that what made the homes in Bath so appealing was that although they followed the strictures of Georgian architecture as a theme, they each had their own set of variations on the theme. In her report, she stressed the importance of maintaining those variations in order to maintain the elegance of the homes.

Garret also brings up the example of Union Park street in the South End, a British-style mews. It is elegant for its similarly themed buildings, each with subtle variations in railings and doorways. Each building being a different expression of a similar theme. Here the theme is expressed in a common language, creating a sense of unity, but allowing each building to retain its unique character.

Redefining the Problem

Robert Grudin suggest that creative individuals view problems as "phenomena whose internal principles and external relationships...are open to redefinition."³⁷

In order to come up with an elegant solution, a designer must "think outside the box" by tearing a problem down, assessing the assumptions underlying the problem definition and then building up a

³⁷ Op. cit. Grudin 1990 pp. 12-23.

solution by viewing the problem in a different light. Often this involves redefining the problem by broadening its scope or coming up with a new angle of attack.

Grudin describes analysis as the “re-creation of the subject under study.”³⁸ He suggests that creative people have a “love of the problematic” and enjoy creating new problems or reformulating existing problems.³⁹

Weisberg describes creative formulation of a problem as approaching the problem in a different way than the approach taken by others.⁴⁰ The Gestalt psychological view describes breaking out from drill-induced thinking in order to free ourselves from the “rut of past experience.”⁴¹ Edward DeBono calls it lateral or divergent thinking.⁴²

William J.J. Gordon describes a process of “making the familiar strange.” Saying that the first step in innovation results from “strange” new concepts used to view a “familiar” problem. The next step is to gain a new understanding by making the strange familiar again.⁴³ Grudin summarizes the thought as,

The ability to find strangeness in a thoroughly familiar context [which] exists independently of the strangeness or familiarity of external phenomena....The mind’s

³⁸ Op. cit. Grudin 1990 p. 38.

³⁹ Op. cit. Grudin 1990 pp. 12-23.

⁴⁰ Op. cit. Weisberg (1986) p. 142.

⁴¹ Op. cit. Weisberg (1986) p. 42.

⁴² Op. cit. Weisberg 1986 p. 53.

⁴³ Op. cit. Grudin 1990 p. 54.

capacity for making itself strange, for greeting phenomena with a set of shifting perspectives.”⁴⁴

The phenomenological viewpoint is that all viewing is “viewing as.”⁴⁵ For example, elegant solutions are often born out of viewing a problem as an opportunity. A designer views a problem in order to solve it, and therefore creates a project. In pursuing this project, he performs *eidetic variations*,⁴⁶ considering what would make the context a bit different and how that might affect its sense. In the end, the designer views *beyond*,⁴⁷ seeing beyond the issues to the essence of the problem, and eventually to a solution.

Viewing the issues in a new light is a source of elegant solutions.

Sometimes elegant solutions are born out of a mistake. When Garret and her husband Bob, a carpenter, were renovating their home, they decided to use an oak door casing, because they very much liked the prominent grain of the oak. Unfortunately, the plinth blocks (usually a square with a bullseye), traditionally used where the vertical and horizontal elements meet, looked terrible in oak, precisely because of the prominent grain. But by the time they recognized the problem, the vertical elements of the casing had already been cut, and it was too expensive to start over with new materials. This constraint led to an elegant solution where they used a black rectangle of wood as the infill detail. The new solution acknowledged the joint where the elements change direction by using a new material, and did not take away from the effect of the grain in the oak. Garret and Bob viewed the problem at hand authentically, recognizing that the change in direction must be acknowledged, but

⁴⁴ Op. cit. Grudin 1990 p. 55.

⁴⁵ Op. cit. Rota & Thompson p. 29.

⁴⁶ Op. cit. Rota & Thompson p. 30-31.

⁴⁷ Op. cit. Rota & Thompson p. 32.

they freed themselves from the familiar solutions and came up with a new approach. Countless people later commented on how much they liked the effect.

Garret believes that elegant solutions are achieved under the following conditions:

- When there is clarity about the end goal up front.
- When the designer has no particular method in mind about how to achieve that goal.
- When the traditional solution is registered, but the designer is thinking of other ways to achieve the goal.

An example that Grudin uses comes from Peter Drucker's *Innovation and Entrepreneurship*. In the shipping industry, operators were concentrating on reducing costs by building more fuel-efficient ships when the real money sink was the cost of interest. A shipper's largest expense was idleness, not fuel consumption. The elegant solution was to develop container ships and roll-on, roll-off ships that would minimize their time in port. This redefinition of the problem recognized that separating loading and stowing would save money. Grudin calls this approach "rebuilding reality," by creating a new context.⁴⁸

Another example of problem redefinition providing an elegant solution was provided by Patrick Brennan. He and Gary Hutton had a client who wanted a very large, custom dining room table that could seat up to 25 people. The problem they faced was where to store the table leaves. The clients insisted that the leaves for the table should be stored right there in the dining room, so they wouldn't have to drag them all over the house. Rather than build a closet for the leaves that might be intrusive, Patrick and Gary came up with the solution of building a custom sideboard based on traditional designs. The sideboard they designed had 20 drawers of differing heights each with custom brass drawer pulls that were cast as the numbers 1-20. The drawers, of course, didn't open, because the piece was really used for storage of the leaves, which were inserted through a hidden door on the side. This piece was both functional and superfluous at the same time. It was elegant, however, because it

⁴⁸ Op. cit. Grudin 1990 p. 132.

fit the style and traditions of a classic dining room while performing the function that the client required.

Patrick enjoys a bit of illusion in furniture design. He likes to play on the idea of transformation, recognizing the assumptions that the viewer brings to design. In the case of the sideboard, the function of the piece was still storage, which is the traditional use for a sideboard, only it was a different kind of storage. An additional function of the piece was to fit in with the decor of the room, to be unobtrusive, which this piece does very well. Part of the elegance in this solution is that it also provides counter space, just like a traditional sideboard.

In order to face a problem authentically, a designer must critically assess assumptions.

Paul Henning believes that problem definition is crucial to design. According to Paul, it is important in any design to recognize the assumptions you have made, and layer the design on top of them. He says that it is easy to forget, as you get involved on the detail level, what the real problem is that you are solving.

Jacob Getzels and Mihalyi Csikszentmihalyi also identify of the importance of critical analysis in the early stages of the creative process in their study of creative artists.⁴⁹

Albert Einstein said, “Common sense is that residue of prejudices acquired before the age of eighteen,” which speaks to GianCarlo Rota of the importance of thematizing the unspoken, unexamined falsehoods by which we form our impressions of daily life.⁵⁰

Robert Grudin stresses the importance of a sense of innocence and playfulness, encompassing a willingness to get rid of preconceptions and view the problem with a clean slate.⁵¹ He also stresses a

⁴⁹ Op. cit. Weisberg (1986) p. 122.

⁵⁰ Op. cit. Rota & Thompson p. 1.

⁵¹ Op. cit. Grudin 1990 pp. 12-23.

lack of pre-judgment.⁵² In the process of rendering the familiar unfamiliar, he suggests “casting away assumptions...discarding ordinary associations and distinctions.”⁵³

Design is a process of tearing down and building up. If a designer does not look critically at the assumptions upon which a design is founded, then she cannot view the problem authentically. It is crucial to thematize these assumptions and face them in order recognize how to build upon them.

Elegant solutions exploit latent advantages.

Kymus Ginwala says that NREC’s business model is to search for customer needs that NREC can satisfy through its unique expertise in fluid dynamics technology.

One recent business that NREC entered is called “re-rating,” which refers to updating compressor turbines for chillers, such as large building air conditioning systems, that have been retrofitted with newer, non-ozone-depleting refrigerants. The new refrigerants are not as efficient as the older, CFC refrigerants and typically result in a 10-20% reduction in BTU output. The obvious solution to the problem is to upgrade the compressor with a more powerful one. Unfortunately, this presents two major problems: compressors can cost several hundred thousand dollars each, and the systems in many buildings cannot be removed except with a blowtorch, since they were put in place during construction.

NREC came up with an elegant solution by recognizing that turbine technology has greatly improved over the years since most of these systems were installed. NREC’s solution is to retrofit a new, custom-designed compressor turbine that can recover much of the lost output of the refurbished system without replacing the entire compressor, saving building owners a great deal of money. NREC’s expertise in designing turbine blades, combined with their optimization software puts them in a unique position to fill this niche.

⁵² Op. cit. Grudin 1990 p. 31.

A similar re-rating business has been developed to help gas transmission companies reduce the NO_x emissions from the reciprocating engines used along their transmission lines in order to comply with EPA regulations. By adding more air to the combustion mixture with a turbocharger, NREC has made the engines run much more cleanly, saving the cost of replacement.

Elegant solutions view problems broadly.

Marc Meyer recounts Al Lehnerd's experience at Black and Decker, where the problem of double insulation was viewed as an opportunity to rearchitect the entire product line.⁵⁴

Lehnerd described a classic example of product family and platform renewal that Black & Decker achieved in consumer power tools in the 1970s. The "old" architecture in the company's major tool groups had little in common with other product groups or even within them. Traditionally, the company had redesigned its products one at a time. There were more than a hundred different motors, which were manufactured on different production lines involving substantial labor content and materials waste. Lehnerd and his colleagues decided to redesign the entire product portfolio, utilizing elements of common product architecture for all tools, whether a drill, sander, circular saw, or hedge trimmer. The "new" architecture featured a common universal motor with a fixed width but variable length, thereby producing power ranging from 65 watts to 650 watts. On a single, high-volume, highly automated production line, motors for hundreds of different power tool products could be produced at substantially lower per-unit costs.

Black & Decker applied this approach to other key subsystems of the product architecture with a similar effect. The result was striking: a drill formerly marketed at \$20 was replaced with a more durable, lighter drill profitably sold for less than \$10. Rather than product architecture constraining product variety, Black & Decker's common subsystems enabled variety, allowing engineers to focus on the other

⁵³ Op. cit. Grudin 1990 p. 53.

⁵⁴ Marc H. Meyer and Michael H. Zack, "The Design and Development of Information Products," *Sloan Management Review*, vol. 37 no. 3 (Spring 1996).

features of their power tools, such as new types of bits, sanding surfaces, or blades. Product variety increased over time. The company's cost advantage drove dozens of competitors out of the business, and its market share in the consumer power tools industry grew from 20 percent to a dominant share during a five-year period.

Viewing a problem broadly is the key to designing a lasting solution. In *The Power of Product Platforms*, Meyer and Lehnerd outline a product development strategy based on viewing problems broadly. They say that the purpose of a product platform is to serve as the basis for a line of robust products. Robust products are “highly functional, elegant in their design, fairly priced, and a pleasure to use.” The authors contend that robust product platforms are developed as the result of a unique approach involving a design and development strategy that is forward-thinking, and has as its core values flexibility, extensibility, simplicity, manufacturability, marketability, and periodic renewal.⁵⁵

Underlying the product platform strategy is a focus on a family of products during development, instead of a single product focus. The family of products approach rests on developing a series of derivative products by extending or reorganizing the subsystems present in the common product platform. The method employed is to break the platform down into its component subsystems, design each of these subsystems so they provide optimal system performance (as opposed to optimal subsystem performance), and then standardize and simplify the interfaces between the subsystems. This modular approach reduces the complexity of the resulting platform (as measured by number of parts, part types and interfaces), resulting in a more elegant, and often less expensive, solution. Once the basic platform has been developed, derivative products flow from it in short order.⁵⁶

Rada Basu of Hewlett Packard states that HP actively encourages engineers to reuse portions of software code. Both the engineer who reuses the code and the engineer whose code is reused are rewarded. While the initial cost of writing reusable code may be higher, the potential benefits down

⁵⁵ Op. cit. Meyer & Lehnerd (1991).

⁵⁶ Op. cit. Meyer & Lehnerd (1991).

the road are seen as worthwhile in a company where long term success is the key value. This value system encourages software designers to pay attention to details.

Elegant solutions respond to unarticulated needs.

When a product meets an unarticulated need of the user, it delights the user. This is an important criterion for elegance. Al Lehnerd suggests that a designer should “imagine that you are the product; then think about how you, as the product, frustrate your users.”⁵⁷

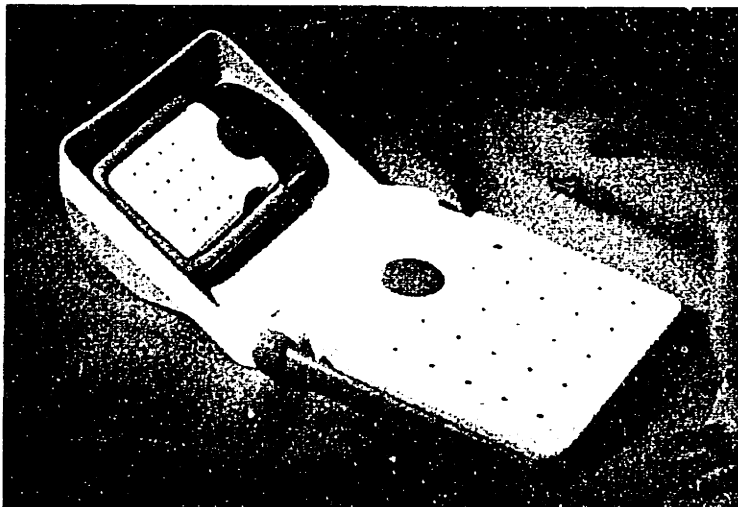
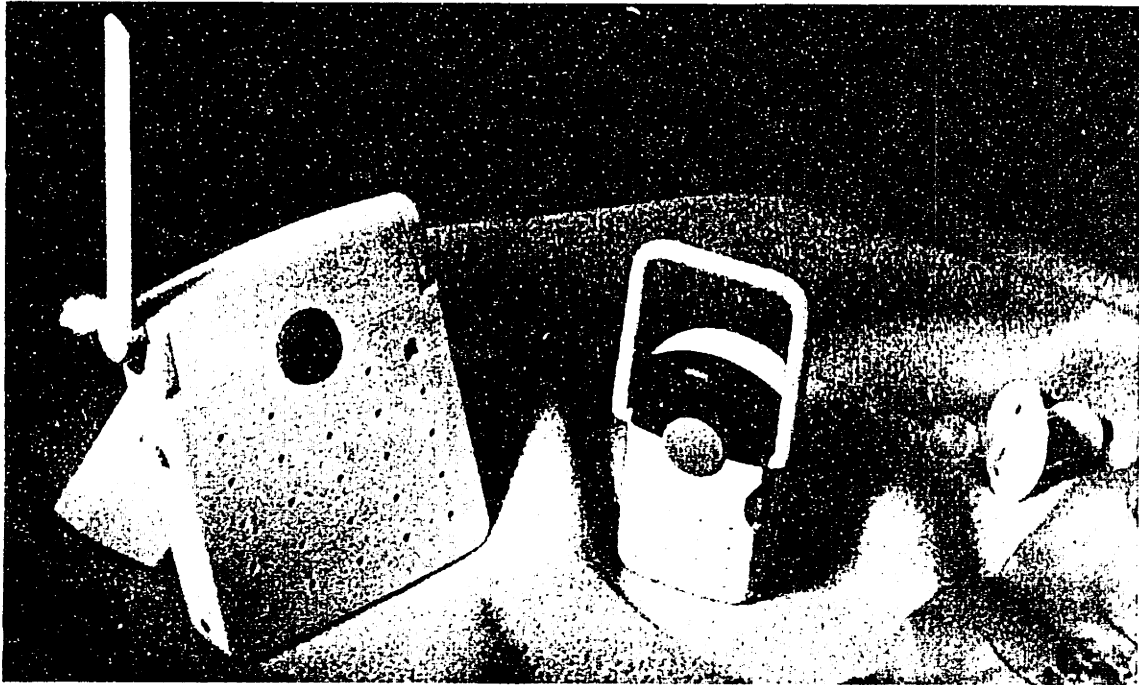
According to Design Continuum, “the challenge of identifying opportunities is difficult when a market is well understood, but is more arduous when customer needs are unarticulated or have yet to be imagined.”

Garret Wohl points to the Hong Kong-Shanghai bank building in Hong Kong, one of the most expensive buildings in the world. The building, designed by Norman Foster, expresses its structure on the outside, and is a wonderful example of elegance in architecture. Apparently Foster won the commission because he hung around after making his initial presentation and asked the bankers and users of the building what they wanted. He seemed to express a genuine interest in serving their needs.

Gianfranco Zaccai describes Design Continuum’s specialty as the talent to connect a technical possibility with an unexpressed and unmet human desire.⁵⁸

⁵⁷ Op. cit. Meyer & Lehnerd (1991).

⁵⁸ Gianfranco Zaccai, “How to Make the Client/Consultant Relationship More Like a Basketball Game Than a Relay Race,” *Design Management Journal*, vol. 2 no. 2 (Spring 1991).



Design Continuum's Range Check Nursery Monitor features a range check button on the remote unit that verifies that the baby monitor is in range, alleviating parental fear that the baby will cry but they will be too far away to hear. Baby sounds can be detected audibly or through LEDs. The antenna on the remote doubles as a handle, and there is a space in the base unit to rest the remote. The entire assembly folds together for easy transport.⁵⁹

⁵⁹ Op. Cit. Design Continuum.

The Role of Ego

A major factor in the success of a design project is what the designer brings to the project, and the process and environment that the designer employs in developing a solution. One of the personality traits that characterizes creative people is a firm sense of the self as creative.⁶⁰

As Robert Grudin suggests, it is important that a creative person possess the confidence that breeds calm attention which is open to new ideas.⁶¹

A designer must balance his own ego with the needs of the client.

According to Paul Henning, ego is essential in a designer. “When working with a client, there can be a clash of egos. Ego on the part of the designer or the person who appreciates a design is what propels a design as ‘good.’ Good design brings out a passion in people, but sometimes the more passionate dictate their sense of good design to others.” When evaluating design interns, Paul says that is important to see the intern fight for his beliefs and stand up for his own opinions. “With a client, it is sometimes necessary to show that you can be controversial and have backbone.” This does not imply ignoring the client’s viewpoint, but in the end it is up to the designer to meld the competing forces into a coherent whole, to unify the client’s vision with his own.

In fact, not every client is for every designer. When Patrick Brennan was working with Gary Hutton in San Francisco, they visited a potential client’s newly acquired home. It was a lovely old Victorian with original sconces throughout. The client said that she wanted to get rid of them all. Gary and Patrick cringed, and suggested that she at least save them in the basement, because they were historically significant parts of the house. The client couldn’t understand why she would want to clutter her basement with old junk. They didn’t take the job because they felt it was important for themselves as designers not to violate their principles.

⁶⁰ Op. cit. Weisberg 1986 p. 73.

Woodie Flowers also speaks of the importance of ego in design. He says that it is crucial to foster a student's self-image as a creative person in order to foster creativity. He feels that our educational system doesn't do enough in this regard, so he is actively searching for and implementing ways to change this shortcoming across the educational spectrum. Similarly, Robert Grudin speaks of problem of an educational emphasis on professional strengths rather than mental wholeness that can work to suppress creativity.⁶²

A designer must act as a translator, transforming ideas into concrete form.

Patrick Brennan describes the role of the designer as a translator. He sees the designer as a chameleon who takes everything into account and "changes colors." Patrick describes taste as "enlightened choice," and says that sometimes it is up to the designer to do the enlightening. According to Patrick, a designer's job is to determine the essence of the client's need despite what the client may say. A designer must see through the layers of description to the essential need being expressed.

In the foreword to *Notebooks of the Mind*, by Vera John-Steiner, Howard Gruber discusses the importance of translation as part of the creative process. He provides the example of three choreographers. George Balanchine draws his inspiration from the music, Merce Cunningham from spatial and geometric metaphors, and Martha Graham from poetic and mythic sources, but all of them translate these ideas into movement.⁶³

Sonya Pinkus describes her work at Shreve, Crump and Lowe, where she designs jewelry for customers, as an act of translation. Often the customer has some vague notion about a piece, or a stone that they want to use. Sonya must listen to the customer's desires, develop a theme and then

⁶¹ Op. cit. Grudin 1990 pp. 12-23.

⁶² Op. cit. Grudin 1990 p. 39.

⁶³ Op. Cit. John-Steiner 1985 p. ix.

produce drawings. She also tries to do some enlightening when what the customer is describing is not tasteful.

One example Patrick gave was of a client who was talking about shiny, undulating, glittery objects. Patrick usually works with French Provincial or modern, simple lines. At first, Patrick thought, maybe this client isn't for me, but agreed to work with her anyway because he thought perhaps he could translate her ideas into something that would please them both. When they were walking through a fabric store, a colorful Indian shawl with tiny mirrors caught his eye. He thought that it was beautiful, and also fulfilled the client's wish, so he suggested that they use it as a wall hanging, which led to the idea of covering one long wall in the apartment with different pieces of fabric that could be easily changed at any time. The client was quite pleased and the result was striking. Patrick was working as a translator and synthesist, trying to satisfy both the client and his own ego at the same time.

The Role of Synthesis

It is crucial for a designer to come to a new project with an open mind, but also to bring to the project a design discipline and a willingness to draw on experience or gain new experience in order to see the project through to a successful conclusion. The designer must recognize the layers of contextuality and the interdependence of contexts⁶⁴ in light of a project in order to synthesize an elegant solution.

According to Gianfranco Zaccai, "The designer is a catalyst that synthesizes the rational and emotional evaluation of concepts."⁶⁵

Robert Grudin describes the importance of a sense of wholeness in a creative person, an ability to perceive interrelationships among elements interacting and participating in larger forms.⁶⁶

⁶⁴ Op. cit. Rota & Thompson p. 12.

⁶⁵ Op. cit. Zaccai (1991).

A designer must take an integrated approach to projects in order to achieve elegance.

In order to satisfy all of the competing needs and constraints in a design project, the designer must take an integrated approach to a project.

Design Continuum succeeds because it pursues a fully integrated approach to product development. Continuum sees its role as helping clients:

- uncover profitable opportunities
- develop ideas
- turn ideas into products
- launch them in the marketplace

According to their brochure, success “requires a continuum of vision, skills, and sensibilities of talented people from diverse disciplines working together.”⁶⁷

To this end, they employ “pods,” which are multi-disciplinary teams of researchers, designers and engineers, who work with the client’s marketing, R&D, manufacturing, service and QA personnel. Continuum encourages pod members to step outside their disciplines in order bring fresh perspectives to design problems.

Bringing the multi-disciplinary team together ensures “that the results of the design process not only respond to real user needs, but that they visually attract and engage the user while being durable, reliable, cost-effective to manufacture, and easy to service and maintain.”⁶⁸

⁶⁶ Op. cit. Grudin 1990 pp. 12-23.

⁶⁷ Op. Cit. Design Continuum.

⁶⁸ Op. Cit. Design Continuum.

Gianfranco Zaccai, Continuum's founder, warns that companies need to "understand design as a precise problem-solving methodology, and not simply a visual or aesthetic contribution to a product." He notes that in many instances, unfortunately, "the designer is viewed [only] as a decorator, assisting marketing to implement its vision or disguising R&D compromises to make them cosmetically acceptable to the consumer."⁶⁹

A designer must draw on experience and be open to learning.

GianCarlo Rota provides the example of a hammer in his discussion of the role of experience in contextual viewing. No amount of viewing a hammer will tell someone what a hammer is unless they are familiar with the function of a hammer. Viewing a hammer *as* a hammer requires contextual familiarity with the use of a hammer as a tool.⁷⁰ Similarly, solving an engineering or design problem requires certain background in order to authentically understand the nature of the problem. The designer must understand the context of the problem. Experience provides this contextual understanding.⁷¹

DeBono provides the example of an engineer noticing that the long loops in kidney tubules formed a "counter-current multiplier," an engineering device that increases the concentration of solutions. Until that point, the purpose of the loops had stumped physiologists. The engineer was able to see the function based on his unique background of experience.⁷²

At Continuum, pods are selected for a project based on expertise in an area, interest in an industry or technology, or relationship with the client. A "virtual consultancy" of trusted professionals that the

⁶⁹ Op. cit. Zaccai (1991).

⁷⁰ Op. cit. Rota & Thompson p. 14.

⁷¹ Op. cit. Rota & Thompson p. 3.

⁷² Op. cit. Weisberg 1986 p. 68.

company has developed relationships with over the years, provides outside expertise whenever it is needed. This way Continuum ensures access to all the relevant expertise needed for a project.

NREC's business model exploits the company's fluid dynamics expertise. NREC developed the NOTAR fan system for McDonnell Douglas Helicopter when Douglas was unable to develop the system on its own. Douglas wanted to design a helicopter without a tail rotor, because the rotor is responsible for a significant number of helicopter accidents, and causes pilots a great deal of stress, since they can't see it and don't know where it is at any given time. The design goal was to use jets of air in the tail to perform the stabilization task that the rotor performed. Douglas had been unable to develop an axial compressor capable of blowing air down the length of the tail from the body of the aircraft with enough force so it could be used to control the craft. NREC employed its expertise to design a custom compressor turbine for the task, and now all of Douglas's new models use this design.

A designer must grasp interrelationships and fold them into the design solution.

Arthur Koestler describes the creative process as one of *bisociation*, whereby previous unrelated ideas are brought together and combined. For example, Gutenberg's combination of the letter seal and the wine press in his invention of the printing press was allegedly inspired at a wine festival. Koestler argues that moving from one "associative matrix" to the next occurs only after immersion in the problem.⁷³

Grudin describes a sense of "continuity of perception"—a creative person being attuned to new combinations of ideas or materials and aware of the dynamic interaction between two normally distinct frames of reference.⁷⁴

⁷³ Op. cit. Weisberg 1986 p. 22.

⁷⁴ Op. cit. Grudin 1990 pp. 12-23.

Similarly, Jacques Hadamard notes that the etymology of the term *cogitate* is the from Latin word for thinking, *cogitatio*, which literally means “shake together.”⁷⁵

Henri Poincaré suggests that the realization that a combination of ideas represents a potential solution is an aesthetic one, based on an individual’s sense of beauty.⁷⁶

Phenomenologically, a designer must view the interrelationships as relevant in a context with a background of unthematized facticities (experience) in light of a project.⁷⁷ The key here is seeing the relationships as relevant.

Gianfranco Zaccai of Design Continuum believes that,

Most capable industrial designers are less concerned with formal preconceptions and making things pretty than with finding elegant solutions to problems associated with marketing, manufacturing, use and maintenance of manufactured objects. These people grasp the interrelationships among the physical, psychological and environmental forces acting on objects and use these insights as the bases of design solutions.⁷⁸

An odd example of interrelationships and elegance appears in Charles Mee’s play, *The Investigation of a Murder in El Salvador*, in a speech by the character Stanton,⁷⁹

“I don't mean to compare myself to a poet—really, not at all—but even bankers actually hope that what they are doing is, in a sense, creative. Building something.

⁷⁵ Op. cit. Weisberg 1986 p. 20.

⁷⁶ Op. cit. Weisberg 1986 p. 21.

⁷⁷ Op. cit. Rota p. 39.

⁷⁸ Op. cit. Zaccai (1991).

⁷⁹ Charles Mee, *Investigation of a Murder in El Salvador*, public domain (1984).

Bringing into being something that hadn't been there before. Structures that no one had seen before you made them and not only do you make the structure but it results in physical, palpable things... Sometimes you can look at the financial plan that has been put together to finance a skyscraper, and the financial plan is a beautiful thing really by itself, a novel thing, very often an avant-garde thing, even a thrilling piece of intellectual daring, if you are sensitive to that sort of thing. And you look at the finished building and you actually see all these extraordinary structures of finance and political arrangements and mechanical stress and the molecular structure of the materials and you are moved by it. And there is something very powerful and captivating about a structure.”

Stanton’s aesthetic appreciation of a business deal provides an example of what Robert Grudin calls “using the whole mind in all endeavors.” He posits that any activity can encompass the joys of creativity, “What liberates the imagination is the sense that work in its theory and practice holds aesthetic possibilities, that jobs can be elegantly conceived and gracefully done.”⁸⁰

To reduce a problem to its essence, designers use a language of visual metaphors.

Sonya Pinkus, says that elegance is derived from “reducing a problem to its essence.” Sonya describes her design process as follows:

1. Translate the problem into her language (a graphical language).
2. Incorporate the various issues into groups.
3. Consider the functional connections between the groups.
4. Simplify the design by removing extraneous elements.

Physicist John Howarth talks about the importance of abstract visualization in creative problem solving,

⁸⁰ Op. cit. Grudin 1990 p. 55.

You reduce the number of variables, simplify and consider what you hope is the essential part of the situation you are dealing with; then you apply your analytical techniques. In making a visual picture it is possible to choose one which contains representations of only the essential elements—a simplified picture, abstracted from a number of other pictures and containing their common elements.⁸¹

The French writer Anaïs Nin said, “The core of creation is to summon an image and the power to work with the image.” The power of working with visual metaphors means to refine and simplify them. This is a process of distillation, reduction to the barest essentials.⁸²

The artist Judy Chicago speaks of the “transparency of the psyche,” seeing through successive layers to the very core of reality.⁸³

According to beat writer William S. Burroughs, “When you start thinking in images, without words, you are well on your way.”⁸⁴

Albert Einstein also spoke of a visual symbology in his work, describing the importance of “clear images that can be reproduced or combined.”⁸⁵

Patrick Brennan provides an example in a storage solution he created for a large loft living space that had no closets. Patrick drew inspiration from the myriad of boxes his mother used to bring home from a shopping jaunt and leave temporarily piled in the hallway. The boxes from the different shops had different sizes, colors and textures. For the loft, Patrick created three six-foot by twelve-foot storage

⁸¹ Op cit. John-Steiner 1985 p. 84.

⁸² Op cit. John-Steiner 1985 p. 28.

⁸³ Op cit. John-Steiner 1985 p. 99.

⁸⁴ Op cit. John-Steiner 1985 p. 29.

⁸⁵ Op cit. John-Steiner 1985 p. 85.

units. Each one had a variety of textures, shapes, styles, finishes and pulls, so they resembled piles of fancy boxes; a whimsical yet practical solution. In order to satisfy the need for standard size storage areas, however, not all of the individual spaces described on the outside of the unit were articulated on the inside, some were combined into larger spaces.

A designer must cultivate sources of inspiration.

Every designer must have a source for inspiration both within and outside the context of a project. Paul Henning uses popular culture: "I listen to a lot of rap music. Music really influences me. I'm not the kind of designer to page through a design magazine, because I don't necessarily want to be influenced by what I do. I want to be influenced by music and plays and by advertisements. Things like that."⁸⁶

Patrick Brennan says that he often draws inspiration from his favorite books on design, such as "Jean-Michel Franc." His method is to:

1. Look through books.
2. Get inspiration, often while doing something else entirely.
3. Draw like mad, sketching ideas whether he thinks they are good or bad.
4. Bounce the ideas off someone else, like a partner, who can often push an idea from good to fabulous, in a form of aesthetic proof-reading.

Effie Chou, prefers to draw inspiration by immersing herself in a project and gaining an understanding of the environment of the client. She feels that this immersion is necessary for intellectual integrity, and to truly represent the needs of the client in the final product. For example when designing a corporate logo, she wants to understand the company and what it does rather than work with abstract shapes. She believes that for the work to truly stand out from the crowd, its

⁸⁶ Op. Cit. Duncan & Butterick (1997).

inspiration must be drawn from within. A logo built on abstract shapes devoid of context will look like everybody else's logo.

Effie's inspiration comes from looking at books, thinking about the client's environment, quiet reflection while driving or showering, and then working with pencil and paper as well as paper cutouts. Only when she has a reasonably solid idea does she turn to the computer to flesh out and render the idea into a prototype. She feels that turning to the computer at the very start is too restricting, because she ends up worrying about technique too early in the process. She knows other designers who immediately turn to the computer, but she often finds a sameness in their work.

A designer must be open to inspiration.

According to Robert Grudin, creative people display openness and receptivity. They don't search for ideas, rather they "make room for them to visit."⁸⁷ Creative people view the world as capable of innumerable configurations.⁸⁸

He argues that what dominates at the moment of creativity is not the mind but the idea, "the suddenly articulated power of our own inner energies." New ideas transform our self and expand our reality. In this way, creativity is a form of freedom. Creative vision is the edge of freedom. It is how we redefine our world and ourselves.⁸⁹

⁸⁷ Op. cit. Grudin 1990 p. 6.

⁸⁸ Op. cit. Grudin 1990 pp. 12-23.

⁸⁹ Op. cit. Grudin 1990 p. 6-7.

A designer must be prepared for hard work.

Vera John-Steiner speaks of the importance of sustained, productive work, requiring craft, logic, mastery and commitment to transform the inner shorthand of inspiration into artistically and intellectually convincing achievements.⁹⁰

Robert Grudin also identifies a passion for work. He says that successful creative people are totally involved in their craft, and don't create an opposition between work and leisure. They are serious about what they do and see it as having consequence. They are persistent and patient.⁹¹

A designer must display courage and be willing to take risks.

As identified by GianCarlo Rota in his description of solving a mathematics problem, facing the new takes courage. Robert Grudin says that "to think creatively is to walk at the edge of chaos," it requires a willingness to "break the rules."⁹² He sees the creative person as displaying heroism because of the traits required: integrity, courage, endurance, and freedom.⁹³

⁹⁰ Op cit. John-Steiner 1985 p. 8.

⁹¹ Op. cit. Grudin 1990 pp. 12-23.

⁹² Op. cit. Grudin 1990 pp. 12-23.

⁹³ Op. cit. Grudin 1990 p. 7.

IV. Transcendence

In the creative process, at the moment of inspiration, when the authentic solution leaps out at the designer from the sea of possibilities, there is the phenomenon of revelation, of the truth revealing itself.⁹⁴

When phenomena reveal their commonalities, they point to the authentic solution⁹⁵, to the elegant solution. Creative people know the rush of adrenaline, the giddiness, the temporary loss of identity that accompanies this revelation.⁹⁶ They feel a oneness with the power of nature⁹⁷, as in the Zen description of a surfer becoming one with the wave.⁹⁸

Michael Polanyi speaks of crossing the heuristic gap which lies between problem and discovery.⁹⁹ Crossing this gap is the moment of transcendence, when understanding comes in a flash and we see a certain point of view. We only see it, though, if we are attuned to it. We must be ready for it and need it.¹⁰⁰

Elegant solutions provide the user an opportunity to experience this revelation for themselves.

⁹⁴ Op. cit. Rota p. 8.

⁹⁵ Op. cit. Rota p. 8.

⁹⁶ Op. cit. Grudin 1990 p. 33.

⁹⁷ Op. cit. Grudin 1990 p. 38.

⁹⁸ Op. cit. Grudin 1990 p. 11.

⁹⁹ Op. cit. Grudin 1990 p. 44.

¹⁰⁰ Gian-Carlo Rota and Jeff Thompson, *The End of Objectivity: The Legacy of Phenomenology* (Unpublished Manuscript), p. 1.

Gianfranco Zaccai describes six design parameters as the critical forces that a designer should consider:¹⁰¹

1. **Technical Performance.** Design of the product from the inside out. The product meeting the demands placed on it by users. Also manufacturability, shippability and serviceability.
2. **User Needs.** The human interface of the product being compatible with user's physical capabilities. This is the fit between the inside-out and outside-in forces that shape design.
3. **Economics.** Crucial because it affects schedules, budgets, features, production processes and materials.
4. **Culture.** Products that ignore culture seem odd and out of place.
5. **Environment.** How does the product interface with the physical environment during production, during use, and upon being discarded?
6. **Psychology of the Ego.** The things we use contribute to our sense of self. Objects should fulfill needs such as comfort, prestige, humor, and tactile as well as visual pleasure.

Elegant solutions go beyond these criteria and unify them by communicating the creativity required to develop the solution. They possess a beauty that reveals the latent unity of thought. This beauty results from the user's insight into the integrity or fitness of the design. Elegant solutions "are not only suitable to themselves but display fitness for the greater hierarchies that they inhabit." They display inner coherence and contextual fitness, symmetries that imply a "natural justice." Enjoyment of this beauty on the part of the user implies a unison between reason and emotion. It begets pleasure and brings about renewal.¹⁰²

¹⁰¹ Op. cit. Zaccai (1991).

¹⁰² Op. cit. Grudin 1990 p. 59-60.

Conclusion

The phenomenon of pleasure experienced by the viewer of an elegant solution is the same phenomenon as the pleasure experienced by the creator of the solution at the moment of revelation. That moment of transcendence, when the function is grasped and reality is suddenly reshaped, is a moment of pleasure. We get to peer briefly into what seems like a higher order organization of our universe, and our fear of nothingness is briefly quelled.

Elegant solutions come about through the right combination of client and user input that define a problem well enough for the designer to synthesize a balanced and integrated solution by bringing his experience to bear and combining it with an authentic view of the issues that points to inspiration, and results in transcendence. Then comes the hard work of translating this vision into a reality.

Bertrand Russell said,

Mathematics is the art of drawing precise conclusions from imprecisely drawn figures.¹⁰³

I would posit that design is the art of realizing precise forms from imprecisely articulated needs.

¹⁰³ Op. cit. Rota p. 22.

Appendix A: Opposing Viewpoints - The Behaviorist View

The behaviorist viewpoint as explicated in *Creativity: Genius and Other Myths* by Robert W. Weisberg can be summarized as an incrementalist view of creative problem solving. Weisberg doesn't see creativity as some special form of thought, but simply as drawing on experience in a stepwise fashion. While this view is rather limited and naive, his book does provide a reasonable overview of the psychological view of the creative process.

Weisberg bases his analysis on the example of his brilliant insight of using a quarter to plug a hole in his engine. First he thought of using some cardboard, but realized that it would bend, then he thought of using a circle of metal, but didn't know how he would cut it. His flash of insight came when he pulled out some change to pay a toll and voila! This idea of using an ordinary object in a new way sums up the extent of Weisberg's creativity.¹⁰⁴

Weisberg describes an experiment in creativity where the subject is asked to attach candle to a door so it burns properly. The subject is given a wax candle, a book of matches, and a box of tacks. The subject is supposed to think out loud as he solves the problem. As described by Weisberg, the thought process of "successful" solvers usually goes like this:¹⁰⁵

¹⁰⁴ Robert W. Weisberg, *Creativity: Genius and Other Myths* (New York: W.H. Freeman and Company, 1986), p. 5.

¹⁰⁵ Op. cit. Weisberg (1986) p. 6.

- I could tack the candle to the wall, but it might split.
- I could create a platform of tacks, but this would be awkward.
- I could create a platform from the tack box and tack that to the wall. Aha!

The tack box solution is seen elegant because candle doesn't drip. According to Weisberg, elegant solutions come about from the inadequacies noticed in previous attempts at a solution. The more inadequate alternative solutions are made to seem, the more likely the box solution will come about. Adding additional criteria, like stipulating that the wax cannot drip on the floor, produce a higher percentage of box solutions among subjects.¹⁰⁶

Again Weisberg misses the point with his insights, but he does bring out some valuable issues, such as:

- the role of constraints in problem solving.
- the process of moving from inauthentic, escapist attempts to solve the problem to an authentic solution.
- the phenomenon of pointing.

I would argue that the candle example involves a revelation, where the box is viewed *beyond* its function of holding tacks, and is instead viewed *as* a tool. This transcendence involves a change of context, and the authentic solution is pointed at by this phenomenon. What Weisberg describes in the steps of coming up with the solution is the process of eidetic variation where we make minor changes to the context and look at various inauthentic solutions before coming up with the elegant solution of creating a platform from the tack box and attaching it to the door. This process is what readies us to view the authentic solution as the solution.

¹⁰⁶ Op. cit. Weisberg (1986) p. 8.

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