

# Between C and K: Archaeological Practices of Mediation in Engineering Design

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There is a Chasidic teaching about the Mezuzah, a small container which encloses a parchment upon which several passages of the Torah are written. The Mezuzah is placed on the door posts of houses and gates. The teaching expands on the placement of the Mezuzah, a place between the inside and the outside. There is a moment when you are no longer inside, but not yet outside. In this in-between state, you are gathered up into the G-d Head, the Ain Sof, and made anew. The philosophers in the mystical tradition explore this notion, and consider similar moments, such as when an egg contains a being that is no longer an egg and not yet a chicken. Here again, the Rabbis suggest that this is the moment that the being is brought into the Ain Sof, the Source of Undifferentiated Being, and reformed. According to this teaching, this gathering up may occur at the threshold between any set of polarities, any set of dualities. (Omer-man, 2002)

Between the moment an idea for a new invention is conceived and the moment a manufactured product comes off the production line, all work done in design engineering is done through the agency of representation. Representation in the field of engineering design encompasses a broad range of media, including rough sketches, physical prototypes, photographs, engineering drawings, stories, lists, charts, descriptions, and numeric digital files. Given representations central role in design, it would seem that successful development of an engineered product may be largely dependent on the careful management of the “media cascades” which drive the design process. What does a media cascade look like? What are the characteristics of an effective media cascade? What work, so to speak, does a media cascade do for a design engineer?

The work of the design engineer is to bring concepts into being. A design engineer begins with a notion of something with the potential of existing, and reaches a point when the thing actually exists. Thus, the design engineer plays between the poles of the potential and the actual. Contemporary design theory offers a useful analysis of making representations of the potential and the actual in the design process.

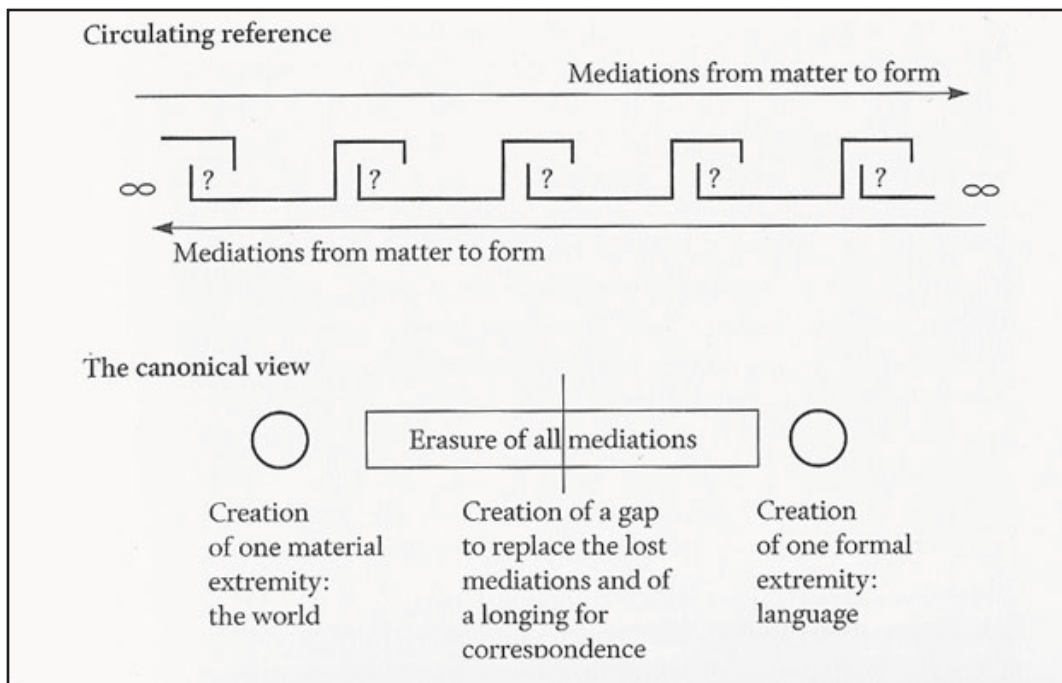
C. K. Theory (Hatchuel and Weil, 2002) posits a set of dualities, Concepts and Knowledge in an attempt to fashion a unified Design theory, based on Set Theory. A “Concept” is defined as, “a notion or proposition without logical status”. A piece of “Knowledge” is “a proposition with a logical status for the designer of the person receiving the design.” (Hatchuel and Weil 2002: 11-12) By logical status, the authors mean something that exists.

Furthermore, Hatchuel and Weil posit a fundamental proposition “design reasoning must always make a distinction between two related spaces: the space of concepts and the space of knowledge.” These spaces are made in relation to one another; K is the precondition of C, and the contents of C can expand the set of K.

How does a design engineer cross the space between C and K? What happens in the moments when the designer traverses the threshold between Concept space and Knowledge space?

The road to understanding what occurs in this space has several markers. The first I will consider is to be found in the science studies of Bruno Latour. In his seminal “We Have Never Been Modern”, Latour suggests that the quest of Modernism is the distillation of phenomena into dualities, the paradigm of which is seen in Kant’s model of the gulf between “things in themselves” and the “transcendental ego”. Language and objects are likewise separated by an unbridgeable chasm, which keeps knowing and the objects of knowing at bay. Latour explains that we have never been modern, because we are actually in the work of making “hybrids”, entities which lay between the poles of duality. Our problem, Latour suggests, is that we either fool ourselves into thinking hybrids don’t exist, or we are seduced into believing our real work is the work of purification, that is to say making dualities. (Latour, 1993)

In his book “Pandora’s Hope”, Latour introduces his notion of “circulating reference”, which illustrates the method scientists use to do the work of making knowledge from a field study done at the threshold between the Amazon rain forest and the Savannah. With the eye of an anthropologist, Latour shows that scientists make a chain of steps from the site to raw data to knowledge. There are gaps, Latour tells us, but they are very small gaps. Latour’s chain of events moves from phenomena to knowledge in a fairly straight path. Latour eloquently unpacks the place between phenomena and a scientific paper. There is not a single chasm, but there are many small and rationally negotiable gaps. (Latour 1999)



Latour: chains of translation

Latour’s circulating reference sheds light on the design process. Products are not born completely

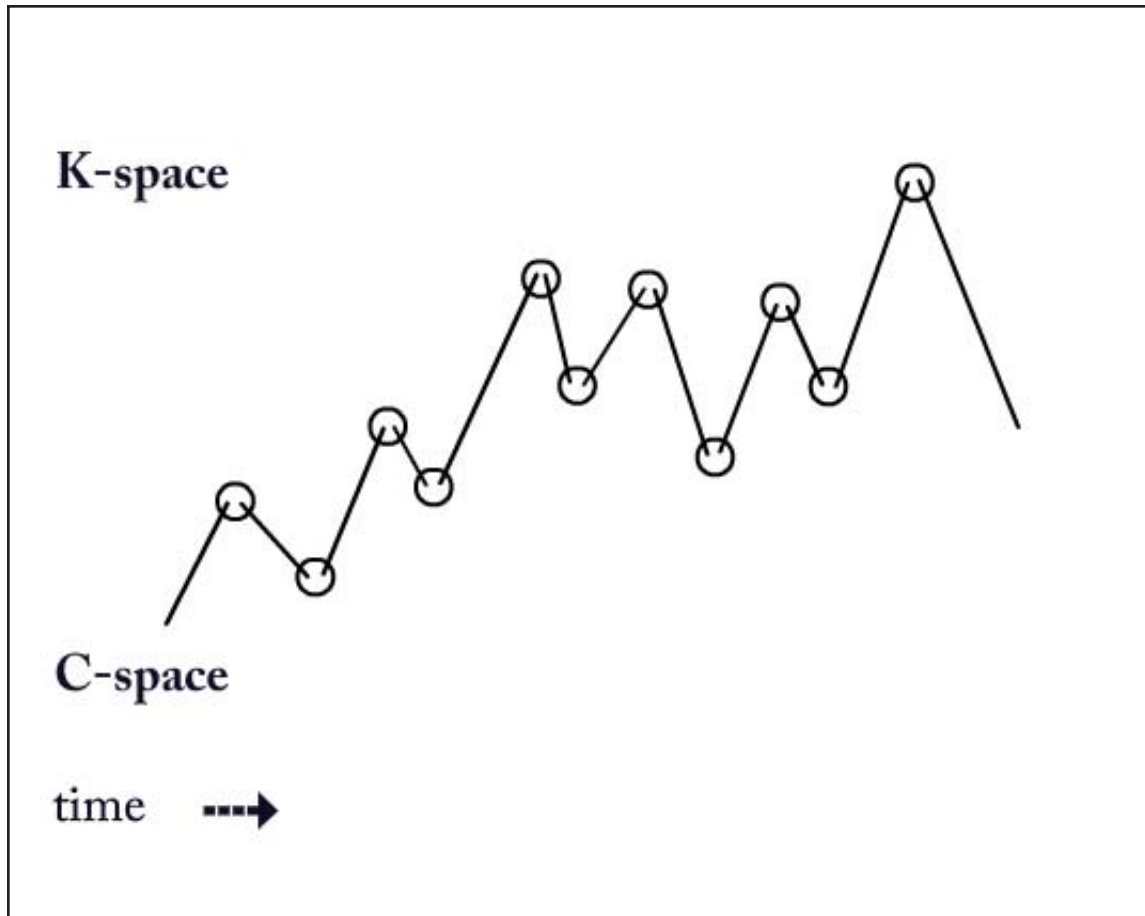
formed, as Athena was born from Zeus's head. Instead, designers make many transits on the journey. There are many small gaps in the method states of the design process. The means of conveyance on the journey between potential and actual are representations. It is between the poles of idea and manufactured product that the work of mediation, that is to say the work of representations or proxies, occurs.

In engineering design, the use of representation holds both the transitive and intransitive meanings of "mediation". As an intransitive verb, mediation can mean "to form a connecting link or a transitional stage between". The transitive meaning of the word is "to be the medium for bringing about (a result) or conveying (a gift, etc)". (The Oxford Universal Dictionary On Historical Principle 1955: 1226) When a design engineer embodies an idea in media, he or she may be said to be "mediating". Both the transitive and intransitive actions of the verb are at work in mediating. We see the intransitive meaning at work in the implementation of successive models, which form a bridge between an idea and a manufactured product, as well as a bridge between team members. The transitive form of mediation speaks to the work of a representation when it brings about a result or conveys an idea. "Mediation" also carries legal connotations, in respect to making an agreement between parties at odds. This sense of mediation, one of seeking resolution between two seemingly incommensurate entities, makes a compelling metaphor in traveling the path between non-corporeal idea and embodied manufactured product.

I will raise the question again this time from a slightly different perspective. How do design engineers negotiate the many small gaps between Concept space and Knowledge space? Do they follow the linked path of circulating reference, starting with phenomena and ending with knowledge, which scientists follow? Or do they make a different path?

Engineering design is in the business of making new things, which differentiates this practice from the practices about which Latour speaks. The path from idea to a manufactured object seems to resist the type of linear path that Latour uncovers. If Hatchuel and Weil are correct in their observation that the Concept space is characterized by propositions lacking logical status, then the gaps between the steps in and around the Concept space may not be so rational as those outlined by Latour. Nonetheless, Latour's methodology provides a model for looking at the process of engineering design.

While the dualistic purifications of Concept space and Knowledge space are useful notions, the work of the design engineer is precisely situated in the space between. The work of the design engineer is neither a pure concept, nor pure knowledge, but consists in making something new out of the movement between concepts and knowledge. The outcome may be called a "hybrid", though that word assumes two truly distinct realms. I suggest that for the design engineer, in practice, the pure realms are touch stones for exploration and development. What the design engineer does is shift perspective between these poles in order to give birth to a new product. To do this, the design engineer mobilizes different media, and implements these media through use of a grammar that embodies the implications of C-space and K-space.



Between C and K: the gaps (circles) in the design engineering process occur when media changes.

I would like to push the notions of C and K even farther apart than what Hatchuel and Weil suggest, in order to make a greater space between C and K. The notion of Knowledge in C-K Theory is limited to that which exists. In engineering design, the bar is far higher than Hatchuel and Weil let on. As we shall see, the kind of knowing necessary for a successful product includes rigorous scientific knowing, kin to the knowing that Latour posits in “Pandora’s Hope”. To expand the space between C and K, I will turn to Archeology.

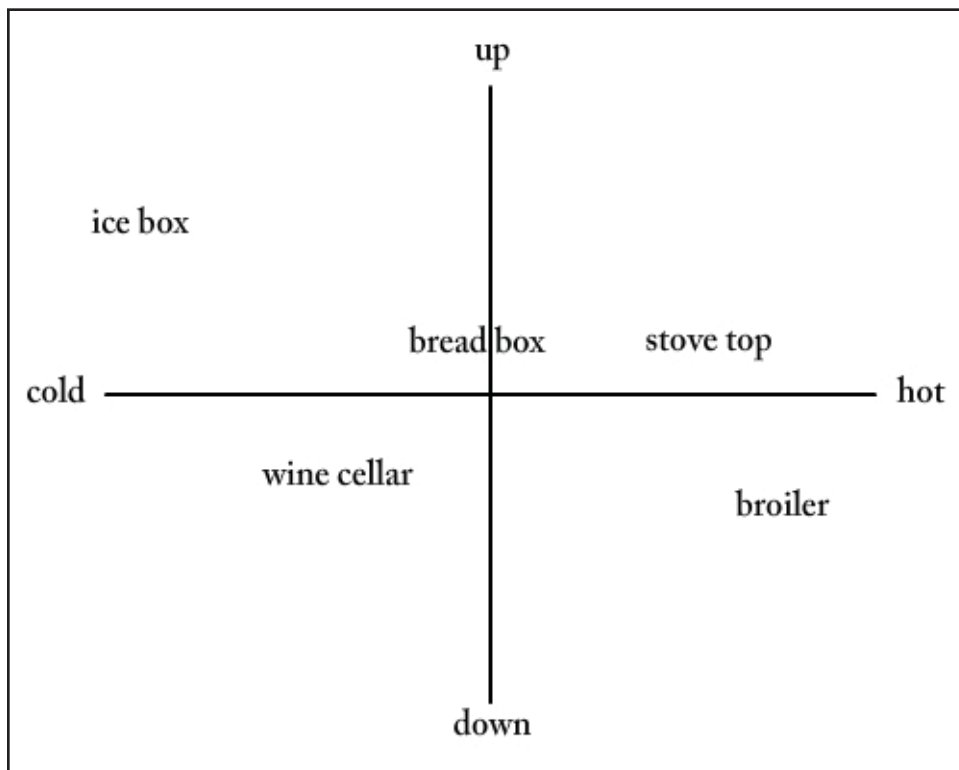
Archaeology and Design are kissing cousins, so to speak, and benefit can be gained from appropriating the discourse of one to the other. In the most straight-forward sense, archaeology can be seen as “the study of things”, often to gain insight into the experiences of those who used the things. Design can be seen as the “creation of things”, often to impart an experience to those who would use the things. Investigations into the role of media in archaeology being done by Timothy Webmoor, Christopher Witmore, and Michael Shanks at Stanford’s Metamedia Laboratory have expanded and deepened McLuhan’s pioneering work in media studies, often summed up by McLuhan’s dictum, “the medium is the message” (McLuhan 1964)

For both Webmoor, and Shanks, media are not neutral. Timothy Webmoor’s insights into the

agency of maps are particularly useful in unpacking the use of engineering drawings in the engineering design process. Michael Shanks' examination of the role of photography as an active agent suggests paths which designers may take in product development.

In his paper "Mediational Techniques and Conceptual Frameworks in Archaeology", Timothy Webmoor examines how the production and use of maps conditions and restricts the thought process of the map reader. Maps, Webmoor argues, are not neutral. They are media, and as such they carry a "message". The map, according to Webmoor, is "a fundamental conceptual framework that archaeologists utilize in directing their methods and formulating interpretations" (Webmoor 2005: 52) and that these frameworks "predispose certain interpretations." In Webmoor's view, the word "map" is considered to include, "any spatial representation conveying visual information in a strictly coordinate, graphical manner." (Webmoor 2005: 77) These by implication may include 2x2's, common conceptual frameworks in the academy.

2x2's are a method to compare both qualitative and quantitative data on a coordinate system. Often 2x2's are more informal than a rigorous scientific graph, and used as a quick method of comparison. Examples of 2x2's include comparing hot/cold on one axis with up/down on the other axis, or graphing time on one axis with events on the other density. 2x2's can be used to illustrate conceptual frameworks, as well as theoretical frameworks.



2x2: some things in my kitchen

In "Thinking with Eyes and Hands", Bruno Latour examines the modern way of knowing in respect to embodiments of knowledge in common use. "We can hardly think of what it is like to know something without indexes, bibliographies, dictionaries, papers with references, tables,

columns, photographs, peaks, spots, and bands". (Latour 1986: 14). These are all parts of what Latour calls "immutable mobiles", distilled pieces of information which can be easily transported, shuffled and combined without damaging the contents. Maps are a prime example of how the specifics of a place can be generalized and packaged, transported and potentially acted upon from afar.

How new is this knowing? Haven't maps and mathematics been around since before the Ancient Greeks? The kind of powerful quantitative science we take for granted is relatively recent. Hankins points out that at the time of Boyle, there were only two quantitative laws known: Galileo's law of free fall, and Snell and Descartes' law of refraction and reflection. Boyle's law was the first law to show the relationship between two measured physical quantities. (Hankins 2006)

Until the 1830's graph paper, the staple of modern scientific mediation, was not widely available. In fact, practitioners of the ancient science of astronomy were unfamiliar enough that they had to be instructed in the construction of a coordinate grid and placing data points on the grid. John Herschel's 1833 paper, "On the Investigation of the Orbits of Revolving Double Stars" was instrumental in establishing graphs as a tool for scientific enquiry. (Hankins 2006)

It is interesting to note that the noun "graph" used as a short hand for "graphic formulas" appears for the first time in 1878. Used as a verb to denote assigning data points on a rectangular coordinate scheme, "graph" makes its first appearance in 1898. (OUD 1955: 838) Now *that* is Modern!

In their book, "Instruments and the Imagination", Hankins and Silverman argue that the instruments of science "have a life of their own. They do not merely follow theory; often they determine theory, because instruments determine what is possible, and what is possible determines to a large extent what can be thought." For Hankins and Silverman, scientific instruments "mediate between investigators and the phenomena they study – by expanding the senses, modeling nature, generating visual images, engendering conventions of scientific correctness, or creating a new language of scientific discourse." (Hankins and Silverman 1995: 5) In other words, the mediation of scientific instruments may be considered a type of "cognitive prostheses", a concept amplified by Lev Manovich, in that they extend and modify our ability to perceive as well as to think. (Manovich, 2006)

The purpose of mapping, Webmoor explains, "revolves around the identification of boundaries". (Webmoor 2005: 72) Again, these lined boundaries, like the lines of maps and engineering drawings, characterize "knowledge". Making boundaries is characteristic of Latourian purification. This is more than the language of disengaged, removed perspective; it is facilitating the portrayal of all surfaces as abstracted and mathematized. "Mathema" (the root of mathematics) in ancient Greek is often translated as "knowing", a knowing that is associated with the contemplation of unchanging, immutable truths.

The trouble is that the map is a construct, with a claim to authority because of its mathematical referencing. A map, like an engineering drawing or an equation, may exhibit compelling internal consistencies, but may not accurately refer to a real place or object. Maps claim a truth of their own. They have an authority by virtue of the coordinate grid upon which illustrated boundaries

are placed. The grid and the boundary are the stock and trade of the grammar of truth-making.

In his “Vision, Media, Noise, and the Percolation of Time”, Christopher Whitmore cautions that immutable mobiles filter out much of what may be essential to the work of the archaeologist. “There is much more to the material complexity of, for example, a series of terraces on the side of a mountain on the Greek island of Kea than can be transformed through highly refined combination of text, map, plan or photograph upon which archaeology relies.” (Whitmore 2006: 271) In respect to design engineering, we are faced with a similar situation. While design drawings and numeric analysis make possible both high tech invention and mass manufactured products, they often do not express many of the qualitative elements that make a product meaningful to a user.

Stated from the perspective of C-K Theory, there is little to stop design engineers from making mediations which employ the conventions of K-space grammar, and thus make a claim to reality, but have no firm grounding in phenomena, or what C was attempting to get at. This would make them akin to fakes or forgeries. The challenge of the designer is to make sure K representations actually address real user needs.

These maps, like charts and equations, are how we "know" in contemporary terms. But this "knowing" by itself is a partial knowing, and serves as an isolated 'dangling reference'. The sense of a map is only made when there is a movement between either mediational techniques or movement between map and "place". Webmoor shows this when he walks us through the ancient city of Teotihuacan, map in hand and tells us what he sees. In doing so he meshes the work of wayfinding with the work of navigation. The phenomenology of this place, when map and presence dance in the telling/showing of Webmoor, yields a new sense of how spaces relate. The fruit of his hybridization of these modalities is a thrilling insight into the possibility of understanding Meso-American space. We see anew. This new vision is not quantitative. Instead it signals a qualitative shift.

Webmoor's exploration elucidates Ingold's concept of “Wayfinding and Navigating”. (Ingold, 2000) The methodologies and tools of “Wayfinding” and “Navigating” suggest two paths similar to the methods and paths of design engineers. Wayfinding occurs when one walks through a landscape without a map. One relies on direct phenomenon and discussions with local inhabitants to move through a territory. It is direct, specific, and immediate. Navigation, on the other hand, requires a map. One determines where one is through consulting the map and comparing it to what one sees.

Effective engineering design process parallels the movement between wayfinding and navigation. When we negotiate new territories in engineering design, we do a combination of both Wayfinding and Navigating. We make rough ambiguous models, engineering drawings, and many kinds of models which lie in between.

It may be correctly argued that Latour's notion of circulating reference and the chain of small gaps stands precisely because the notion of a large gap between object and representation is a fiction in scientific work. There is a crisis in engineering design, however, because little attention is

paid to the places in between. Often, the process of moving from idea to manufactured product “elides” the steps between, which ensure user requirements are effectively embodied in engineering metrics.

Webmoor speaks of how the grammar of the map changes the nature of the phenomena it represents: “The detail of the cartographic map can often, however, elide the very feature – or for that matter, an urban or built architectural space – that it presumes to envisage in its visual conventions... Furthermore, maps by virtue of their ‘univocal scientific strategy’ flatten sensory data into the restricted medium of articulated lines and create ‘gaps’ and ‘blank spaces’”. (Webmoor 2005: 57, de Certeau 1984: 94)

The same can be said of engineering drawings and other reductive models like CAD drawings and Finite Element Analysis software. While they provide necessary and essential embodiment of knowledge, at the same time they parse out information which may be critical to translating idea to manufactured object.

Engineers tend to want to reference the “map”, in the form of engineering drawings, more than the wayfinding. It is part of the training of the contemporary engineer, part of trusting mathematized representation as the portal to knowing. So much of what we take for “knowing” is tied to the two dimensional projection of a three dimensional perspectival representation of space. This is made from a fixed single point of reference, which infers either time has stopped (no motion), or a view from eternity - a Newtonian “God's Sensorium”. Indeed, this kind of seeing does freeze objects, and give them a measure on a coordinate grid (or its analogue), and with that measure comes mathematical knowing, Truth's second self.

Artists, on the other hand, have been known to recoil at the sight of a 2x2, a graph, or an equation to represent the work they pursue. Intuition is more in keeping with the knowing of an artist. Sensate experience is direct and true for an artist. Until the likes of Andy Warhol, artists often labor to make single and unique objects. The notion of managing manufacturing variances to meet the demands of engineering tolerances (necessary for equitable mass manufacture, building rocket ships, or medical devices) is often far from the pallet of an artist.

Both the scientist and the artist are correct in their view. However, in terms of engineering design, both are seeing with one eye shut, both are making “dangling references”. Perhaps a richer kind of knowing can be found in the place in between. This place in between can be detected in engaging mutually operative elements, in the way that Webmoor walks us through Teotihuacan.

Movement between the map and the perceived landscape is a method of moving which brings us to the place in between. For a design engineer, making a rough model is creating an analogue to the perceived landscape, as ambiguous and non-mathematized as the place where the Savannah meets the Rain Forest in the Amazon. This type of comparison of a rough model to a mathematized representation is key to successful product development. Work done at Stanford's Center for Design Research (CDR) supports this proposition.

Eris Ozgur, Margot Brereton, and Micah Lande, all researchers at Stanford's CDR, have pro-

posed models that suggest that there is a mixing and a local movement from C to K, and K to C. This occurs on several levels of mediation. It occurs in the language used in describing the design process and the types of questions designers ask: questions that can be answered with “yes” or “no”, and questions that cannot be answered with “yes” or “no” (Ozgur, 2002). It occurs in the prototypes, or models used in product development (Brereton, 1999). Micah Lande has proposed a model which describes a movement between what he terms “engineering models” and “design models” (Lande 2008). These models have analogous features to C-K rubric: engineering models have clarity and are mathematical. Design models are ambiguous models, and models which are evocative of what can potentially be, rather than the actual.

Barbara Tversky has shown how sketches may be considered as “cognitive tools”. One of the many uses of sketches is “to promote inferences and new ideas; to organize and convey information. For the former, ambiguity is productive; for the later clarity is necessary.” One of the significant features of an ambiguous sketch is that it promotes creativity, “as it allows re-perceiving and reinterpreting figures and groupings of figures. Furthermore, the experience of the practitioners using rough sketches is a factor governing the ability to interpret them. Experts are “more adept at making functional inferences than novices, whose inferences are primarily perceptual.” (Tversky, et al, 2003: 1)

This ambiguity allows for the creation of what Tversky calls “new knowledge”, or new ideas (Tversky, 2006). This is a different knowing from that of canonical scientific knowing. This is a process knowing that allows for making functional inferences about potential objects.

Maps, on the other hand, exhibit clarity. They “omit some information, and highlight, even distort, other information.” (Tversky, 2003) Maps stand in contrast to rough sketches and perform different work for the creators and users of them.

The rough sketches Tversky examines are akin to the wayfinding of Ingold. They approximate the raw, unmathematized experience of making sense of a landscape. Rough, ambiguous sketches allow a design team to generate new, unexpected ideas; they open the possibility for serendipitous events and learning.

Ambiguous mediation is not limited to sketches in the practice of design engineering. Rough prototypes are created, not only because they are quick and inexpensive, but because they afford the same benefits of ambiguous sketches. One of the characteristics of a successful rough prototype is that it generates many stories from the group. Users discuss ways in which to augment the piece; members complete the model in different ways and in different scenarios, which is to say they speak qualitatively about it. (Edelman, et al)

These models are “abstract” in that they do not make claim to a single instantiation of the object. They can be understood as undifferentiated, pluri-potential proto-versions of what may come to be actual. Mediations of this sort are understood as not being like the final object they represent; they make no claim to truth in the way that a map makes claim. Like the interpreters of Tversky’s rough sketches, these rough physical sketches are better utilized by practitioners with expertise.

Engineering drawings, on the other hand elicit discussion concerning optimization, and measurable aspects of the object they represent. (Edelman, et al) These discussions are quantitative in nature. Engineering drawings are an abstraction: they omit and highlight features of the object they represent. These drawings depend on the conventions of linear perspective, which is a process of homogenization which allows all elements to be combined and reshuffled like a pack of cards (Latour, 1986). CAD drawings take this homogenization further by stripping away a single, unique point of view, by offering virtually unlimited mathematized views through the movement of a trackball or mouse.

The perspective replicated by engineering drawings, like those of photographs, is considered the “hallmark” of a realistic image. (Shanks 1997: 80) Michael Shanks takes a close look at the work of perspective in photographic images. Perspective, Shanks tells us, is a convention of realism which has been questioned in modern and post-modern work. (Shanks, 1997)

The artist David Hockney makes a case that properly speaking, we do not see in linear perspective, per se. Because we have two eyes and are never completely stationary, we can never achieve true renaissance single point perspective in our field of vision. Hockney makes the somewhat controversial claim that from the mid-fifteenth century on, artists used any number of devices to project the world onto a flat plane. (Hockney, 2006) This projection is an abstraction, which facilitates us to know phenomena in a mathematical fashion.



Durer: single point perspective using a draftsman's net

Thus far, we have examined both ambiguously rendered media and its opposite, mathematized media. We have explored mediation that affords augmentation and qualitative exploration, and mediation that affords optimization and quantitative knowledge. What of the place in between? What of the small gaps which allow us to cross this divide with confidence? How can we hold on to precious, meaningful qualities and express them through the agencies of quantified mass manufacture? It seems that we have little practice in rendering media in the vast space in between.

I will offer two paths, two methods to make media in the place between. The first is in the use of photography, not as documentation, but as a generative practice. The second is in the creation of “deep maps” as a means instantiating “hybrid” method states.

Photography is commonly used in Archaeology to document findings and to support arguments. According to Michael Shanks, photography is not inert, it does work for us. Photography can give a sense of place that neither text nor map can. It can give a unique point of view. It can convey materiality. By virtue of its embodiment of linear perspective, a photograph makes the claim that it is real. “This picture is not recognized as a picture, but as what it represents itself as – reality.” (Shanks 1997: 80) A photographer can include an object’s surroundings, or leave them out of the frame. Shanks’ notion of photography is that it calls forth certain qualities of the world, while others are left behind or altered. Photography in the service of archaeology is what Shanks calls “photowork”. (Shanks, 1997)

Lev Manovich unpacks photography as a “cognitive prostheses”. As such, the work of the photograph puts the inner private world of the photographer outside, in the realm of the public and the shared. The desire to “objectify the psyche gave birth to modern imaging technologies such as photography, cinema, and virtual worlds. Indeed, is not the whole idea of photography to objectify private memories and private mental images?” (Manovich 2006: 215) This is to say that photography allows us go from the inside to the outside; it is an “externalization of the mind”. (Manovich 2006: 205)



Rene Magritte, “The Treachery of Images” (La Trahison des Images, 1928 - 29)

Magritte’s painting embodies much of what Manovich and Shanks refer to when they discuss the work of a photograph. The image of the pipe makes claim to being a pipe. The image is selective in that it shows only the pipe, unengaged, disembodied and decontextualized. There is no hand, mouth, or pipe stand. Another telling aspect of the painting is the text which it unfolds. The mixing of text and image gives richer meaning to the image, and even suggests that text itself is an “image”. Descriptive text is indeed a representation of an object. The name of a thing gives us a handle, for better or worse, which affords the speaker and listener a way move the thing in a way that is not possible to move the object itself.

Both Shanks and Manovich indicate that photography shares grammatical attributes from what can be considered the realms of C and K: a single, interior, and personal vision is mixed with mathematized linear perspective. The personal is objectified, but remains intensely personal.

Photowork can be applied as a generative method, in addition to a documentary method. In addition to placing its subject matter in perspectival space, characteristics specific to the mechanics of a camera's optics enable a different way of seeing and communicating what you see. Variable depth of field is a powerful tool which allows a photographer to literally blur foreground and background, so that only one facet of the subject is clear. Distortions of space are made possible through the use of lenses with variable focal lengths. "Short" lenses bend space, while "long" lenses flatten it. The truncated dynamic range of both film and digital sensors make the designer more aware of the tonal qualities of an object, as well as how the eye manages light and dark. The close-up not only calls attention to flaws that the naked eye misses, but reveals otherwise hidden worlds of structure and texture.

Photowork affords the design engineer an environment in which new opportunities can be perceived in their work. Charles and Ray Eames, widely considered the pillars of American design, made use of the camera for just this purpose.

"For the Eameses, and particularly for Charles, photography was not merely a way to record things, it was a part of the process of design, part of the process of understanding the furniture. It wasn't a matter of taking these pictures and examining them later for flaws--no, it was the act of moving around the object, viewing it through the lens, making a series of decisions about taking a picture, and perhaps isolating and assessing the object without distraction or delusion. That process was the critical experience for Charles." (Eames Office Resources)

Corita Kent (Sister Mary Corita), an influential artist during the 1960's, was a long time associate of Charles and Ray Eames. Kent reports that Charles Eames believed that the camera should be used in the design process in much the same way, and with the same frequency as the pencil. Much of Kent's teaching centered around Eames' notion of reframing objects in order to see them in a fresh way. (Steward and Kent, 1982)

Students visiting the photo studio at Stanford University's Product Realization Lab use photowork as a generative process in much the way Charles and Ray Eames did. Design engineering students bring work in progress to the studio in order to get a sense of where they need to go. Professional lighting techniques help designers envision prototypes in a more developed state. A frequent refrain from students after a session lighting and photographing their prototypes is, "Now I get it. I see what I need to do."

Photography holds an important place in the tool box of the engineering designer. It offers a unique, individual point of view, while embodying the rhetoric of three dimensional space projected on a two dimensional surface. It allows designers to make public an internal vision, and thereby makes a place in between, a threshold where we can linger, if only for a moment, where phenomena and mathematized knowing coalesce and the work is brought forward. Through the rubbing together of these different kinds of knowing, a new vision can be brought forth.

The second methodology which design engineering can appropriate from archaeological practice is found in the notion of deep maps. Mike Pearson and Michael Shanks introduce the deep maps as a way of facilitating a richer understanding of place than an ordinary map can provide:

"Reflecting eighteenth century antiquarian approaches to place, which included history, folklore, natural history and hearsay, the deep map attempts to record and represent the grain and patina of place through juxtapositions and interpenetrations of the historical and the contemporary, the political and the poetic, the discursive and the sensual; the conflation of oral testimony, anthology, memoir, biography, natural history and everything you might ever want to say about a place ..."  
(Pearson and Shanks, 2001)

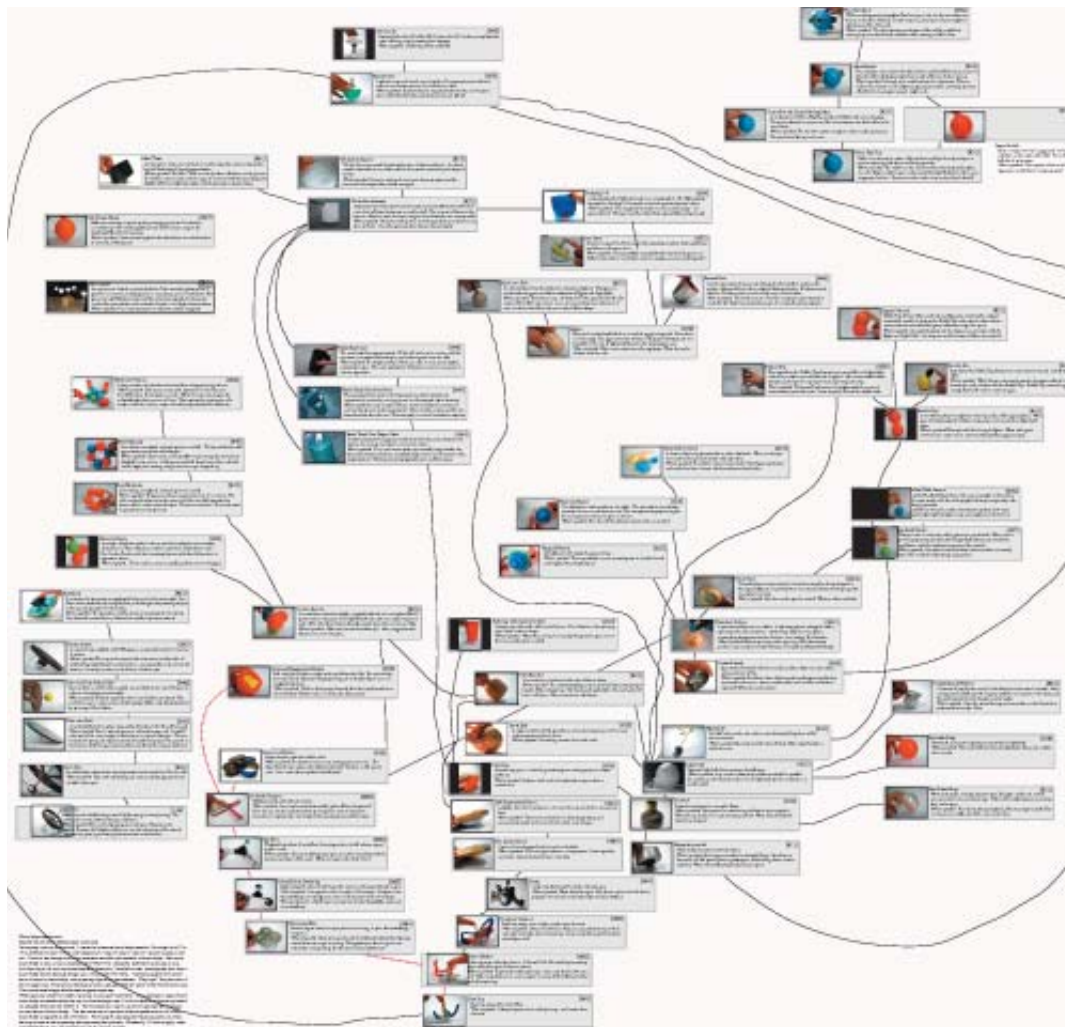
Shanks' colleague, Clifford McLucas, of the Brith Gof theatre group, amplifies some of the qualities of a deep map:

"Deep maps will be sumptuous – they will embrace a range of different media or registers in a sophisticated and multilayered orchestration... Deep maps will only be achieved by the articulation of a variety of media – they will be genuinely multimedia, not as an aesthetic gesture or affectation, but as a practical necessity... Deep maps will have at least three basic elements – a graphic work (large, horizontal or vertical), a time-based media component (film, video, performance), and a database or archival system that remains open and unfinished." (McLucas, 2006)

McLucas and Shanks suggest that a deep map invokes the form of a traditional map in a broad sense, along with rich, multilayered media. The result is a hybrid, which leverages both types of media to allow a more complete experience of a historic place. The concept of deep maps invites the placement of very rich data points on graphical coordinate schema. Deep maps are a method of consciously conflating purifications of here and there, of now and then, of the cerebral and the sensual, of the domains of C and K.

The notion of overlaying Wayfinding and Navigation is not facile. Design engineers often don't know where they are going, or don't know how to get where they want to go. The work of invention is often as much discovering how to make something as it is discovering what to make.

The concept of deep maps can be used to unpack the work of Carissa Carter, currently a Master's Candidate at Stanford's Joint Program in Design. Carter has developed several methods for product development which mirror the Shanks' deep map.



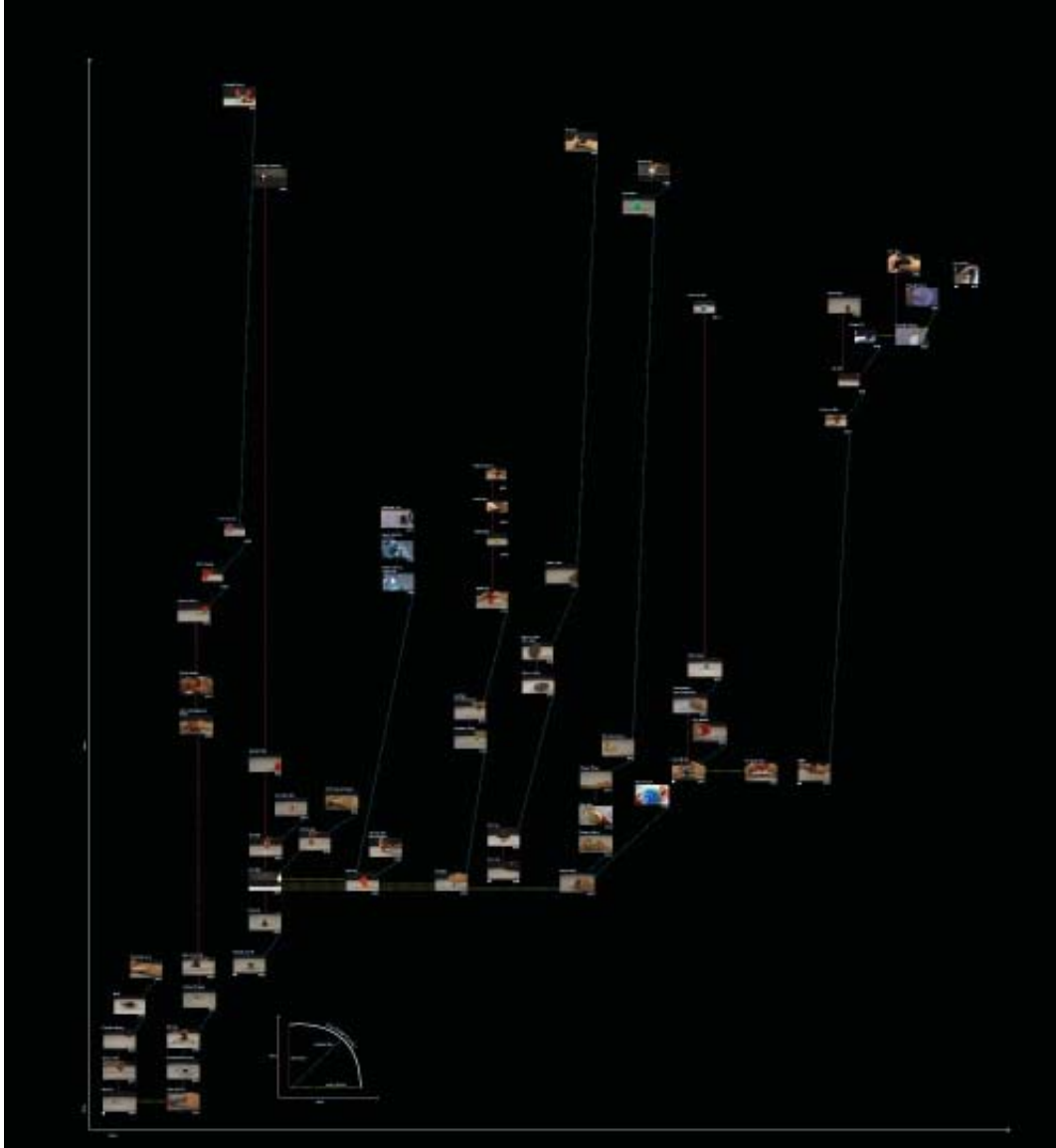
Carissa Carter: rough version of rich map (2008)

In one representation of her exploration into spinning objects, Carter places photographic images and textual descriptions of prototypes on a sheet of paper. The descriptions describe what motivated Carter to make the prototype, what she learned from it, and what direction to explore in the next iteration. Carter draws lines, connecting the images in a type of genealogical tree, or cladogram, which traces her ideas as they develop.



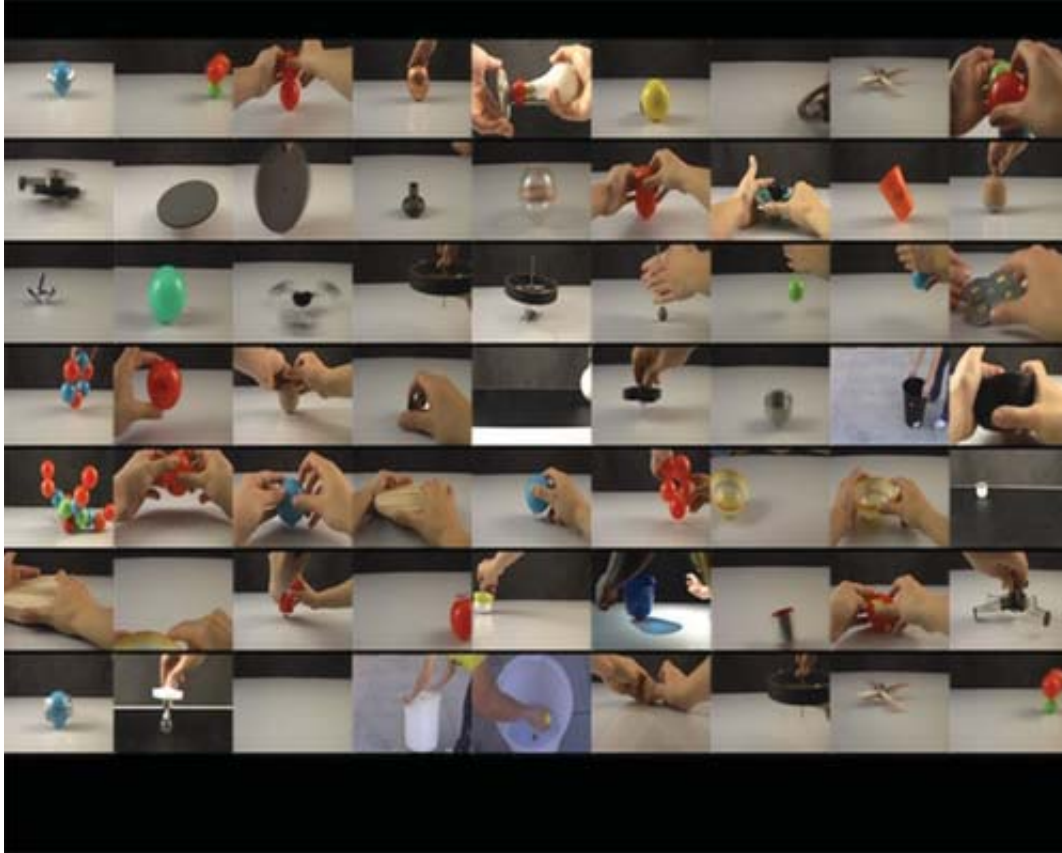
Carissa Carter: interactive version of rich map (2008)

In another representation, Carter places magnet-backed photographs of prototypes along with descriptions of what she learned from experimenting with them on a wall sized ferrous sheet. She invites other designers to arrange and rearrange the image/text elements in order to discover latent connections between the pieces.



Carissa Carter: videos of spinning objects on a coordinate scheme (2008)

In another representation, video clips of each prototype in action are placed in a coordinate system.



Carissa Carter: still from video of spinning prototypes (2008)

In yet another, many video clips, arranged in rows and columns, play simultaneously. Process time is compressed to reveal a totality; many moments are elided into a single symphonic now.

Carter, originally a geologist, consciously uses these deep maps as a way of mixing the two ways she has learned to know: collecting and analyzing. The photos are kin to the rock samples she collected; the coordinate system is akin to the scientific analytic tools she used to catalogue the samples. In a manner similar to Bruno Latour's description of botanists moving plant samples around on a table to make connections and distinctions, Carter moves images and text around to find affinities and a way forward. Unlike Latour's account of the botanist's process, in which associating the samples on a grid happens later in the process, Carter uses a coordinate grid while parsing through her prototypes as a generative method. (Latour, 1999)

Carter combines the methodologies of Wayfinding (connecting iterations as she goes along) and Navigating (using a coordinate grid) in order to gain insight into her work. Carter's practice parallels Webmoor's practice when he guides us through Teotihuacan. Carter's practice, which fits under the rubric of deep maps, affords design engineers a way to linger in the place between. By moving between representations which embody the grammars of two different way of knowing the world, Wayfinding and Navigation, Carter's work develops in a rich and compelling manner.

Fluency in the methods of mediation and knowledge of how mediation affects change in both

a design and a designer are crucial to the effective management of representation. Christopher Witmore describes this shift that occurs when we use these tools. “Throughout the process of transformation that occurs during excavation...we are collectives with our media and instruments. As sociotechnical collectives our senses extend through the map, the theodolite, or the tape. With these ‘actants’, with these sensory prostheses, we tune into, focus on, and see specific qualities of things.” (Witmore 2006: 281)

In the generative process of design engineering, we craft many of our mediations, or ‘actants’, which can be considered as cognitive prostheses. As such, they give affordance to different ways of thinking and communicating. Used properly, some have the potential to promote the generation of a field of ambiguous phenomena which allows for the creation of new knowledge, or new ideas. Other media, like engineering drawings, allow for the optimization of potential products so they can be produced in the millions, at high quality, and for profit. The construction and use of media in the path between these poles of unique, qualitative experience on the one hand, and universal, quantitative knowledge, on the other hand, is the work of the design engineer.

In this paper, it has been my hope to see Design Engineering through the lens of current Archaeological practice. In doing so, I have appropriated features of both the discourse and the methodology of Archaeology.

Both photowork and deep maps are methods which afford design engineers an opportunity to linger in the place between. In the case of deep maps it is between the poles of Wayfinding and Navigating. In the case of photowork, it is between the private space of subjective vision and the public space of objective knowing. Implementing mediation in the mixed manner as outlined by either the use of photowork or the crafting of deep maps ensures our mathematized models are not empty. These techniques help ensure that the unique qualities for a desired, user experience, replete with rich materiality, are embodied in the universal quantities of mathematized media.

The practices of photowork and deep maps focus on making fresh work and making fresh the vision of the maker; these practices are, so to speak, outside jobs and inside jobs at the same time. In the short term, when design engineers mix models in this way, they have the opportunity to see something new in their work. In the long term, they develop confidence in tools which can change the way they see.

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