Strategic Briefing

Explicating the core of the design as a cognitive artifact

Fayez Al Hassan,[1,2] Paul Rutten,[1,2] Henk Trum[1]
[1] Physical Aspects of the Built Environment
[2] Center for Building and Systems TNO-TU/e
Faculty of Architecture, Building and Planning
Eindhoven University of Technology
f.al.hassan@bwk.tue.nl

1. Introduction

A building as a concrete material artifact is the outcome of a stage of an evolutionary process. Previous stages successively end with artifacts of less material substances. A design, for example, is a semi- material artifact: a drawing on an external sketchpad. Prior to this stage, there is another stage involving the conception of the design as an immaterial (mental) artifact in the internal sketchpad of the client and the designers' working memories. In other words, the conception of the strategy represented in a sum of underlying structures of concepts in a certain order that can be translated into mental images representing the design main concepts.

In the past, the master builder implicitly performed this stage. In today's common practice, it has almost been lost because it is hardly anyone's specific responsibility in a multidisciplinary design context. Moreover, there are no models or tools to help replicating it, although we are nowadays more than ever in urgent need of regulating an important complex information hinge between the client and the mono-disciplinary design team members. The reproduction of this stage is therefore especially important when working collaboratively. The core of the design challenges as a mental artifact can be represented in the internal sketchpad of the client and designers' working memories and can therefore be comprehended at the start of the design process by which all participants form a common reference and a shared memory. However, the core of the design, in order to be represented in such an effective form, has to be in a certain format, which is not the thousands of pages of the traditional brief because our working memory cannot deal with this large amount of necessary and unnecessary information at the start of the project. Only a few chunks can be simultaneously activated in the working memory in a way that can represent the whole design problem, and the strategy reflected as a set of the underlying structures for concepts that need to be developed in a certain order. This is an action to combine the concept of limits to the immediate memory span and the cognitive processing capacity of the brain as an information-processing machine or the *concept of chunking*. In this paper, we will try to discuss a theoretical basis for designing a tool, which can help explicating the design as a mental artifact based on this core concept, and also we will try to illustrate the state of art in this particular research area followed by recommendations, which indicate some future researches.

2. Vision toward a solution

Our approach for explicating this stage suggests in fact a return into the natural intuitive way of thinking by designing. For instance, if you were asked as a client how do you like your future building (house, company…) to be, your mind will be invited to create some shortcuts of mental

images, pictures or what we articulate in general as concepts. If you were asked to try to order the same shortcuts that you have created before, but this time considering your priorities, the result you get is a series of shortcuts of mental images, in a certain order. The sum of these mental images in an order, which reflects priorities, is simply what we call the Strategic Brief.

The creation of underlying structures of these mental images belongs to the realm of the responsibility of human cognition (Sternberg 1999). Providing a tool, which can help to produce the cognitive underlying structures of these mental images can therefore lead to the generation of mental representations and ultimately external representations. Dym and Brey (2000) have therefore proposed that design representations should be understood as cognitive artifacts for generating mental representations and (ultimately) novel external representations. Explicating the process of producing the underlying structures of concepts that need to be developed in order is what we call Strategic Briefing. From this notion, this project takes its title. The Strategic Brief in this cognitive format can then form a common background, a shared memory, and a reference for collaboration. By holding it in their memory, participants will be able to understand their positions in the context of the whole, and also will be able to decide which of these mental images are more related to each of their specializations.

Providing a tool, which can help producing this Strategic Brief means reaching the climax by filtering and encoding the essentials of the design problem representation. This suggests that the building design process should start with a minimum of relevant information, which can be accrued into the underlying structures of concepts representing the core of the design. This implies first trying to explicate the minimum of this relevant information that can be accrued into mental images, and also to explicate the mechanism that allows their intertwining to take place.

This will be a shift in briefing from the recent data centric approach into a concept centric approach, which will help to regulate an important complex information hinge between the client and the mono-disciplinary design team members. It is therefore one of the most important activities at the very beginning of Strategic Design Process (introduced by P.G.S. Rutten in his Inaugural Speech at Eindhoven University of Technology, 1996), which concerns the integral multidisciplinary design processes of buildings and aim among others at lowering the risks of mismatches in time between actual and desired performance.

3. **Identification of our research area in literature**

In literature, several authors recognize this central PhD Project problem illustrated in this paper. Oxman (1995) mentioned that in the recent decades two dominant research directions have been developed. One of them is how to explicate the cognitive processes, which can lead to the conception of the design as a cognitive artifact, including all related research areas like symbolic representations, intuition, the process of design cognition and the manipulation of representation as a cognitive capability in design. Hamel (1995:53) argued that describing the development of the design problem conception is a question that still needs to be answered. Simon (1996:133-136) launched an open question that is also still needs to be answered. This question is about finding a way in which the theory of design may be viewed in relation to other knowledge like psychology: man's relation to his inner environment or man's relation to the complex outer environment in which he seeks to survive and to achieve. However, up until now there has only been limited success. The reason is that staying in only one field of science will not help attaining this aim. Beheshti (2000) mentioned at least ten areas that define the agents of design, and can describe the study of creativity and cognitive activities of design like: philosophy, psychology, logic, epistemology, ontology, aesthetics, etc. This means that significant results in these research

areas are needed in order to invoke a discussion on fundamental principles of design thinking, and to allow gaining insight into the nature of the design as an innate human faculty. Therefore, there were no direct available means, theories, or methods in the literature, which can help achieving our objective. Research by design or a combination of an integral, holistic, intuitive understanding based on axioms and well-known information, and also on existing knowledge in the realm of design studies, cognitive (psychology) science, complexity theory, and the theory of dynamic systems may therefore the only way to achieve our objective of synthesizing a theoretical basis for the tool design. Designing in general, and designing of this tool in particular, implies first accessing the inside using well-known information and axioms, trying to synthesis in order to form unknown knowledge, which is in our case the tool. This is a totally different approach from the usual scientific research, which starts making measurements, collecting and analyzing data in order to conclude a formula. For explaining the design of the tool and the consistency of the logic, we would like to summarize how we started from axioms and well-known information and ended by the theoretical basis for designing the tool.

4. **Theoretical basis for designing the tool**

The well-known information and knowledge that we start with is basically related to Simon's argument (1996) that the artificial world may be considered the result of the interface between our inborn needs (for buildings), representing the inner environment, and the context in which we find ourselves, representing the outer environment. This interface is only possible by engaging our sensing systems because everything we know about the world comes to us through our senses (Gasson 1974). When generating concepts, we argue therefore that individuals can only satisfy their needs through their sensing system, by making or breaking relations between the inner environment and the outer surrounding environment (Al Hassan et al. 2002). Making or breaking relations between the inner and the outer environment requires us as human beings to use or not to use one or more of our sensing organs because everything we may need, or we may like has to be searched by our sensing systems, and everything we may need or like has to be found in our environment. This is in fact symbolization of the human needs (for buildings) or *what to find*, the means of our sensing modalities or *how to find*, and the outer environment or *where to search*. By performing a link between these elements (*what to find, how to find, and where to search*), our minds start generating this artificial world in the form of underlying structures for concepts, which can be translated in later stages into concepts and then into a physical reality. An example, one can say that a building has to have an Aesthetics value related to Seeing relevant to a certain Community (*Museum on Greek style*) or a building has to have a Recognition value related to Smelling relevant to a certain Organization (*Bakery or Flavor shop*). Just by mentioning such a set of words, you recognize that your mind is invited to start imagining something, i.e., it starts generating concepts.

Generically speaking, we can say that each possible concept that our minds can generate has to have at least these three basic elements. This could explain the mechanism of how our minds can encode the simplest form of an underlying structure of a concept, which is a mental map of *what*, *how*, and *where to find*. Explicating the drivers and the process of encoding underlying structures for concepts, in addition to how constraints influence this process would provide the theoretical basis for designing a tool, which can assist the production of the strategic brief, as a sum of underlying structures of concepts in order, representing the core of the design as a cognitive artifact.

The process of designing the tool

Designing the tool, which can assist strategic briefing has to deal with the following steps:

- The first step that has to be made is toward explicating the phenomena of generating concepts. This implies defining which kinds of things belong to the three main elements, the human needs, the sensing systems, and the outer environment, and then to develop three taxonomies corresponding to each of them. This means that we need first to discuss the taxonomy of the human needs (for buildings) or the inner environment, the taxonomy of the human context or the outer environment, and the taxonomy of sensing systems.
- The second step is to explicate the process of linking between these taxonomies, which is in fact the process of generating underlying structures for concepts.
- The third step is to explicate how constraints influence the process of generating underlying structures for concepts or the strategizing process.

Performing these steps will form the theoretical basis for designing the tool.

A taxonomy of human needs (values)

Because the design as a cognitive artifact can relate to many different needs that a design can accommodate, the tool should necessarily be based on a general theory of human needs that forces designers to systematically think about and develop corresponding design concepts.

Abraham Maslow's theory (1943) states that people are constantly motivated by needs, which he diagrammed in his famous model of the human hierarchy of needs (there are many other theories, but we preferred to mention Maslow because he was the founder of the concept of the human hierarchy of needs). However, by analyzing this model we find that it does not recognize the difference between the kinds of existences and the awareness of them, which give birth to what he called needs, and the recognition of these needs, which reflects what we call values. Also, Maslow's model is limited to human needs in the social context, while our interest is in human needs for buildings. This requires us to reconsider this model, develop a generic model of human needs, and then derivate a particular model, which can fit the human needs for buildings. As a result of this reconsideration, we argue that the origin of these sharply distinguishable and shared human needs is related to different kinds of existences of human beings, which we have arranged as follows: the biological, physiological, physical, functional, cultural, intellectual, human and spiritual existences (Figure 1). Seeking to survive or to enjoy one or more of these levels of existences means first bringing this driven awareness as a value to the conscious mind (Ross 1985). Sternberg (1999), emphasizes therefore the cognitive nature of these human needs, and argues that the concept of mental representation is fundamental to cognitive sciences. These values arranged in the same order correspond to the awarenesses of these different kinds of existences are as follows: being safe, feeling comfort, performing function, getting recognition, enjoying aesthetics, and inspiring symbols (Figure 1). As portrayed in Figure 1, this spectrum of driven awarenesses, which reflects the basic human needs, varies from *Immanent to Transcendent*. The awareness of these needs at the lower levels, like safety and comfort, are immanent, have short-term effects and a high frequency. In contrast, the higher levels like getting recognition, enjoying the aesthetics, or inspiring symbols are more transcendent, have long-term effects and an indirect feeling of need.

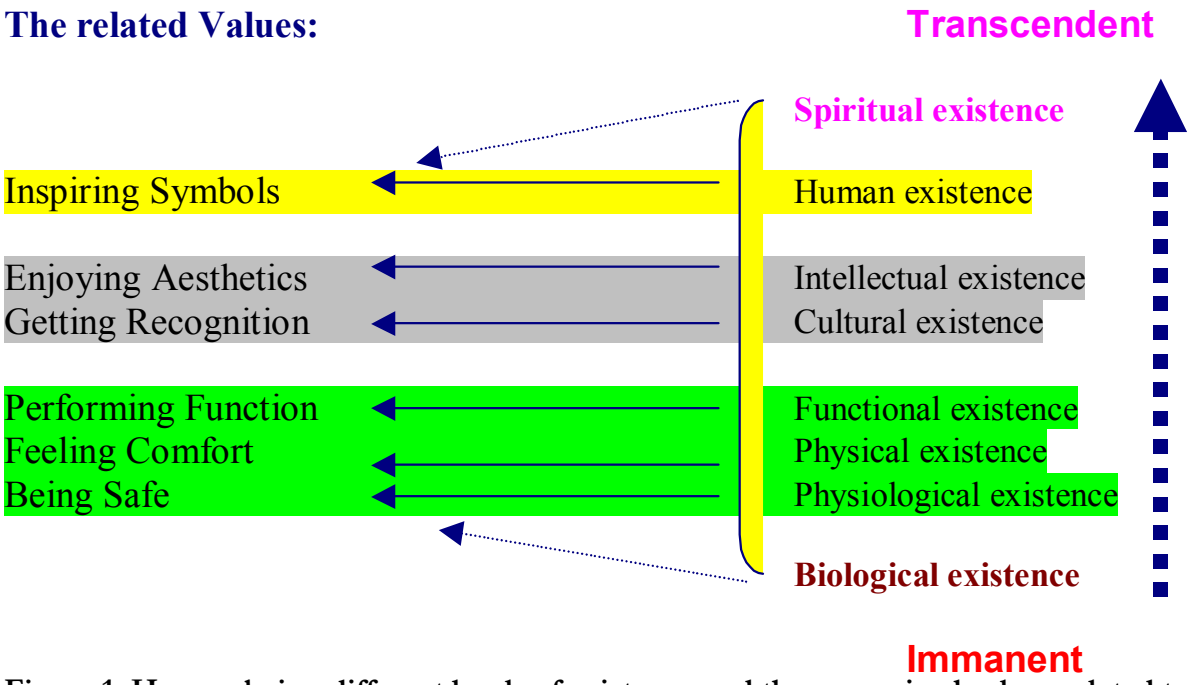


Figure 1: Human being different levels of existence and the recognized values related to each of them.

This can be simplified and reflected in a taxonomy of human values, which can related to designing of buildings as illustrated in Figure 2.

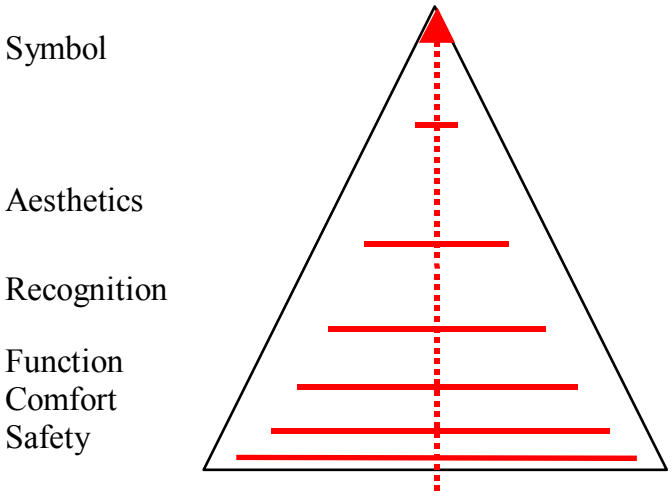


Figure 2: A taxonomy of human values related to the design of buildings.

This taxonomy reflects the human beings' awareness of needs for buildings of three types:

- Material well-being: like satisfying the biological, physiological, physical, and functional necessities. These basic necessities can be translated in the field of design into safety, comfort and better using or functioning of buildings.
- Psychological welfare: such as getting recognition, being told for something, (related to audible thus), followed by intellectual (related to visible), such as enjoying the aesthetics of buildings.
- Mental prosperity: like being (mentally) inspired by the symbolic meaning of buildings.

A taxonomy of the human environment

The human environment or the context in which a human being's mind finds itself, and where it searches to fulfill the needs are arranged as follows: Individual body: (you, biologically and physiologically), Family: (a group of individuals), Organization: (TU/e), Society: (the Netherlands), Community: (European Community), Globe: (the World), and the Universe. Human values (as reflected driven awarenesses of needs) can therefore be searched and experienced at different levels (Figure 3).

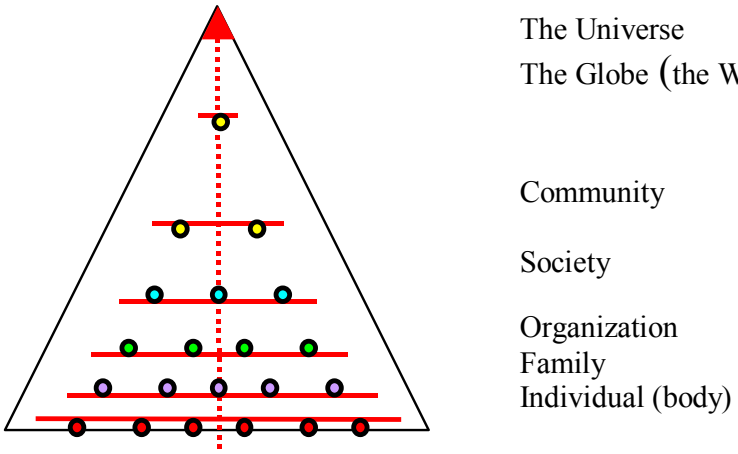


Figure 3: A taxonomy of human environment.

A taxonomy of sensing

Sensing systems are human equipments necessary for interacting at all levels of the environment for satisfying different kinds of awarenesses of existences (values) (Figure 4).

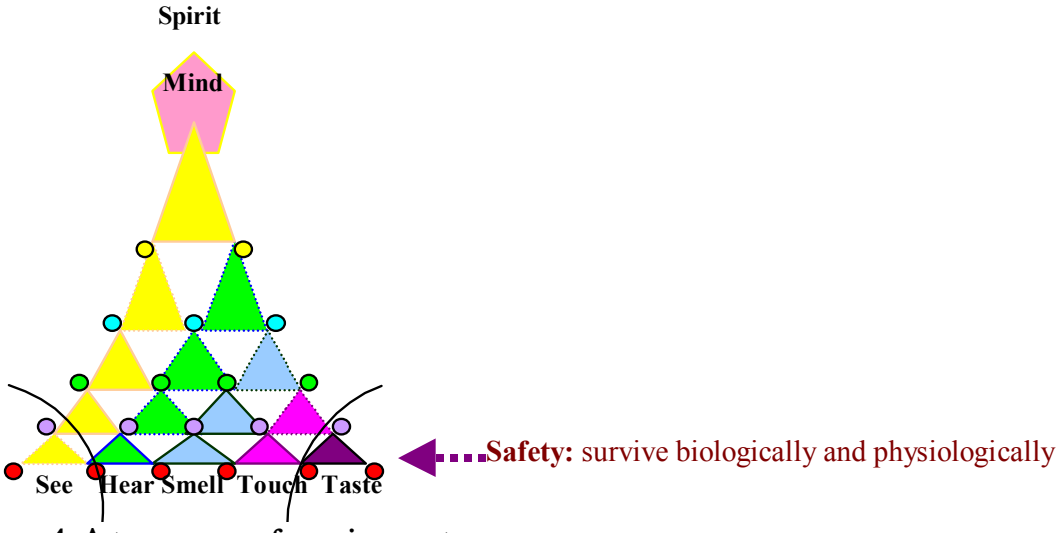


Figure 4: A taxonomy of sensing systems.

The first five are taste, touch, smell, hear, and see. The sixth one is the mind, which is the sense of the total encoded or decoded sensory information (Harth 1995). The seventh one, which is the spirit, will be out of consideration by the further discussion in this paper (Figure 4). To satisfy their awareness of needs (values), human beings are urged to interact with the environment. For

the purpose of survival at biological physiological levels at the basic lowest level, for example, human beings may need to interact with all sensing systems like when they eat. When eating, we taste, touch, smell, hear, see, and mentally inspire (Figure 4). In the opposite, human beings try to protect themselves and to ensure their safety at the biological physiological levels, for example, from experiencing the pain of an interaction with the environment while most or all-sensing systems are engaged like being victims of buildings collapses.

It is important to note here that the levels of interaction correspond to the engage sensing organs, and to the successive higher levels of perceiving the values (Figure 5). By an interaction at the family level we use one sense less than at our individual level. The sensing we loose in order, when we go higher is: taste, touch, smell, hear, and see, correspond to approximate ranges of the sensing, and to the natural and gradual awareness. At each level up, we miss one sense until we leave the realm of the sensing system into the mind, where the encoding and the decoding of the total sensory information takes place.

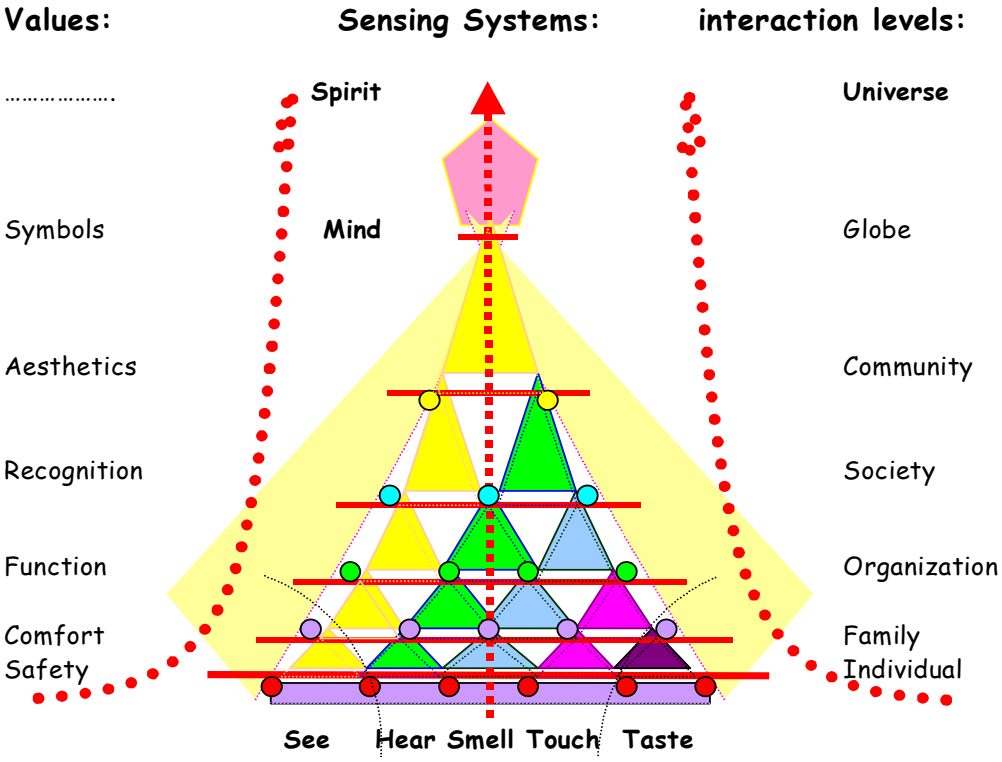


Figure 5: The different interactions with the environment in relation to the values and to sensing organs concerned.

By striving to achieve higher values, human beings use less sensing modalities (Figure 5), which also means interacting less consciously. For example, seeing on the lowest level is different from seeing on the fifth level. Seeing on the lowest level (mostly combined with other sensing modalities) is supporting the aim of surviving, and the quality of escaping danger, which is in our case Safety, while seeing on level 5 is just for seeing, e.g., seeing to enjoy Aesthetics. Only human beings can be affected when missing these higher values, over a long span of time.

Having discussed these three taxonomies of the human values, the sensing modalities, and the environment allows us to discuss the process of linking them. This will introduce what we call the Self-Graph for generating underlying structures of concepts.

The Self-Graph for generating underlying structures of concepts

The above three mentioned taxonomies define the components of what we like to introduce as the Self-Graph (Figure 6). These components are as follows:

- *A*: A taxonomy that reflects the awareness of certain kinds of existence articulated as a value.
- *B*: A taxonomy of sensing modalities concerned in the interaction with the environment for satisfying certain values.
- *C*: A taxonomy that represents the levels of interactions with the environment, where the values can be searched.

The recognition of a certain value at a certain hierarchical level of the Self-Graph activates a certain sensing modality. In turn, the sensing modality activates a certain level of interaction with the environment. For example, that your building has to have a symbolic value related to seeing relevant to a certain society (Figure 6). This process of linking between components that belong to the three taxonomies of the Self-Graph, which we will call Synergizing, describes the mechanism of encoding the simplest form of an underlying structure for a concept.

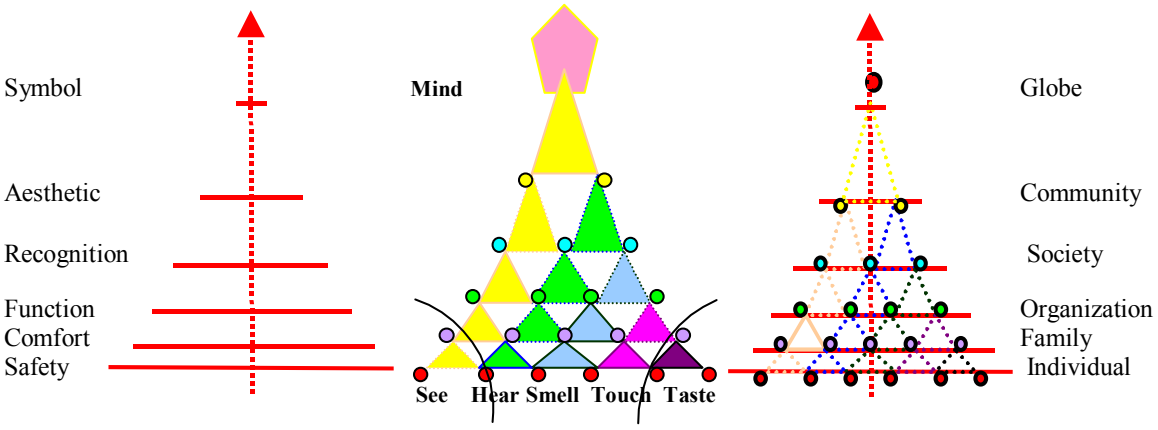


Figure 6: The Self-Graph components.

The Self-Graph that holds the three taxonomies of human beings' values, sensing, and the environments, and the mechanism of relating them will then work as a "*center of narrative gravity*" (Harth 1995). This center, which can be used for intertwining the client's brief as a set of underlying structures of concepts, contains what Akin (2002) called the "*conceptual variables and the schemata that provide the underlying order and structure for an architectural design.*" However, we still need to discuss how external constraints influence this process of generating underlying structures for concepts, or the process of generating concepts in scarcity.

Generating concepts in scarcity

In their dreams, people can think as they like and develop any concepts they like. To our dreams, there is only one restriction: our internal mental preference, which can be related to our kinds and levels of intelligence. In most other situations, the contexts in which we live define different constraints such as ideological, social and/or pecuniary, which can restrict the process of generating concepts. Because of that, designers need to take into consideration the different clients' preferences, and also their different external constraints. The concepts, which can be

generated by the same person when choosing in abundance (variety), are therefore different from those he is generating when choosing in scarcity (Hoebeke in Boonstra 2004). When choosing in abundance there are no external constraints, e.g., no ideological, social and/or pecuniary restrictions. When choosing in scarcity, the situation is different; usually we reconsider the concept resulting from choosing in abundance, by taking into consideration the external constraints. The reconsideration changes the underlying structures of concepts and their orders, which can take place at two levels as follows:

1. If the product that we are going to design has more than one value, or even all of them like the case of the design of buildings, while the resources are limited, for example, if you want to have a house while your resources (money) are limited, you will look more for the functioning, the comfort and the safety of your building, whereas other value like aesthetics or symbols may become simply non-existent or be pushed into the background. This means that the most prepotent value will monopolize and the less prepotent values will be minimized, even forgotten or denied. Maslow (1943) argued therefore "*It has been observed that an individual may permanently lose the higher wants in the hierarchy under special conditions.*" This means that by encoding the brief we need first to prioritize between these values: safety, comfort, function, recognition, aesthetics, symbol in terms of personal preference or/and urgency (internal or/and external constraints), so that the most preferred/ urgent one will have the priority and so on. Prioritizing between these values results in restructuring the underlying structures, i.e., it will redefine the quality and the final conception of the product as a whole on the highest level.
2. The associations between values (in cases of a product with more than one value) add attributes, which can define other values and direct the searching. For example, if you say that your building has to have a Symbolic Safety related to Seeing relevant to the whole Globe, then you have better specified in which direction the symbolic value has to be searched. In other words, 'Symbolic' has to be related to Safety, thus when seeing the building, the building has to tell us that it is safe, and this impression has to be perceived by everybody on this globe. A different example is that the concept that needs to be developed is Symbolic Function related to intuitive Mind decoding relevant to the whole Globe. In other words, the function of the building has to be symbolically interpreted by the mind in the same way globally. This process of associating between each value to the other values, which defines the direction of searching we will call Synthesizing (in order to discern which of these two values is the main value and which contributes to the definition of the direction, we will give the main value an adjective state, while the second value(s) stay as they are in the noun state(s)). These extra two dimensions add two elements to the simplest form of an underlying structure for a concept:

- The first determines the relations between all values in a process of Prioritizing;
- The second determines the relations of each value to the other values in a process of Synthesizing, which defines the direction of searching.

This is in addition to the previous relations of each value in a certain sensing system, and on a certain level of interaction with the environment or the process of Synergizing. Here we like to add that the synergizing defines the quality of each concept that belongs to the final product. For example, in the previous example, if we reduce our ambition to develop the same concept but on an organization level or on the individual level instead of a global level, then the invoked concepts will qualitatively lower. In conclusion we argue that the process of generating concepts in scarcity contains the following cognitive operations:

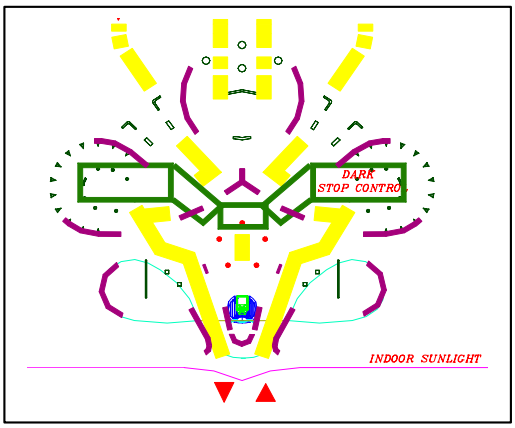
1. Prioritizing between the main set of values.
2. Synthesizing between each value and other values.
3. Synergizing of each values (synthesis) into a certain sensing system, and into a certain level of interaction with the environment.

These cognitive operations add procedural knowledge of how to achieve to the declarative knowledge of what to achieve. In other words, the manipulations of the original Self-Graph structure as a result of the cognitive operations: prioritizing, synthesizing and synergizing, resulting in a cognitive artifact that defines what and how to achieve: the content and the process, which are in fact the two sides of strategy (Bowman et al. 1997).

By introducing the Self Graph and the mechanism of generating concepts in scarcity we explicate the process of generating concepts' underlying structures in general. By explicating this process we performed the theoretical second basic step for designing the tool. However, we still need to relate this mechanism of generating underlying structures of concepts to the design of buildings. This is because the design problem may have many levels, for example: city level, whole building level, or workplace level.

Encoding the core of the design

Relating each underlying structure for a concept to a certain level of the building design problem (City, Building, Building section, or Work place level), adds an extra dimension to the simplest form of an underlying structure for a concept. An underlying structure of a concept will become like: Functional Comfort, related to Mind intuitive decoding, relevant to the whole Globe, the design problem is on the Building sections level. Figure 7 is an example for developing such an underlying structure of a concept. The Building section(s) in this example are the departure and arrival halls in an Airport Building complex.



- The indoor sunlight in buildings gives the impression of cheerful welcome.
- Gives a hint for easy orientation inside the building and intuitively leads to the right direction to achieve the final destination.

Figure 7: Example of underlying structure.

Figure 7 shows an example of developing the following underlying structure: Functional Comfort, related to Mind intuitive decoding, relevant to the whole Globe, the design problem is on the Building sections level (the departure and arrival halls in an airport building complex).

In this concept you recognize that using daylight for natural orientation preserves the feeling of spontaneity and directness from the main entrance till the visitor's destination. This can direct the movement of passengers to their different aims, which means comforting the functioning of the departure and arrival units. Buildings with uniform light level confuse this intuitive natural orientation.

The next section will explicate the strategic briefing process for encoding the core of the design as a synthesis of underlying structures for concepts.

The strategic briefing process for encoding the core of the design

The Strategic Briefing Process for encoding the core of the design as a cognitive artifact contains the following operations:

1. *Prioritizing*: By prioritizing we mean grading the values: Safety, Comfort, Function, Recognition, Aesthetics, Symbol in terms of personal preference or/and urgency (internal or/and external constraints), so that the most preferred/ urgent one will have the priority and so on. This defines the design problem on the highest level as a *system of values*. This ordered set of values defines what drives us to design or *why* we start generating concepts.
2. *Synthesizing*: By synthesizing we mean making associations between the values beginning from the highest value or the value marked as number one, and the rest of the values, then the value marked as number two and the rest of the values, and so on. Making associations between the values therefore creates motives (value with direction of searching) necessary for directing the search, as to say 'I want Symbolic Safety,' for example. This will transform the system of values into a *system of motivations* or *what* to find.
3. *Synergizing*: By synergizing we mean relating the system of motivations into sets of sensing organs and the levels of interaction with the environment. Both define the *how* and the *where* to find. Saying that you want symbolic safety for example, will directly invoke two questions:

- How do you want to perceive this symbolic safety in your building? For example by seeing or by hearing or…etc.
- With whom do you want to communicate this symbolic safety? With only you, your family, your organization, a certain community, or the whole globe?

This will transform the system of motivations or the what to find, into a *system of orders*, with two components of *how* and *where* to find. We also must not forget to decide at which level the design problem has to be solved, i.e., which architectural units we have to consider in our solution.

4. *Symbolizing*. By symbolizing we mean mapping the results of the previous processes by connecting *why* to search, *what* to find, into *how* to find, and *where* to find for each architectural design unit (City, Building, Building section, or Work place level). An example of such an encoded order is the following mental map of an underlying structure of a concept of designing an Airport Building: Develop a concept: Recognized Function, related to Seeing, relevant to the whole Globe. The design problem is on the Whole building level, i.e., the building function has to be visually recognized and means the same for everybody on our globe: Airport & Fly. Designing the roof of the airport building complex to look like flying wings, a bird, or any other form related to flying can invoke similar impressions (Figure 8: shows an example of developing the following underlying structure: Recognized Function, related to Seeing, relevant to the whole Globe. The design problem is on the whole building level: the airport building complex.).

Symbolizing therefore is the last stage of the encoding process. The result of symbolizing is a symbolic representation of the design challenges or what we call the strategic brief.

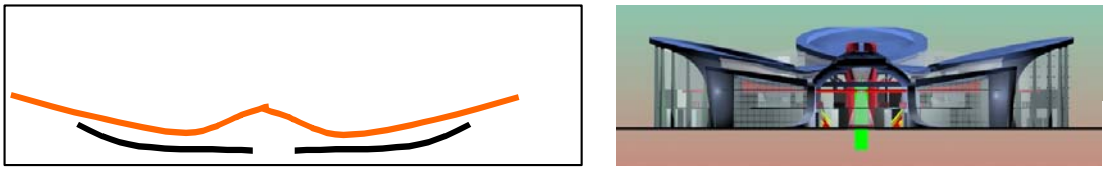


Figure 8: An example of developing the following underlying structure.

5. Benefits

The Strategic Brief, which represents the design as a cognitive artifact as a set of underlying structures for concepts, can support the focus and the effective searching by the designers. Holding an underlying structure for a concept like an outline of a searched concept in the memory activates the mechanism of selective positive feedback (Harth 1995), which allows this outline to become sharper with other information fading into the background. Designers will become better focused, and their search for concepts becomes easier and more effective. Furthermore, reaching this climax by encoding the essentials of the design problem and representing it in a symbolic format will encourage designers to deal with this problem intuitively. This means solving the problem first by formulating the strategy that is in fact the core of the design solution, which indicates the following: the conceptual process design, the concepts that need to be developed, the product's expected quality, an estimation of the time needed, the capability of the designers who can translate these underlying structures for concepts into concepts, and finally an estimation of costs (Figure 9). This means a comprehension of the design solution on the highest level or the comprehension of the core of the design. Cross (2004) emphases that "*the successful design behaviour is based not on extensive problem analysis, but on adequate 'problem scoping' and on a focused or directed approach to gathering problem information and prioritising criteria.*" Dorst (2003:117) also concludes that the strategy that seems to work the best is to pose or identify priorities, solve the high-priority problem and adapt all the other solutions to this 'core design.'

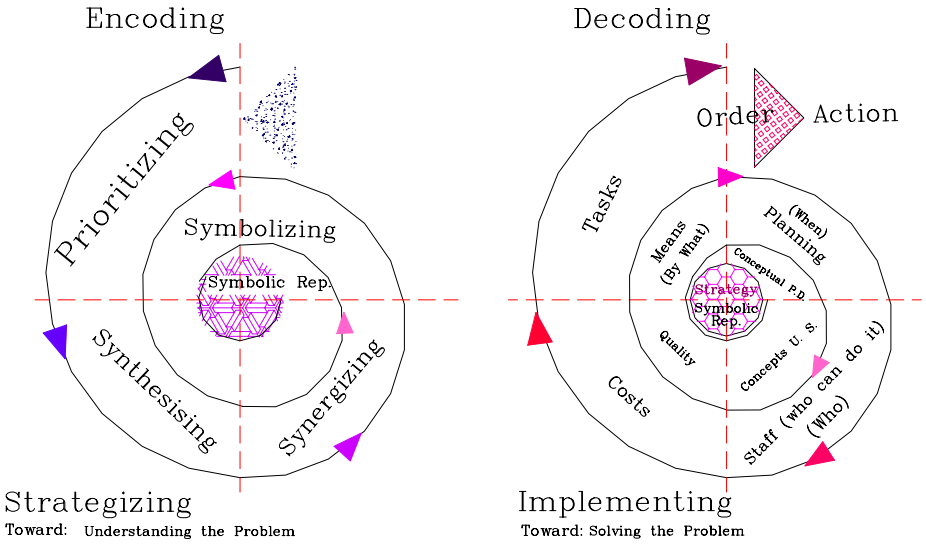


Figure 9: The intuition between the symbolically encoded design problem and the decoded strategy.

The creativity is then in formulating the question, more that in answering it, and thus, in what Glegg (1969) describes as "*the secret of inventiveness is to fill the mind and the imagination with the context of the problem.*" This is what we mean by the encoding of the design problem in an abstract symbolic format. Relaxation means giving intuition a break to decode the problem by transforming the symbolic representation into a strategy, which is in our view the same thing but opposite in direction (Figure 9).

Designing this tool therefore adds a significant contribution to the debate on how to access the designers' creative minds. It provides a mechanism for forming a problem scope, a shared memory and a reference for collaboration. Every participant will understand his/her position in the context of the whole by deciding which of these concepts is more related to his/her specialization. Mao-Lin Chiu (2002) emphases the importance of developing such a tool by saying: "*We need a process model of collaborative design to describe the context of the design tasks, which is important for all participants to understand his/her position in design collaboration.*"

6. The state of art and future research

The theoretical basis explained in the previous sections has been translated into an application protocol and a tool in order to lead the future users step by step from their first acquaintance with the design problem to the creation of design main concepts. Further, for illustrating the applicability of the tool in practice, a multidisciplinary group of students in the Master phase worked on a project. The group's design was evaluated according to many points of attention and criteria, before the process as well as afterwards, including the resulting building design. Based on analysis of the results of evaluations, made by the participants in the test group, we conclude that the tool provides a mechanism that enables us to repeatedly attain a unique common design problem representation articulated as a synthesis of underlying structures for concepts in a certain sequence. The content and the sequence of these underlying structures define how and when each design team member has to contribute to the whole design process. This leads to a more effective use of design team capabilities, and forms an essential basis for organizing efforts, directing and harmonizing the search for collaborative solutions. Moreover, the test showed that working with abstract knowledge by dealing with concepts instead of data can help to avoid information overload in the early phase of design by means of the following:

- It can simplify the transformation of information between the client and the participants on the one side and between the participants' themselves on the other side.
- It provides a mechanism that enables us to repeatedly attain a unique common design problem representation, and to form a shared vision.
- It allows for the possibility to make very important decisions at the earliest phase when starting a project and forms an essential basis for organizing efforts toward collaborative solutions.

In conclusion, we argue that successful design behaviour is based on adequate problem conception and on a focused strategy for gathering project information.

This ongoing PhD project illustrated in this paper is expected to be finished this year. It is expected to offer a significant contribution to the field of design theory and research, design management, design education, and to the education systems in general, because it delivers from a data centric approach towards a concepts centric approach. It is a step forward to the natural and intuitive way of human working, which is highly needed nowadays for the effective transforming of knowledge. Continuation of this research could therefore take place in many

fields, especially in fields related to design theory and management, design education, and to education systems in general.

For design theory and management this PhD project is an early step toward understanding and explicating the cognitive processes, which can lead to the design as a cognitive artifact because it relates the design to the field of knowledge representation. However there is still a work to do in order to scientifically prove and improve the two hypotheses that we used to underpin the designing of the tool: the Self-Graph and the Strategizing Process. This is a field of science were researchers and designers from cognitive psychology and design together need to work on. Further, all kinds of organizations are nowadays more than ever in urgent need to open up the possibility for the underestimated intuitive encoding and decoding of information. Discriminating between what is necessary/unnecessary, or relevant/irrelevant of this overload of information to a certain problem is becoming more and more complex process. This makes decision making difficult, especially in the early phase. The step that we made by explicating how a design can be comprehended as a whole, and also solved as a whole is very important for the development in this direction. Strategic management studies can therefore benefit from it, because making decisions on a strategic level implies seeing the whole picture, while "*western culture has progressed so rapidly in science and technology and it has become very good at breaking problems into pieces. Unfortunately, it wasn't very good at putting it back together*" (Carnmer 2000). Putting it back together is only possible by learning how to abstract knowledge, filter and encode information, which can be supported by training using visuals.

For design education, this tool would be a good instrument to use in design teaching, because it helps teachers to make openings to different possible solutions, especially in the early phase of design where students usually struggle to make a start. It also encourages speculations about the tool's appropriateness for being generalized and applied in a wider field like industrial design, or the design of vehicles. Practically, especially designers can use the concept of encoding and decoding knowledge because creativity implies accessing the inside, which is only possible when learners are trained to encode and decode knowledge and also are trained to use visuals. Training to use visuals would be a good preparation in basic education systems, which can support the ability to encode and decode knowledge in higher education levels. Elaborating these concepts in practical trainings will therefore be a good proposal for further research. This work may also be very important to the development of artificial intelligent design help instruments because "*the future direction for CAAD research lies in the understanding of the mapping between designers' cognitive thoughts and their external representation.*" (McFazean in Segers 2004).