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Measuring Design Simplicity

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1. Introduction

From John Maeda (2006) it's clearly known that the study of what is Simplicity is central to Design and Engineering. This chapter deals with this, introducing a method to measure Simplicity.

Design and Engineering are today less an act of drawing or designing something but rather the act of designing a program that in itself conceives a diversity of solutions pertaining to the service or function that we intend to draw or design.

This drawing and designing activity may thus be defined by the creation of new materials; genetic manipulation; software and interface conception; formulation of new forms of languages, mostly those of visualization nature; conception (design) of social, political and cultural ideas; generation of new behaviors with growing complexity.

By opposition and in consequence of complexity and also from the intervention of Design and Engineering we all can access better life quality, we can access better technological artifacts and products while allowing its interaction in a simpler way.

Hence this chapter aims the essence of "simplicity" and how it shows up in several existences, whether it may be in Design, whether it may be in Engineering.

The first time ever someone described how the better organization and functionality of systems can be linked to Simplicity was, in 1870, Claude Bernard (Gene, 2007). However Simplicity, as commonly understood, is not an easy thing to describe, much less to comprehend. What is taken as Simplicity is an undetermined number of concepts to explain what supposedly Simplicity is. The result is a great dispersion that cannot afford reasoning. Some have been able to reduce the given conditions for the existence of Simplicity to ten concepts designated as laws (Maeda, 2006). However we cannot consider it as a definition to describe "simplicity" because such multiplicity is just and only descriptive. If we ought to have a classic image of

the state of the art for Simplicity is we can remember the first knowledge of the relation between triangle sides, which was an in-equation:

$$a + b \geq c \quad (1)$$

In-equations have an infinite number of solutions. For millenniums solutions were published with possible triangles. The amount of three side set measures could close in a triangle. So it was until Pythagoras simplicity:

$$a^2 + b^2 = c^2 \quad (2)$$

As equations have a finite number of solutions never again was it necessary to write down tables for possible triangles. The comprehension of real space metrics brought up the great growing efficiency to those who design structures. The solution for the problem of knowing if three given measures of line segments would originate a triangle is said to get simplified, and metrics allow simplicity.

Just as in the time when one could only know that the addition of two sides of a triangle was bigger or equal to the length of the third side, to find the solution for simplicity we can also, today, establish tables.

One of the most recent (2006) is that of Maeda. It functions as a synthesis proposal in the rules of Simplicity built in ten laws judged by being different and independent from each other.

This chapter aim is to present a measure for simplicity that will turn it into a parameter central to Design and Engineering.

Until now there are a certain number of rules or laws for Simplicity. The most recent attempt to reduce diversity of notions, Maeda (2006) defines ten laws. But every time we arrive at number ten we cease the main question again. Why ten? Why not eleven or nine? Maeda and his theory of Simplicity suffer from the fact of not having been brought to the Science domain, meaning it has not been made measurable.

Thus this chapter's object is also to clarify Information's concepts, taken as data synonymous, stated arguments and rarely faced as Science parameters, either in Design or Engineering, so thus measurable, though observer dependent and relativistic.

In this context, the chapter is meant to suggest, until designers find out about it, that Simplicity can be measurable and can be so from Fisher's Information Amount (1925) definition. At the same time, the notion will come by that simplicity's measure is also relativistic yet measurable, thus "mathematizable", using concepts initiated by Jacob Bernoulli and those more recently funded in mathematics by Dempster and Schafer (1978).

In 1925, Fischer, upon realizing that just as space and time, information is something we all know until someday someone asks us about it. Yet he also knew that physical language description is based in the fact that, whether or not gathering knowledge of its essence, time

and space are measurable. With measure one can add measurement, one can establish comparisons; one can recognize solutions, and the future can be sound.

In 1925, before a set of data, Fisher foresaw the possibility of measurement or calculation of information amount over an unknown variable. A set of data gives an information amount over an incognita that can be measurable or calculated. After Fisher, measuring or calculating the information amount that allows a set of data to acquire uncertainty reducing became a possibility. After Fisher it became possible to know if one is acting upon the incognita, guessing, predicting or foretelling.

The method had been established by Jacob Bernoulli back in 1713. In his "The Art of Conjecture" (*Ars Conjectandi*), he establishes the way to calculate the probability of happening. This probability (*probabilitas*) is not the case. It is not a synonymous of *chance*. It is the method of how sure one is about something that is going to happen to the incognita. Bernoulli proposes the method we have selected to present the theory we are about to show, the method of combined argumentation.

We will increasingly use the results from Melo-Pinto (1998) in the recognition technique (the knowing of what the incognita is) and the mathematic method of combining arguments developed by Dempster and Shafer. They both have defined the set for each argument and its weight as a function in the System of Beliefs.

This chapter establishes that for a given System of Beliefs there will be as much simplicity as the lesser the number of data set elements that will be giving the higher amount of information about the incognita.

It will also be concluded that before a same set of data there will be Systems of Beliefs for which there will be higher concentration of information about the incognita.

Hence this chapter is about a measure of Simplicity before a System of Beliefs. Simplicity is as bigger as the smaller the number of elements of the data set that brings the higher quantity of information about the incognita. The relativistic character of Simplicity's measure will be evidenced as well as how to manage it following from the System of Beliefs' properties.

In parallel, it will be established that Design concepts, as well as those of Engineering, have been guiding conception's structuring for Simplicity showing that the concepts expressed in this chapter are not as possible triangles tables were before knowing metrics in Euclid's space, but rather a metric for Simplicity.

This principle may be sustained by several applications; particularly through the Universal Principals of Design. It is also built upon arguments or data, as proposed by Lidwell et al. (2010), who stated that Design essence is one of the meanings of the artifact that surround us and that we effectively use in our daily life. Hence, we will demonstrate how Design Simplicity is also an Engineering parameter.

Following Claude Bernard, who in 1870 discovered physiologic medicine and stated that *the condition for a free and independent life lies in the stability of the internal mean*, which naturally depends on the wellbeing of each individual and is built under his own system of beliefs.

Simplicity is also related to a system of beliefs, and as such it will always be associated to the on-looker that applies it or observes it. Hence one can state that “Simplicity” is relativist, once it’s System of Beliefs’ are dependable and that variants from the same System of Beliefs can be understood as a School. It will suffice that a set of designers or engineers share the same arguments for each one of them as well as the same weight.

2. Simplicity

The social and economic impact of information systems in society is a reality in part due to the progress in telecommunications in its most recent shapes: internet, television, computing systems and mobile phones. However a new challenge arouses in the digital era, related either to Design, Engineering, or Technological level application, which consubstantiates the need to attain Simplicity, either of contents, either above all of the designing of related interfaces.

Actually Simplicity is also a quality that not only arouses the passionate devotion for product aesthetics and design, but also became a strategic key tool to allow businesses to confront their own complications (Maeda, 2006).

Hence, we can state that Simplicity is something we all long for... For example to refer to the unquestionable commercial success of Apple’s iPod – a device that has less functionality than others available in the market with the same function: a digital music reader. People want and prefer products they can use with simplicity.

The first time someone described how things are in fact simplicity-related was, back in 1870, Claude Bernard. But simplicity as usually referred can be everything but simple.

According to the meaning pointed out by Portuguese lexical online dictionary (<http://www.lexico.pt/simplicidade/>) simplicity is a feminine substantive that may signify three qualities:

- Quality of what is easy to understand or do: a work’s simplicity;
- Luxury absence: to live with simplicity;
- Natural, spontaneity: to speak with simplicity.

In the realm of this chapter thus it will be transmitted to the reader the idea that necessarily individuals who work in science have to speak or write or act mandatorily in a complicate and not complex way, makes no sense when one just wants to communicate.

Today, the requirement is to know how to communicate with simplicity, with clarity, interest and repetition, if thus is necessary, to achieve the main goals to transmit understandably (Kotler, 2000).

Already Priest António Vieira, in one of his most important sermons, “*O Sermão da Sexagésima*”, spoken in Lisbon at the Capela Real, back in 1655, were he vindicated clarity, simplicity, syntactic and dialectic rigor, rigor in logic thinking, and what he defined as an oratory art of aesthetics simplicity, advocating that the preacher should opt for a single matter, define it,

share it, confirm it by the Holy Readings and with reasoning, the preacher should always use, if possible always with examples and rejecting contradictory arguments, hence he might be able to conclude and persuade...

It is this persuasion capacity that by nature is present in human life through different degrees and combinations that allies simplicity and complexity.

But what is effectively Simplicity? Having also apprehended how really complicated it is to establish a measure of Simplicity, Maeda (2006) was able to describe Simplicity in ten (chapters) laws:

- To reduce – the simpler way to achieve simplicity is by means of a conscious reduction;
- To organize – organization makes a system of many look like a system of few;
- Time – time economy transmits simplicity;
- Learning – knowledge simplifies everything;
- Differences – simplicity and complexity need one another;
- Context – what lies in the simplicity's periphery is definitely non peripheral;
- Emotions – more emotions is better than less;
- Confidence – in simplicity we trust;
- Failure – some things may never be simple;
- Singleness – simplicity is to subtract the obvious and to add meaning.

Then he adds three more components, which are:

- Distancing – more seems like less simply by going far, far away;
- Opening – opening means simplicity;
- Energy – use less, win more.

Still according to Maeda, simplifying a design is harder than making it complicated. The great majority of examples he uses are the result of experiences and problems he underwent.

However his considerations about simplicity in life, in business, in Technology or in Design or Engineering, are not to be considered as having been obtained in the basis of a method from a scientific nature.

As well as we do not consider a science that same method of gathering the catalog of squared angles registration that we referred in the framework of this chapter.

It finds out that, as to the meanings of simplicity, we are allowed an infinite variety of data, and as such the information we have is still short, so being before an in-equation as it has an infinite number of solutions.

In this chapter we will be led to know, as Pythagoras did through his theorem, that there is also a way that allows us to be objective, measuring, on the contrary of the description from

Maeda (2006), one can describe Simplicity as it has been sustained by Fisher (1925), as the first definition of information amount.

In a predictable future, Simplicity is thus doomed to be Design and Engineering's motto, of a whole Industry, as it has been featured in its own time, the discovery of Pythagoras's Theorem... Shortly, we aim to give to the reader's understanding that simplicity is not something intuitive. In fact, today we possess and have access to great data complication, on the other hand the same data are complicated to process, hence we have very little information, which by analogy leads to conclude that if we are facing an enormous simplicity, a few data set will give a great amount of information about the instrument, or the system, or whatever.

Simplicity, like easiness, hardness, information or complication is a matter of the observer's measuring. It depends on his own system of beliefs.

3. Information and information theory

According to (Drekste, 1999) Information Theory is a branch from probability theory and from statistics mathematics that identifies the amount of Information associated or generated by an event occurrence, or the realization of the state of things, by uncertainty reduction and the elimination of possibilities, presented by the event or by the state of things in question. Relatively to Information "choice" and "amount" are always mentioned and how to measure Information.

Sir Ronald Fisher (1890-1962), a renowned scientist from the 20th century with large contributions to Statistics, Evolutionary Biology and Genetics, introduced in 1925 the concept of Fisher Information, long before the *entropy notion*¹ from Claude E. Shannon (1916-2001) with the maximum probabilities technique and variable analysis.

However, the concept and notion of information is vague and intuitive. When we ask a question, we are requesting data from someone. When we watch a television show or a movie, we are absorbing data. While reading a magazine, or listening to music we know we are dealing with some kind of data. In a general manner, we use, we absorb, we assimilate, we manipulate, we transform, produce and transmit data for as long as our existence.

In 1948, Shannon gave us a more recent definition of Information amount, as the measure of freedom of choice of each one of us when we select a message (data) between all messages of a set.

For Shannon, the content of Information in each message consists only in the quantity of numbers (bits), of zeros and ones leading to the message conveyed. Information can thus be processed as a physical measurable amount.

¹Shannon's entropy has to do with the fact of the addition of all data, which, according to F. Carvalho Rodrigues is incorrect. We must work with a set of data the smallest and simplest as possible, to maximize the amount of Information to acquire.

When we want to transform data into Information, we must bear in mind three basic rules (Snodgrass, 2007):

- Organizing data: when confronted with a set of grades these must be numerically ordered;
- Data description: when comparing two or more sets of grades these should be referred in the same scale;
- Interpreting data: upon seeing punctuation tests in a graphic way one must bear in mind that the visual representation is an interpretation in full respect to numerical tests.

Information and knowledge are the result of human action while aggregating data (symbols or facts) in a social or physical scope, out of context, not directly or immediately significant (signs). Data setting in a determined context acquiring meaning and value, being thus designated as Information. Knowledge comes from the successive accumulation of relevant and structured Information capable of action production, partially based in experience. The data transformation in Information and therefore in knowledge requires a cognitive effort in the perception of the structure and of the allowance of a meaning and a value.

Information can thus be grouped at several “levels” from the most basic shape to the most complex one. In these different levels we refer (Bernoulli, 1713; Quinn, 1980; Waibel and Stiefelwagen, 2009) to:

- Context: it is a situation in which something occurs, using any relevant Information to characterize the situation (state description of relevant entities) of an entity that might be a person, a place or an object, to an interaction between a user and an application and including both.
- System of Beliefs: as it will be further explained it refers to the arguments and their own weight. The System of Beliefs is relativist, varying from each observer.
- Context: the situation in which something happens using any relevant Information to characterize the situation (state description of relevant entities) of an entity that might be a person, a place or an object, for an interaction between a user and an application, and including both.
- System of Beliefs: as it will be further explained, it refers to arguments and their relative weight. The System of Beliefs is relativist, varying from the observer.
- Objectives: the goals (or the objectives) refer to what we seek to achieve and when we have results to achieve in mind and no reference on how the results must be achieved. It represents what should be obtained but does not specify how to do it.

A possible structure for Information levels is shown above.

- **Bits and Bytes/Signs** are (SINGH, 2007) the raw material, representing binary Information in the format understood by computers, i.e., zeros and ones that correspond to waves of electric impulses. Zeros represent no current going on and ones represent current going on, like an electric switch. It's the lowest existing level in computers and, for that reason, the one that exists in higher quantity. It is impossible to the observer to distinguish what is

represented in it, only finding usefulness when it's found in relevant form. Raw material is no longer considered a level of Information.

- **Symbols** are the alphabet used to order bits, shaping finite strings (words) and infinite strings (messages). Words and messages can be shaped as text or as verbal enunciation, numbers, diagrams and even static or moving (video) images. The occurrence of certain symbols may influence the occurrence of others in several time periods, inducing the amount of Information obtained as each symbol is analyzed.
- **Data** are isolated measures about events. According to (Jones, 2000) data are usually seen as being the most fundamental shape of Information. Usually the meaning "data" means something raw or non-refined that must be "polished" as to transform itself in a finished product. One may be "flooded" with data yet it doesn't mean we have information. An example: People and city's names are usually classified as information, while a serial number one gets at the hospital is "data".
- **Information** is (Jones, 2000) data in a context acquiring semantic value understood as sememes². The acquired information needs to be selected, elaborated and analyzed until it can be used and usually denotes data in a combined shape and in a specific purpose. The terms "data" and "Information" are in general and usually used simultaneously, so a vast set of data hides Information only discovered after data analyzing.
- **Meaning** is Information in a System of Beliefs (Dorbolo, 2003). Beliefs and ideas we have form a system whose parts are interrelated in various shapes. This system is dynamic, i.e., it alters itself as new Information is added, and when it happens all new Information is altered by the system. We all have Systems of Beliefs that condition the way we see and the way we relate with the world.
- **Knowledge** is meaning in several contexts. It's a set of aggregations that surpasses the semantic value of each individual element. It has to do with the way things are made and how they exist. The context (Brezillon, 1998), seen as knowledge, enables necessarily to make the distinction between contextualized knowledge (knowledge used in a certain time) and knowledge context (knowledge that restraints contextualized knowledge). The bigger difficulty we face is that, at a certain time for a follower, contextualized knowledge may become contextual knowledge. There are two kinds of Knowledge (Laudon, 2009):
- **Tacit:** concept (Polanyi, 1974) to situations in which the cognitive/behavior processes are conducted by unconscious cognition. Its the kind of knowledge characterized by being knowledge-practitioner, developed through action, experience, ideas, values, etc. so for that reason shared through conversation and changed experiences, through observation and imitation, not being easily codified, described or reduced to rules.
- **Explicit:** its (Sullivan, 2001) a summary based in direct experience that can be easily articulated or codified through a system of symbols which makes it communicated or diffused. This kind of knowledge is to be found in products, patents, source software code,

² According to Porto Editora Portuguese Language Dictionary, the word "sememas" means the signification unit in a lexeme (lexema), which pertains in a set of semes (semas), the minimal significant component of a word.

etc. Explicit codified knowledge is valuable, raising the capacity of observed and negotiable knowledge, easing communication and learned codification transmitted in rules and thus enduring.

- **Perception** (Frazer and Norman, 1977; Dember et al., 2011) is the meaning filtered by the System of Beliefs. It's the process by which organisms interpret and organize the sensation to build a meaningful experience of the world, generally enhancing processing additional sensorial inputs, the process by which sensorial stimulation is converted in organized experience. The sensation is usually referred to non-processed sense results and, either sensation either perception, in practice, are hard to separate.
- **Meaning** (Frazer and Mackay, 1975) is the meaning understood in terms of objectives. In statistic terms, for very simple models it is possible to find meaning in a numerical equivalence. The test of meaning has the broadest range of applications and requests a model to make the description of an answer as a whole or just a reduced answer.

It is so deductible that the Theory of Information explores the possibility of quantitatively measuring a message's information to utter analysis of its meaning (Carvalho Rodrigues, 1989).

From this we can conclude that before a set of data it is possible to "know" if it has more or less Information over a variable we do not know but want to know.

4. System of beliefs

In the past, guessing was a possible science, having the objective of trying to determine the meaning and causes of events. With science evolution, guessing was abandoned taking into account only predicament and certainty.

All that is known beyond doubt (Bernoulli, 1713), we claim to know or understand. Relatively to all that is left, we only conjecture and opine. To conjecture about something is the same as to measure the probability of something the best way possible, in order to choose the best option to our judgments and actions.

Randomness is not part of our knowledge but the object's property, rendering it impossible to make predicaments about it. The probability is a measure of how certain we are and it's achieved with a combination of arguments. An argument may be defined as a thought to prove or refute a given question.

When an argument fits with mathematics, one can make predictions. When an argument is an image, one can forecast as in "an image is worth a thousand words" as being objective. When one has both arguments (image plus mathematics) one can acquire certainty. Each argument must have a weight and the set of arguments with their relative weight is a System of Beliefs.

Probabilities are estimated by the number and weight of the arguments that prove or indicate that a certain thing is, was or will be. Arguments, by themselves, are intrinsic, or artificial in the daily speech, they are expressed or come out according to considerations of cause, the

effects, the observer, the connection, indication or any other circumstances that may have any relation with the thing under proof. It can also be external and non-artificial, coming from the observer's authority and his or her witnessing.

The way to apply arguments to conjecture and measure probabilities may follow nine rules or axioms:

1. Applied to things where it is possible to acquire certainty;
2. It is not sufficient to weigh only one or another argument, but it is necessary to investigate all that may arrive at our knowledge and that is appropriate to prove things;
3. One must not consider only arguments that prove something but also those that can lead to an opposite conclusion, so that it becomes clear which one has a bigger weight;
4. In order to judge universalities, remote and universal arguments are enough. However to conjecture about specific things, we must add closer and special arguments if available;
5. In the uncertainty we must cease all our actions until we have more clarity and, if we have to choose between two possibilities we must make the option for the one that may seem more appropriate, safer, wiser or at least more probable, even if none is.
6. What is useful and not prejudicial must be preferred over what has never been useful and is always prejudicial;
7. Human actions must not be evaluated according to the outcome, as, sometimes, imprudent actions have a better result, while reasonable actions may lead to worse results;
8. In our judgments we must be careful before allowing things getting a bigger weight than they deserve, nor to consider something as less probable than something absolutely certain, nor imposing to others the same opinion;
9. Once total exactitude can rarely be achieved we consider as absolute certainty only what is morally correct through need and personalized desire.

The System of Beliefs is thus defined as being the set of arguments and their relative weight. Hence, the amount of information allowed by a set of data about an unknown variable depends on the existent System of Beliefs. Therefore with the same set of data we can obtain differentiated results, influenced by the different Systems of Beliefs we all have and that condition the way we see and how we relate to the world.

Another method, stipulating that before a set of data we can obtain higher information amount is to work and focus in the System of Beliefs... For instance, to question and inquire may be boring because it takes too much work and few results in data obtaining.

To investigate the System of Beliefs, we must raise the following questions (Dorbolo, 2003):

- Which beliefs do we have?
- How do beliefs interrelate?
- How do beliefs relate to our feelings and actions?

- Which beliefs we have is heavier?
- Until how far in past are our beliefs recognizable?
- Where did we achieve our beliefs? Did we create them or did we inherit them?
- Did we experience big changes in our System of Beliefs? How did that happen?
- Is it possible to draw a diagram of a specific cluster of Systems of Beliefs, ideas, feelings or actions?

In short, and the most complete that the set of data is, there will always be a System of Beliefs where the amount of Information over the unknown variable will be zero, due to the limitations of the System of Beliefs in presence of the observer. Many times we are told the way things are but we do not listen.

On the other hand we also have to deal with data uncertainty, as these may be “incomplete, imprecise, fragmented, suspicious, vague, contradictory, or disabled in any other way”.

When we approach the matter of information we cannot avoid the observer’s role. Carvalho Rodrigues advocates that the measure we take from the amount of information in messages received by our senses is based in perception. He gives us the example of two works from the Russian painter Kasimir Malevitch³ (1878-1935) founder of Suprematism (1913), who painted “*A Black Quadrilateral and White over White*”, he had enough genius to show in these two works the «the pure feeling supremacy’s, or the perception in painting», painting being only a *color construction on a two dimensional space*.

When we ask what is in those paintings the immediate answer is: A black quadrilateral and a white quadrilateral. However we are before a white canvas in the first painting and a canvas with an almost imperceptible line in the second.

It is exactly over these paintings that that we give the black quadrilateral and the white square higher information amount, because they induce in each one of us feelings which in turn generate action. We also know that “*the rarer the event the higher the turmoil in all human structures*”.

In this case we were led to conclude that the lesser probability for an event’s occurrence, or yet, the lesser its frequency, the bigger our perception upon it, so the higher the amount of information it contains.

“It is this supremacy, the supremacy of our perception over our feelings, the supremacy of information amount we can measure in an event, over its frequency that commands our behavior that induces major modifications in systems”

(Carvalho Rodrigues, 1989).

³ KasimirMalevitch stated that art’s reality depends entirely from the effect of color over the scenario. The depicted painting has not a relation of subjection to the real world. It is, in itself and by itself a real fact: it is as “concrete” as all objects surrounding us. It means that the object-painting is not imitating anything: it exists, as objects exist in nature.

It is not surprising that human made creations in the most diversified systems are fragile and precarious and induce great complexity. They are structures influenced too much by non-predictable events, becoming responsible for stronger and everlasting generated perceptions. A system's structure will only be compatible with a proper information amount, otherwise the structure will enter into collapse and that system will have to organize itself with some other structure.

A system with a great amount of data to obtain less information is said to have a highly disordered structure, and induces in the observer a huge ignorance. On the contrary with an orderly and well organized structure, with a set of data with few elements, one can obtain all the necessary information. In short, the degree of knowledge we can have over a determined system is maximized if its uncertainty is zero.

To do so, a method has been developed to calculate the information amount that events generate in the observer, tested in several domains, in studies related with the loss of cohesion from a society before events related to epidemics, or the effects caused in an army before loss in combat, or still with the detection of faults related to the tannery industry, or the determination of fibers distribution in paper industry.

Hence in this chapter's realm we are describing a method to measure information amount. The concept of measure enhances the observer's existence. Hence, the measure of information amount to Simplicity is a relativist measure, it is always dependable on who is effectively observing, because it depends on the observer's System of Beliefs.

In this sense, the choice of what messages or which messages' specter to allow measure may take the designation of those messages as relevant factors to a determined structure within a system.

Hence convictions and concepts into which each observer allows importance, are what we designate as a System of Beliefs. Naturally each observer will have his own, and it is single, and by the time the observer is growing through out his own existence and the world around him, he accumulates ever more beliefs and concepts in respect to serials of things.

One of those things would be, for instance, what the Simplicity's meaning is before a determined individual or group of individuals. Probably meaning can change from one individual to one another. Not in general, but in its specificity, which as we saw can induce to several definitions for Simplicity.

It all depends in the relation on how we perceive and understand the surrounding universe, which takes place in our senses, and naturally in our System of Beliefs. Already mathematician Friederich Bessel, while examining time records on stars transit in Konigsberg observatory, and facing the systematic differences present in observations made by different astronomers, concluded that perhaps he would be before the existence of a "personal equation". Being thus, one can state that an equation is also a personal experience, and it enhances the existence of a sensor that picks up information transmitted by our senses and that our brain processes.

A sensor is something like a device that receives a signal. It's associated to a specific sensation. It receives a signal – *stimuli or data* – and responds through out an electrical signal. Hence

understanding that *stimuli or data* are the amount, property or condition detected and converted in electrical signal, which in turn is transmitted to the brain by several sensors having the capacity to recognize the surrounding universe.

In short we can state that sensors are responsible by data transmission to the decision maker that in turn consubstantiates into Information.

As we assessed by Maeda's (2006) proposal on the concept of Simplicity, the concept of Information as we understood it is also from a relativist or subjective nature, due to the multiplicity and variety of the existent definitions.

We are thus before a probability: the measure of certainty of who we really are, is obtained by the combination of arguments we presently dispose, knowing that there is a weight for each argument. This set of arguments, plus each argument weight is, in turn, the System of Beliefs (Melo-Pinto, 1998). Finally we can also state that before the same set of data, different Systems of Beliefs will also give different results.

Hence that we can sustain Bernoulli's proposal on arguments combination method, we will now present the results of Melo-Pinto (1998) in the recognition technique (the knowing of what the incognita is) by the mathematical method of combining arguments afterwards developed by Dempster-Shafer (Yager, 1994). They have both defined the set of each argument and its weight as function constituents of the System of Beliefs.

Schools, either from Design or Engineering, were created as to allow the same school's System of Beliefs to deal with design or the design with the fewer possible data.

The question now raised is how in Design or Engineering we built a System of Beliefs to allow design or the design simpler in itself and for users? We can state that it can be made through combined arguments or weights that are part of the System of Beliefs.

5. Decision processes: Combining arguments

According to Melo-Pinto (1998), decision process results from information gathering driven to that decision. But all along, the natural appearance of new arguments (partial or not) may drove us to remake beliefs by the light of new data.

Still according to Melo-Pinto (1998), who developed a system of decision making applied to the visual recognition of images in degrading situations, he states that *due to different beliefs' functions over the same insight system, based on different bodies of evidence, he supports himself in the Dempster-Shafer rule of combination*, and as such, may help to calculate the respective functions of believe and plausibility. However, as that function is probabilistic it should be evidence resultant. But Melo-Pinto contradicts this fact, stating in turn that value associated to a given image effectively renders the beliefs we have of it, and are independent from evidence. He gives, for instance, the case of a blond woman's image (Marlene Dietrich) from whom we need no additional result to sustain how associated that image is to Marylin Monroe. Hence the capacity of combination is fundamental to a method that deals with different argument.

“Design Universal Principles” may be those “arguments” than can be embodied as Design essence. They are, no less, and according to Lidwell et al. (2010), the meanings we give to the artifacts we use, in usability terms as well as in its influence, perception and usage call in everyday life, and can assume their selves as combined data and arguments.

As seen before, different arguments combining with a specific weight is what embodies our system of beliefs.

The issue we could now raise in this chapter is what is the reason why some products are most desired by some certain people over others? Which method could be used as to allow knowing which arguments each one of us gives more or less relevance?

Today we know that the supposed commercial failure of some products is due not only to problems related to an operative-functional nature, but also because they didn't made sense to the aimed target. Hence we can state that this is a consequence of something that does not fit with the positivist perception of a certain user.

In that sense, this chapter now aims to let know the “Design Universal Principles” (Lidwell et al., 2010), as a first guide to interdisciplinary reference not only to designers but also to engineers as it combines a vast set of arguments in the shape of 125 concepts related to Design and also to Psychology, Engineering and Architecture, organized through five categories, it can be used as a guide to structure the conception for Simplicity, not only for Design, but also as a reference for Engineering:

- How can Design and Engineering's perception be influenced?
- How to help people learn about Design and Engineering?
- How to improve Design and Engineering's usability?
- How to raise the call for Design and Engineering?
- How to improve decision taking in Design and Engineering processes?

These five categories are in turn subdivided into 225 contents that raise questions as diversified as: accessibility, archetypes, linings, cognitive dissonance, color, comparison, confirmation, consistence, convergence, cost-benefice, development cycle, errors, safety factor, Fibonacci's sequence, figure-background relation, usability-flexibility, forgetting, form and function, Gutenberg's diagram, hierarchy, highlight, iconic representation, interference effects, Prägnanz' law, legibility, life cycle, mental map, modularity, normal distribution, among many other, and truly it reflects a decision process, as it has the capacity to combine some of the mentioned arguments that may simplify processes while elaborating a Design or Engineering design.

But is it possible, as we call upon those 225 principals, that we became paralyzed while design acting? After all, where to start designing, which or what aspect should we allow more or less importance? Supposedly hardly anybody will be able give the answer. Even so, believing the existence of those “beliefs”, there can only be, at the most, one or two... Hence, assuring the 225 (15²) “principals” will not be in fact a statement to consider.

What will make sense is to state, that at the most, there was someone who described 225 arguments or weights to build or describe his own system of beliefs.

Hence the concept of Simplicity in Design or Engineering is the one in which effectively each observer beliefs as its own, and that it naturally depends on the amount of information he has relatively to the data he possesses, as the result of combining different arguments or data:

Set of data C

$$C = \{C_i\} \quad i = 1, m \quad (3)$$

Set of data D

$$D = \{D_j\} \quad j = 1, n \quad (4)$$

Maximum Information Amount given by set of data C

$$H_i = \sum -p_i \log p_i \quad i = 1, m \quad (5)$$

$$H(C) = \sum H_i \quad i = 1, m \quad (6)$$

Maximum Information Amount given by set of data D

$$H(D) = \sum H_j \quad j = 1, n \quad (7)$$

$$H_j = \sum -p_j \log p_j \quad j = 1, n \quad (8)$$

$p_i \wedge p_j$ are the sample case $C_i \wedge D_j$ respectively.

Before a system of beliefs Bel_i in which $i = 1, m$ the information amount allowed by the set of data C is:

$$H_{ii}(C) = \sum Bel_i \otimes H_i \quad i = 1, m \quad (9)$$

Before a system of beliefs Bel_k in which $i \wedge k = 1, m$ the information amount allowed by the set of data C is:

$$H_{ki}(C) = \sum_{k=1, m \wedge i=1, m} Bel_k \otimes H_i, \quad (10)$$

If $H_{ii}(C) < H_{ki}(C)$, then the system of beliefs Bel_k is better than the system of beliefs Bel_i for the set of data C .

If $H_{ii}(C) > H_{ki}(C)$ is the system of beliefs Bel_i is better.

If $H_{ii}(C) = H_{ki}(C)$ are Bel_i and Bel_k equivalent to the incognita knowledge.

The same is applied to the set of data D .

$$H_{jj}(D) = \sum Bel_j \otimes H_j, j = 1, n \quad (11)$$

$$H_{kj}(D) = \sum Bel_k \otimes H_j, k \wedge j = 1, n \quad (12)$$

If $m < n$ and $Bel_i = Bel_k$ when

$$H(C) \geq H(D) \quad (13)$$

It indicates that for the system of beliefs Bel_i C we need less number of elements than the set D to give higher information amount about the unknown variable. Hence, C is simpler.

If $m < n$ and $Bel_i \neq Bel_k$ when

$H_{ii}(C) \geq H_{jj}(D) \Rightarrow C$ is simpler.

If $m < n$ and $Bel_i \neq Bel_k$ when

$$H_{ii}(C) \leq H_{jj}(D) \quad (14)$$

Bel_k system of beliefs makes set D the simpler set though with more elements than set C .

If $m < n$ and $Bel_i \neq Bel_k$ when

$$H_{ii}(C) \geq H_{jj}(D) \quad (15)$$

Bel_i system of beliefs extracts more information amount than set C with fewer elements than D . C is simpler.

If $m < n$ e $Bel_i \neq Bel_k$ when

$$H_{ki}(C) \geq H_{kj}(D) \quad (16)$$

C is to system of beliefs K the simpler. It has less elements and allows higher information amount about the unknown.

If $m > n$ and $Bel_i \neq Bel_k$ when

$$H_{ki}(C) \leq H_{kj}(D) \quad (17)$$

Bel_k system of beliefs makes set D the one that gives higher information amount about what we do not know.

In conclusion we can state that for the same system of beliefs the set that gives higher information amount is the simpler.

For the same set of data the system of beliefs that allows a set of higher information amount about the incognita is the most adequate to predict.

One can thus deduct that simpler is what needs less number of elements or set of data to obtain the same information amount or even higher.

This is the essence of Simplicity, and it can be sustained in "Design Universal Principles", in the quality of an interdisciplinary reference guide, either in Design as in Engineering.

However and as complete as it may be, the set of data that can be involved in the conception of a project of Design or Engineering there will also and always be present a System of Beliefs built over a given observer, to whom the information amount over the unknown variable will be zero, as also, there will be a system of beliefs that before a very incomplete set of data will obtain the maximum information amount over the unknown variable.

We can thus deduce that Design in particular and its several schools are liable to be related to mathematics. That schools are a system of beliefs, and they must be not simply a place for knowledge transmission but also a place that promotes knowledge emergence associated to Simplicity.

We will be, as much, before arguments or weights that each School created to give sense to its own design, in this case having as basis the combining arguments according to Dempster-Shafer theory.

Truly a designer can assign determined values to the arguments or weights in cause and another designer can assign to the same arguments or weights another set of values.

Hence Design is no longer a derivation from art, not even from object engineering (MOURA, 2012). Design can be what informs about human creativity, that emerges from the combination and interaction between the several fields of creativity itself, to what we would like to add that it depends on the combining of different arguments and weights of the system of beliefs to what that designer pertains and that will always be the one he received in its School as a student.

We here designate as pertaining to a same school all those who share the same arguments with the same weight.

Hence we can state that we can have as much Schools or Systems of Beliefs as the nature of arguments (Ma) or weights (P):

$$\{Ma_i, P_i\} = E_i \quad (18)$$

$$\{Ma_j, P_j\} = E_j \quad (19)$$

$$\{Ma_k, P_k\} = E_k \quad (20)$$

So that a School can be shaped:

$$Bel_{i,k} \cup Bel_{i,l} \cup Bel_{i,m} \Rightarrow Bel_{i,k} = Bel_{i,l} = Bel_{i,m} \quad (21)$$

when:

$$\frac{m}{n} \cong 1 \quad (22)$$

The result is that a System of Beliefs is a School, a cluster, and it shares the same arguments with the same weight allowed to the same arguments:

$$Bel_{i,k} = E_i \quad k = 1, \dots, m \quad (23)$$

Hence we can deduce that Schools have the gift to simplify things. And that the set of data or arguments is equal to 1. Naturally the better the School the less data it will need to explain or transmit its knowledge.

6. Conclusion

In conclusion, some aspects can be evidenced:

- a. The essence of the meaning of “Simplicity” is not one of easy understanding in the way it has been, so far, described. The common knowledge is that there are undetermined number of definitions to explain what effectively is Simplicity;
- b. That “Simplicity is relativist”, as an example of “easiness”, of “difficultness”, of “information”, or “complexity”, among others, are issues of each one measurements. As a system of beliefs it will always be associated with the observer.
- c. That like “Simplicity”, until now the concept or notion of “Information” is vague and intuitive.
- d. That before a huge Simplicity, we will be before a major amount of information, with restricted data;
- e. That Design in particular and its several schools are also passable of “mathematization”;
- f. That Maeda’s laws to describe “Simplicity” are a set of arguments and weights built in Maeda’s System of Beliefs;
- g. At last that a school is always committed to its shared System of Beliefs, and as such it is responsible for values, ideals, feelings and actions transmitted to those who are or were, part of itself.

In conclusion we can also state that Maeda’s laws are not effectively laws, but methods or suggestions to define simplicity, because as we saw the simplicity measure explained does not need further increase.

Hence, if we use this relativist measure for simplicity coupled with the complexity measure, we then have the quantitative parameters that release us of qualitative laws for engineering or for design. They allow us the necessary amount to assess design, or engineering, or both.

Therefore the encounter between complexity and simplicity is an art, once we are capable of measuring it and, as such, to quantify it, we acquired the necessary tools for either an engineer or a designer, to achieve the objective of conceiving and build concepts, methods, processes or products, either organic or functional, and hence, at the very end this is what an engineer or a designer aims to. Complexity and simplicity is an art over which we are capable to put measures and, as such, to quantify.

In conclusion we dare state that if we were in the presence of a philosopher; he would say that the true definition for simplicity would be: it exists as to make sense within the world that surrounds us.

It will be then demonstrated that “Simplicity” (its measurement) in particular that of Design, being measurable, is also an Engineering parameter.

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