Buletinul Ştiinţific al Universităţii „POLITEHNICA“ din Timişoara

Seria HIDROTEHNICA
TRANSACTIONS on HYDROTECHNICS

Tom 58(72), Fascicola 1, 2013

The Role of Information in Engineerign Design

Crăciun Florina[1] Drăgan Florin[1]

Abstract: From ancient time, people made objects for different purposes: Knowledge have always been transmitting from one generation to another, as tradition. Finding new solutions, new materials and technologies, made design become a continuous process. Our days, this is done with a speed direct proportional to the ability of informing and changing the design criteria. Antoine De Saint-Exupery gave the Little Prince a box to put the sheep in, while Claude Shannon gave the mankind the formula where to put information
Keywords: tools, axe, shape, symbol, information

1. INTRODUCTION

Human capacity for creating needed objects, or for optimizing old ones depends first on his native qualities, and also on education and instruction, based on information gathering.

Fig. 1. Hamangia Thinker (IV century BC) and some ancient tools

The concept “Information” has been used as term in scientific and technical disciplines, as a concept in artistic fields and also as the informing process and results. The informing process may be described as represented in Fig.13: [2]

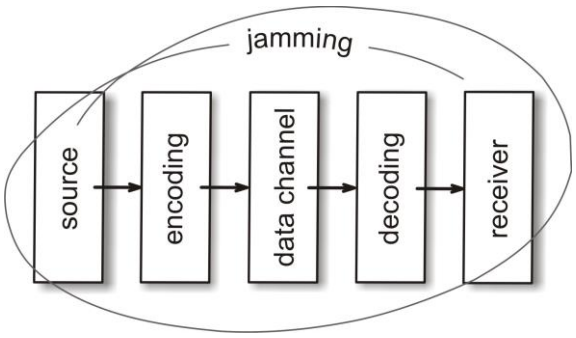


Fig. 2. A graphical representation of informing process

2. THE EVOLUTION OF A TOOL SHAPE

In order to illustrate the long way for optimising a tool shape, we choose a copper axe, one of those which have been found on Aries Valey, belonging to the first bronze age (3500 – 2200 B.C.)

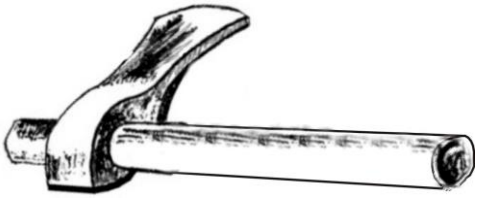


Fig. 3. Coper axe, 3500 – 2200 B.C.

Data transmission channel is in this case, the tradition, which preserves information and transmit it for generations belonging to Wietenberg culture (2000 B.C.). What alterate information given by tradition is the necessity of resolution of some deficiencies in using these tools. For example, fixing the shank in the axe hole, was a real problem for hundred of years along Bronze Age and the variety of solutions demonstrate this, as shown in figure 4.

[1] Crăciun Florina UTC-N, IPR Department, Machine Building Faculty, Muncii Ave No.103-105, No.28, 400641, Cluj-Napoca, Romania, Florina.Craciun@muri.utcluj.ro
[1] Drăgan Florin: UTC-N, Electrical Measurements Department, Electrical Engineering Faculty, G.Baritiu str., No.26-28, 400027, Cluj-Napoca, Romania, Florin.Dragan@mas.utcluj.ro

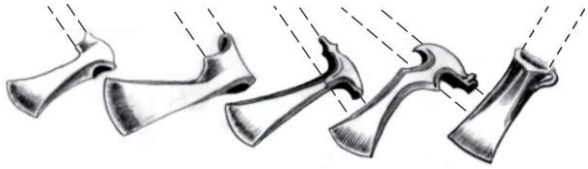


Fig. 4. Steps in bronze axe shape evolution [1]

The axe variants realized in a long time demonstrate that preserving information is not sufficient any more, creative thinking is what led to evolution. Tradition needs to be changed; it has to take into consideration new materials (for instance, iron, as shown in figure 5), new technologies, diversification of function etc.

Fig. 5. Iron axe shape evolution (from V century B.C. to XVIII century A.D) [1]

3. INFORMATION AS A DREAM

A creative manner of thinking always helps us to take models from nature or from other domains and use them as new shapes. Sometimes they are good variants but they may be also wrong solutions.

The dream of flying is one of mankind oldest dreams. The ways to reach this aim are numerous, but copying the natural shapes have not been the best solution, even this led to some remarkable results. Figure 6 represent a bird wing and Traian Vuia's first plane, with which he succeed to rise from soil in 18.03.1906 and displace about 12 m [1].

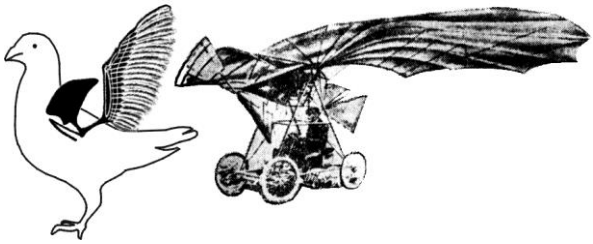
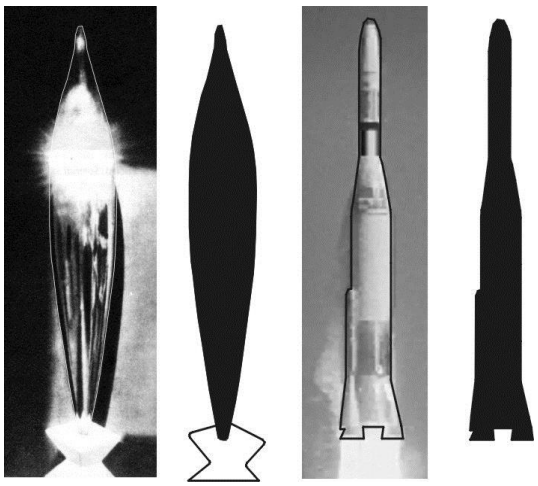


Fig. 6. Pigeon wing and Traian Vuia's first aeroplane

The developing of science and technology gave us the necessary information for solving the problem. In the same time, the engineers had to forget the old concepts based on birds wings. When aircraft flies faster than sound, shock waves are formed which set up resistance. To overcome this, supersonic aircraft are designed with pointed noses and swept back wings. The graceful shape of supersonic aircraft looks very simple, but the design is the result of much intricate research, imagination and creativity. A shape, which is perfect to a certain purpose worth to be considered an art object. Both Art and Science require technical skill. Both artist and scientist try to create order out of the seemingly random and diverse experiences of the world and to convey their experience and point of view to others.

The scientist studies quantitative information in order to discover laws or concepts that are universally true. The artist selects qualitative perceptions and arranges them to express personal and cultural understanding. Both of them transmit their results as information. Considering „the fly" more than a pair of wings, we might imagine the shape of an idea, as artist do.

The welknown masterpiece made by Constantin Brâncuşi (1876–1957) representing a bird ("Pasărea Măiastra"), (Fig.7,a,b) has an aerodynamic shape, similar to a rocket (Fig. 7, c, d) although the artist has never seen a real one. This does not stop him anyway to imagine the shape of "the flying" [1], [2].



a b c d

Fig. 7. The shape of „flying" from an artistic point of view (a,b) and the silhouette of a rocket [1], [2].

4. INFORMATION BY SYMBOLS

The development of the twenty century society determined the information be more difficult defined and understood. The product design process includes considerations of manufacturing, marketing, aesthetic appeal, protection of the environment, ergonomics, financial cost, ease of maintenance, safety etc. The products maker lost the contact with the physical object (like the old craftsman) and information, thinking and communication are realized outside stimulation-respons action. This process is characterized by an abstract thinking based on symbols used in almost all domains.

The development of technical knowledge has been accompanied and made possible by a corresponding graphic language. The connection between engineering and science and the universal graphic language is now more vital then ever before. Designing is now a complex process which became an international activity. A new product, machine or system must exist in the mind of the engineer or designer before it can become reality. The well-trained engineer, scientist or technician must be able to make correct graphical representations of their

ideas and concepts in order to communicate them to others, first of all, to the other members of the team. So, it is important to know and respect those symbols and other technical prescripts established by International Standards in order to be used in industrial design and production process:

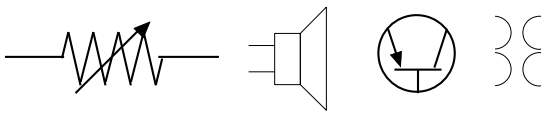


Fig. 7. Symbols used in electrical engineering [1], [2].

In most activities the members of the team have to communicate their ideas each other, in order to elaborate the projects of things that are often virtual.

But first, people have to find ways for communicate with themselves. As Sebeok sais in his book "Signs: An Introduction to Semiotics", that "only human beings think with arbitrary symbols and they are alone in speaking with them". He explained also how nonverbal human communication may be internal (primary) or external (secundary). Therefore, only mankind is capable to elaborate "third" modeling communication systems and use them not only for proximity reality, but to represent "a great number of possible worlds". [3]

It is well known that our days imagination is as important as intelligence and both of them generate progress in every domain. Information became such complex and includes so many terms and concepts that is very difficult to define and describe.

Everybody knows the poetic tale "The Little Prince" written and self-ilustrated by Antoine de Saint-Exupéry in 1943. It is welknown especialy for the profound and idealistic observations about life and human nature, rising from the dialogs between the autor and the child. In these dialogs, the Little Prince asked the man to draw a sheep. After several wrong representations, the narrator gave the little prince a drawing of a box (Fig. 8), telling him that the sheep he wanted is inside. To his surprise, the prince exclaimed that this is what he asked, because the sheep inside the box has all the characteristics for a good-looking and healthy being, beter than all the drawing variants which have been represented before.

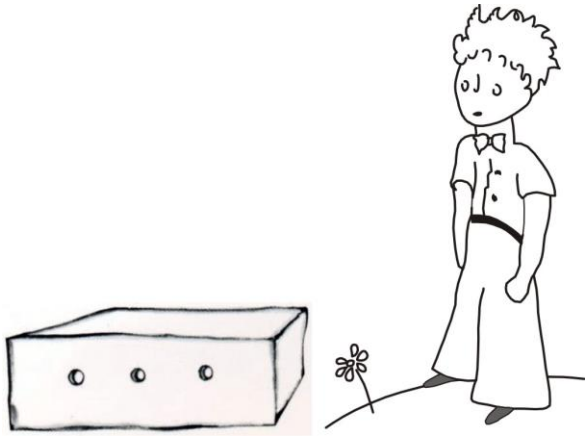


Fig. 8. The Little Prince and the box containing the sheep [5]

In the designing process is important to "think outside the box" and bring out different solutions. Among them it is possible to find the great idea.

Fig. 9. Vasile Pop Silaghi, The Birth of the Idea, 1975 (tempera pe placaj)

In order to develop a concept, from necessity to the product realization the following stages are used:

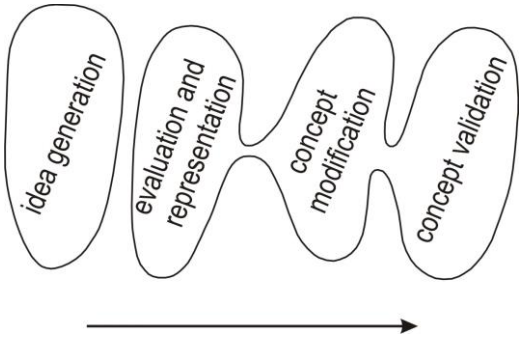


Fig. 10. Steps in developing a concept

Let us imagine the Little Prince asking a designer to draw a chair for him. The first chair model one could imaging is the chair the Hamangia Thinker (ca. IV century BC) is staying on (b) or a Cucuteni chair (a). Sumerian King Gudea (XXV B.C.) was sitting on a chair like the model in Fig.11,c. The function is what impose the first models, as shown in figure 11:

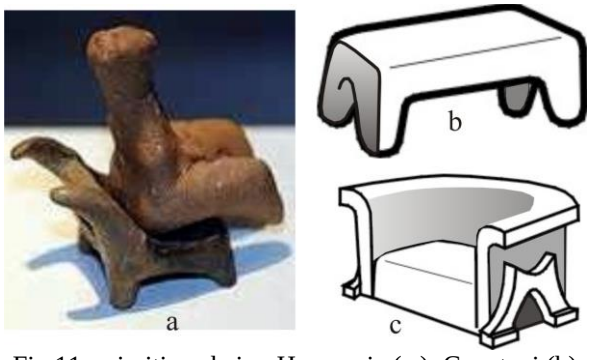


Fig.11. primitive chairs: Hamangia (a); Cucuteni (b) and King Gudea's chair (XXV B.C.), c.

Along the human civilization development, there have been hundredfolds of models of chairs, their shape depending on material, tehnology, fashion and what they had to represent in addition to their primary function: power, culture, creativity, imagination etc.

Fig. 12. Some variants of a chair design

5. INFORMATION AS A FORMULA

In order to simplify the symbol role in thinking and communication analysing system, let have a look upon Claude Shannon theory, described in his „A Mathematical Theory of Communications" published in 1948. Shannon considered that information, represented by a symbol (mathematic, scientific or technical) or by a philosophical concept may be transmitted by an oral, semic or computer language.

The significant aspect is that the actual message is one selected from a set of possible messages. The system must be designed to operate for each possible selection, not just the one which will actually be chosen since this is unknown at the time of design. So the system describing an informing process is not depending on the term which is taken into consideration. If we consider the influence of the statistics of the message we have a continuous range of messages described by a logarithmic function.

Considering that "i" is a message and p_i the message advent probability, the information associated with the message may be represented by the formula [4]:

$$I = \log_\alpha(\frac{1}{p_i}) = -\log_\alpha(p_i) \qquad (1)$$

If we consider α = 2 information will be measured in binary figures (or bytes). The term has various meanings and is used in different technical fields, such as Computer science and statistics.

In biology and medicine, the Information is transmited by DNA structure and starts with plants that use the sun energy to make complex structures from simple molecules. So, DNA as information guides the assembly of proteins and enzymes necessary for the organism function and life.

Only an abstract manner as that proposed by Shannon for interpretating information could stand in the place of such a variety of concepts. This way, information, like any other phisical quantity, can be measured. Subsequently, "information" has been extended to "knowing", or apparition of a new element represented by one or more symbols (text, oral message, images, instruments indication, music staff, DNA etc.) [4].

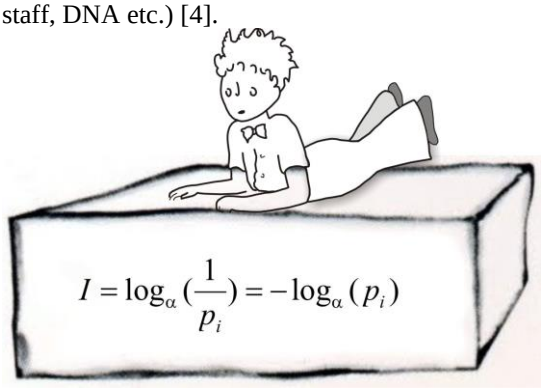


Fig. 13. Shannon's formula for information (1948)

6. CONCLUSIONS

The examples, which have been analysed in the paper and the different points of view taken into consideration in establishing the relation between objects, function, material, technology, aspect, etc, have the role of helping us to have an idea about the complex activity of designing products. Human needs have always been more sofisticated, determined by instincts and emotions as well as traditional solutions. The increasing number and diversity of products needs a better understanding of their functions, in order to choose the optim variant. The role of information increased while it became more difficult to defined, due to the variety of criteria.

When The Little Prince became too exigent with what he pretended, Antoine de Saint-Exupéry gave him the drawing representing a box to put his expectations in. Five years later, in 1948, Claude Shannon gave us the formula to put all information in.

REFERENCES

[1] *Crăciun Florina*, The Influence of Function upon the Form of Industrial Products, ICEGD, Bucuresti, 2005
[2] *Crăciun Florina* Tehnici de comunicare, Edit. Upress, 2008, Cluj-Napoca, România.
[3] *Sebeok, T., A.*, 2002, Semnele: O introducere în semiotică, Editura Humanitas, București.
[4] *Shannon, C.*, 1948, A Mathematical Theory of Communications", Wikipedia.
[5] http://www.trussel.com/saint-ex/stamps/prince.jpg