INTERNATIONAL CONFERENCE ON ENGINEERING DESIGN, ICED'09
24 - 27 AUGUST 2009, STANFORD UNIVERSITY, STANFORD, CA, USA

BEYOND USER-CENTERED DESIGN

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ABSTRACT
The evolution of matter in the universe and biological evolution on Earth gave rise to humanity. Now, humanity has begun to direct evolution by means of artificial biological or technological systems. Technology has become increasingly powerful. It has augmented the capacities of the senses and has boosted mental faculties. Technological development will continue and new, more complex, automated products will be designed in an effort to produce ideal functions. However, technology has an aim and must also have some limits, in order to preserve the security of people or the environment.
Designers of technological systems have developed machines and established methodologies to improve the man-machine interaction, which has led to the concept of user-centred design.
This article discusses the principles that must guide the designer in the light of recommendations or international treaties. In addition, some methods for the basic structuring of the designer's activities are discussed and names are proposed for a new form of design that goes beyond the user.

Keywords: technology, biology, evolution, environment, politics, global-centred design

1 INTRODUCTION
The study of fossils on Earth and matter in the universe leads to greater understanding of evolution. The social and technical history of humanity shows how mental capacities have served to dominate the Earth. This has mainly been made possible by the design of technologies, whose rate of development was initially gradual and incremental, but is now increasingly rapid.

1.1 The biological evolution
Natural structures have evolved in a sophisticated way, from which we still have a considerable amount to learn. However, evolution also led to the disappearance of some species, which can be investigated by studying the fossils that have been preserved.

The adaptation of living beings to the environment became increasingly sophisticated, and eventually humans arose with thought, self-awareness and awareness of the surrounding reality. Human nature is both splendid and imperfect. Its splendour can be seen in health and quiet contemplation of nature, experiences of positive feelings, the ability to think logically, memory, friendship, music, imagination and creativity. Its imperfection can be found in the physical limitations of humans, the difficulties underlying some human relations, the management of thought and personality, and sickness.

1.2 Artificial evolution
The progress of humanity has been partly due to technical developments that have helped to overcome predators and control the environment—even humans' physical limitations. Such technical developments have been guided by the mind, which provides information on where the human is: in other words, what surrounds the individual and how to interact with it.

Technology has increased the energy and power that people have at their disposal, which has enabled them to undertake certain activities. This process began in the Stone Age, when stones were used as tools for digging, carving and cutting, and as weapons of war. In addition, the ability to make fire was a great element of differentiation and superiority at this time.
The current technological age of humanity arose during the industrial revolution, with the advent of the steam engine, which dramatically increased the available force. Prior to this, force had been provided by animals, the use of wind in sails or windmills, and water wheels. Now, key factors are the

use of oil and the mastery of atomic energy from fission. Humanity is close to fully controlling atomic fusion (Figure 1) [1], like that which takes place on the Sun. Hydrogen technology has also been developed, as has renewable energy (Figure 2), which is easily distributed, ecological and inexpensive. Currently, humanity can access the energy it needs, using appropriate technology that does not necessarily involve fossil fuels.

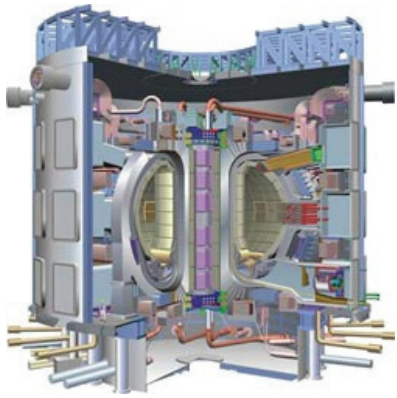

Figure 1. Section of the core of the ITER project (ITER organization)

Figure 2. Solar panels to provide hot water and heating

In addition, technology has helped humanity to increase its awareness and its ability to capture information from all the human senses. Some of the benefits of the senses have been enhanced by technology.
For example, the function of the visual system has been developed to enable greater access to the electromagnetic spectrum. Very small particles can be seen with the help of microscopes, and very distant objects can be observed using telescopes (Figure 3), [2]. Vision is possible in dim light, due to night vision technology, and in very intense light, such as that of the solar surface. In addition, vision can be transmitted over distances. Thus, a broad spectrum of information can be accessed.

Another kind of technological aid is computer technology, which at present enables us to overcome limitations in the speed or ability of certain human mental functions, such as calculation or memory in information processing. Artificial intelligence is another emerging field. Currently, for example, a robot can be directed with thought alone by means of a brain computer interface (Figure 4) [3]. Computer technology boosts some mental characteristics of humans.

Figure 3. Hubble telescope, NASA. (Wikipedia)

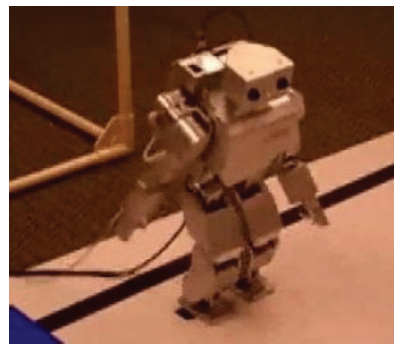

Figure 4. Researchers at the University of Washington can control the movement of a humanoid robot with signals from a human brain.

Therefore, artificial technology boosts human muscle strength, extends the capacity of the human senses, and provides help with some mental abilities. Some of this technology has been applied to replace humans by machines in the most heavy, dangerous, boring or monotonous work (Figure 5).

Figure 5. Heavy machines at work (from Caterpillar)

In addition, technology provides technical assistance in the home, enables people or things to be transported, and contributes to security, health and communications. It can also enhance mental and emotional processes, for example, through music equipment, movies, etc. Although happiness does not only depend on material well-being, this technology can make life easier and richer in cultural possibilities.

Technology has yet to learn much from the nature of evolutionary solutions, their diversity and adaptability. It has made great progress in the past and will continue to do so in the future. Everything suggests that technology will continue to evolve to increase well-being and mankind's potential. People want to have ever better products, which means improving technology to provide product designs that are more effective and cheaper. Society desires these quality products and the economic structure makes it possible to provide them. In a deeper sense, the designer, like a medical doctor, wants to improve the human condition.

2 THE CURRENT CROSSROADS

Humanity has discovered natural laws through research work. It has been, and is, responsible for its own progress, due mainly to the technical aids that it has designed and developed, and even through its errors, limitations and successes.

The evolution of matter and life continues its natural course, but humanity is beginning to affect this development on Earth through the use of the technological systems that it has created. Such systems can enhance physical systems and improve biological conditions. All activities can be affected by human progress, but this process is not without risks.

Generally speaking, technology is different to science. Science searches for knowledge, whilst technology applies knowledge to make something. Therefore, technology is not neutral. It has a purpose and can entail benefits or disadvantages for someone or something. In this respect, technological design requires ethical principles. Thus, "good" technology can be called positive design, correct design or right design to distinguish it from "bad" technology, which can be called negative design, incorrect design or wrong design.

Recently, we have become aware of the environmental limitations of the Earth, which is affected by human actions that have an impact on the environment that supports life and can degrade it. This is an important issue of which we must be aware. A related issue is the concept of sustainability [4], in which Life Cycle Assessment (LCA) is the main methodological tool.

Currently, humanity has reached various crossroads: the crisis of water, energy, food, climate change, demography, weapons of mass destruction, etc.; the meeting of civilizations with their diverse beliefs and cultures; changes in some values that guide human groups, etc. It is essential to respect social plurality, to have a good distribution of resources and potential wealth, and to be aware of the environment. All these crossroads affect designers and the available technological designs.

3 POSSIBLE SCENARIOS FOR THE FUTURE

Humanity in its evolutionary success has achieved enough potential to dominate the world and ensure the progress of humans against many odds. For example, humanity is beginning to ensure its survival against major natural disasters, such as large meteorite falls.

Part of the constitution and functions of biological systems have been discovered. Genetic sequences can already be changed or modified and new combinations can be created that do not exist in nature. Biological evolution, which has occurred slowly over time, is now in the hands of humanity, which can accelerate it. Genetic diseases may be cured in the future, and physical or mental faculties could potentially be enhanced, but this leads to several major ethical dilemmas.

Everything indicates that technical or artificial systems will continue to increase the force that is available, and to improve manufacturing, as well as communications, transport, energy and their

management. Technology may be used to improve the well-being and culture of humans or, in the worst-case scenario, to subjugate and destroy.

Some of the new science and technology areas, such as nanotechnology, biomedicine, biotechnology, neuroscience and quantum theory, have great potential. In the future, hybrid biological-artificial beings may exist that are a mix of biology and technology, or some biological beings may be replaced by artificial ones. In the past, these ideas were only explored in science fiction [5]. Robots will evolve and will be able to do many jobs.

Today's society may be moving towards post-consumerism in developed countries. Paradoxically, in this period the material structures will be more complex and automated, which will give people freedom from material dependence to enjoy the values of the spirit—the rational mind combined with sensitive or emotive values that is the essence of the human being.

Therefore, there are some complex future scenarios, in which some old social structures and beliefs may change, due largely to scientific and technological advances. There are many diverse future scenarios with many potential changes. Progress towards knowledge and some of its possible interesting applications seems to be the way forward. Although there may be risks, it is important to ensure that they are never excessive.

In these possible future scenarios, the designer who normally works for a company would give great importance to promoting well-being through the design of technical products, and to supporting scientific knowledge. On the other hand, they could design sophisticated weapons, objects that do not take environmental issues into account, etc.

The complexity of the world and the increasing complexity of products should be interpreted and designed in complex multidisciplinary teams. Designers must have the methods and knowledge required to make world-class products. Several scenarios can be conceived, as there is uncertainty about how to respond to many issues and the changing paradigms. However, designers have an important role at this time of change and must have some standards that they can apply in their work. They may need to develop a code of ethics, such as that used by doctors. In addition, society must be aware of the fact that safety and sustainability criteria may need to be applied to products that are designed and produced by companies. Such criteria are outlined below.

4 THE USER AT THE CENTER OF PRODUCT DESIGN

Companies that design and sell products need to maximize profits and are in constant competition with other companies. The outcome of this competition is constant product innovation, which benefits the end user, who can purchase increasingly improved products.

Consequently, much of the theory and practice of design is currently focused on the user. For example, an effort is made to improve the user-product interface and to meet the user's needs or desires. Design for users or user-centred design [6] is based on several methodologies or techniques. For example, the following have been developed:

- User analysis, which considers all possible users of the project, or the product, and their requirements in all life cycle phases.
- Ergonomics that are based on anthropometric studies to better accommodate the user interface product.
- Methods have been developed for asking users their opinions and requirements for a particular product and for translating the language of users into technical language, for example through quality function deployment (QFD) [7].
- The reactions of users to new products are analyzed to enhance their interactions, for example through the Usability Test [8].
- The ability to customize products for an individual user within an industrial production (mass customization) has increased.

- Psychological techniques have been developed to capture the deepest desires and emotions of the individual users of products in order to improve them.

Many other user-centred design practices have made products more accessible, easier to use, more user-friendly and more readily available.

5 DISCUSSION

Users take a central role in product design, and designers seeks their appreciation of new products [9], as they are the end customers. Thus, user-centred design is justified. The authors who teach some of the user-centred methodologies mentioned in Section 4 and those who work in ecodesign [10] have led research in these areas, and have progressed in their user-centred design goals, shifting the focus from large populations to groups of users [11], [12], and towards the ultimate goal of taking the desires of individuals into account [13], [14].

In this evolution towards design for individuals, a major question arises: do user-centred design methods imply that the user must dictate all of a product's design? Or is the user the ultimate reason for making product designs?
Some contradictions and conflicting interests arise between individuals or groups and the whole. For example:

- Many people want faster and more powerful cars. However, such cars consume more fuel, which produces more pollution and reduces opportunities to save or share the remaining fossil fuels.
- Users may prefer lamps with incandescent bulbs. However, such bulbs waste energy in comparison with energy-saving bulbs, or LED lamps with a similar light intensity.
- People may want to have very large houses. However, such houses require more raw materials, consumer goods, etc.

In addition, there may be conflicts of interest between the majority and some smaller groups. For example:

- Popular pressure through international treaties has made cluster bombs or anti-personnel mines illegal.

These examples show how conflict can arise between individual or group interests, and the general consensus in international organizations, international agreements or treaties. This can lead to some limitations in the design and use of specific products. Who sets the limits for product designs? What criteria are used?
Figure 6 illustrates a product that is designed exclusively for an individual user (UC-design) and one that is designed for an individual user with awareness of other people or environmental concerns (global design, or G-design).

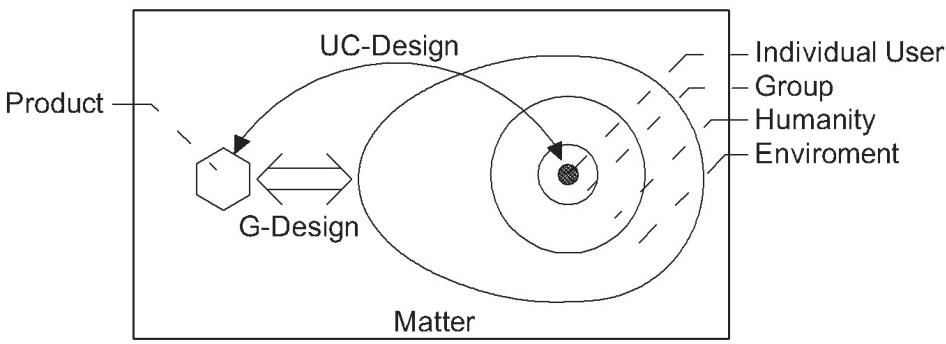

Figure 6. Products for users in a global context

A democracy's politicians, who are elected by the people as their representatives to work for the interests of all, should have the last word. They should establish laws or rules to limit product design, so that all design is for the common good. Democratic solutions should be devised by politicians from the nations that are in international organizations. Global problems should have global solutions.

Some policies have limited technological possibilities in the past. For example, several years ago, the use of CFCs in refrigerators or air conditioning units was banned, as these gases ultimately affect the ozone layer, and contribute to the ozone hole [15]. A ban on the production of incandescent bulbs is likely in some European countries and elsewhere in the world. International treaties and non-governmental organizations (NGOs) are promoting the elimination of certain weapons. Many rules have been established for the safety of people or things, and this trend will continue in the future.

International standards could be used to restrict the boundaries of design for certain products, for example, in relation to their impact on the environment. The cost of products must take into account the cost of their environmental impact. Therefore, the ultimate design does not just satisfy the desires of some users, but first limits those desires according to international agreements. These restrictions ultimately benefit the entire world, including individuals and their offspring.

Methodological advances in user-centred design must continue. Such methodologies should be applied and improved. However, politicians in interaction with scientists and technicians should create a framework of restrictions.

Consequently, a new concept needs to be defined. Its nomenclature must reflect the concept of user-centred design in the broadest sense, but within a framework of recommendations or limitations that are imposed internationally, as discussed below.

6 CONCLUSIONS

Several methods are available for product design and many terms are used to define design activities, some of which can lead to confusion. To order the concepts, it is useful to reflect on where we come from and where we may be heading.

This article has outlined some of these considerations with respect to the design community. We have reflected on the technological development that boosted human progress in the past, promotes it in the present and will probably continue to do so in the future. Several different directions could be taken. In all the scenarios, the designer was, is, and will be a main actor in the field of technology.
We have discussed the evolution of some user-focused design methods, such as: user analysis, ergonomics, QFD, usability tests and psychological techniques to capture desires or emotions. We have also mentioned the evolution of some environmental design methods, such as Life Cycle Analysis (LCA), ecodesign and sustainable design. In addition, we examined the ultimate purpose of a design, in terms of individual or group desires, compared with its advisability on an international scale.

There should be a compromise between the individual or group and the global community. The international collective must impose certain limitations or a framework on individual or group desires. User-centred design is a good philosophy for guiding the designer, but it is not the ultimate philosophy, as the designer must understand the reality and the policy framework that affects the design. Limits should be related to environmental impact and excessive wealth.

Thus, product design should focus on users, but also on globally accepted, international interests. This type of design could be called global-centred design or global design (G-Design); international centred design, or international design; respectful design; or secure design. This type of design supersedes others, such as weapons, that do not take into account the environment or are detrimental to people and things.

One organization that could be responsible for defining and naming this technology is the United Nations (for example, UNESCO) or the International Organization for Standardization [16], in collaboration with the Design Society.

Technology is an asset for the future. Politicians, supported by scientific and technological recommendations, should ensure the common good, which includes the safety of people, things and the environment. Thus, the framework within which products can be designed should be limited.
If individuals have enough information on environmental limitations, they may fully accept the international constraints. However, some individual freedom must be ensured.

Product designers apply scientific discoveries and are involved in technical developments. They use their imagination and creativity to design new and better products. Although their initial purpose is to maintain and grow the companies in which they work, their technology will end up being for all.

Design that is focused beyond the user should be included in courses for future designers.

In summary, the designer and the design community in general will continue to improve the classic user-centred design, but will have to take into account international norms, for example on sustainability, security, or wealth. The following are important:

- To know the international reference values for product design.
- To collaborate with international politicians to define boundaries for product design.
- To work to unify the vocabulary for design activities.
- To teach and discuss these issues with future designers.

All of this is required to ensure that design has a high level of quality and safety worldwide. The design of technology has a great effect on society. In a globalized world, it may be a way to achieve a win-win situation for different groups, with no detriment to people or the environment.

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