ASPECTS REGARDING THE CONNECTIONS BETWEEN CLASSICAL ENGINEERING AND VIRTUAL ENGINEERING

Ionel Staretu[1]

[1]*Transilvania University of Brasov, Brasov, Romania, e-mail: staretu@unitbv.ro*

Abstract: *Virtual reality is considered one of the fundamental directions, with computers and robotics, to reconfigure the global society in this century and even further, as one solution to overcome the current structural crisis, deep crisis with multiple consequences, most negative. This paper describes a possible involvement of virtual reality to shift from traditional engineering to virtual engineering to solve in a significant manner, the current crisis of manufacturing engineering. Thus, we present the general structure of a virtual engineering entity, the main activities and organizational structures, and we briefly review the main types of virtual reality equipment and technologies useful for our purpose with highlighting a specific direction, namely virtual engineering for services and environment.*

Keywords: *classical engineering, virtual engineering, virtual technologies, design,manufacturing*

1 Introduction

Virtual reality is considered one of the fundamental directions, with computers and robotics, to reconfigure the global society in this century and even further, as one solution to overcome the current structural crisis, deep crisis with multiple consequences, most negative. One of the main aspects of this crisis, less evident, is related to product manufacturing techniques and technologies, e.g. [1],[2],[3],[4].

Concrete, solutions used to manufacture most products have remained significantly behind other sectors development, of general human activities such as creation, processing and transmission of information, general circulation of goods (products and services), interpretation of human society and nature in general, human mentality etc. The main aspect of the manufacturing lag refers to the existence of yet another important role of the human factor. Through its specific behaviour, it leads to violation of structural and functional features of the other technical means of processing, technical means of handling and transfer, equipment and processing

technologies of technical and technological information pertaining to product design, technology design and technology management, product testing, transport to the beneficiary, maintenance and technical support during product life, etc.. In this approach, with the actual products, we include as well most services. In the context of the above, virtual reality can be a solution, which, at least in part, can eliminate the sluggishness of manufacturing engineering in general.

This paper describes a possible involvement of virtual reality to shift from traditional engineering to virtual engineering to solve in a significant manner, the current crisis of manufacturing engineering. Thus, we present the general structure of a virtual engineering entity, the main activities and organizational structures, and we briefly review the main types of virtual reality equipment and technologies useful for our purpose with highlighting a specific direction, namely virtual engineering for services and environment.

2 General Structure Of A Virtual Engineering Entity

An entity based on virtual reality equipment and technology has a certain similarity with a current organization, with the important distinction that all activities, from the idea for a product or service to the final documentation required for practical achievement, manufacturing, new product or service. Its implementation is also involved and everything is resolved through appropriate solutions based on virtual reality.

Manufacturing, as phase of physical manifestation of the product, takes place outside the virtual engineering entity in an appropriate location, usually computerized and robotized, with a great capacity for reconfiguration, where the human factor has only a support role both in periods of use and conservation until a new order.

As far as this material is concerned, the simplified structure, by activities, of a virtual engineering entity is given in Figure 1.

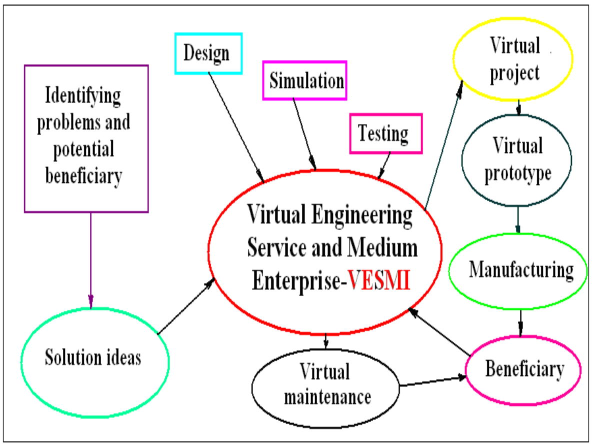


Figure 1: The structure of the activities of a virtual engineering entity

This entity carries out the activities mentioned below in appropriate sections. The first one is identifying problems of behaviour in market prospecting. Then there is finding the optimal solution in the section of creativity and invention through design and simulation activities.

It follows the functional - design department through constructive design. Next, there are activities of technological design and virtual prototyping - department of virtual technologies.

We continue with virtual testing and technical evaluation activities of the functional and constructive performances, virtual testing and certification department. Besides, there are activities of identification of solution and location for manufacturing, manufacturer identification section (usually in close proximity to the beneficiary - as far as possible), activities of commissioning and delivery, delivery and implementation section, maintenance and technical assistance activities along the life of the product, remote compartment of technical support online.

Thus, an entity of virtual engineering practically provides a virtual product, including all technical documentation necessary to its manufacture (once obtained this project similar to the current one, corresponding to the series 0, a manufacturing solution is identified and the location can be virtually at any distance, preferably near the beneficiary). One moves to that stage, where corrections are performed on the computer too. Once done, the physical product is delivered to the beneficiary and receiving and commissioning steps are covered. During the life of the product, technical support, maintenance and, even, any repairs will also be performed online by the entity's virtual maintenance department VESMI. A direct consequence of such an approach is the possibility of decoupling design in the broadest sense of design, from the production stage, which can be performed where a solution is identified, financially and qualitatively affordable, as well as from the distance from the beneficiary point of view. Obviously, virtually, possibly online too, maintenance activities can take place throughout the product life.

In addition, it is not without interest to separate more specifically the concept above in the form of *virtual engineering for services and environment.*

In this way you can tackle globally activities that exceed the service area in the current sense, by including in their category of manufacture too, and of related issues including proper training, and management activities dealing with environmental problems: analysis, protection, configuration and reconfiguration, especially but not only in residential areas.

Thus, one can study various scenarios likely to develop or restructure the environment piecewise or globally, on short, medium and long term.

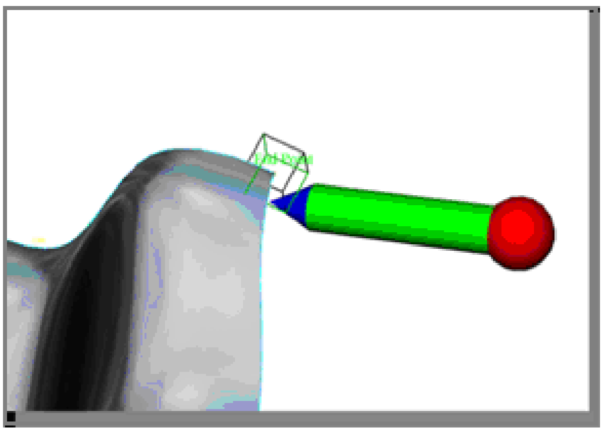
It is not less important the possibility of virtual reconstruction of existing situations in the past and likely in the future, including the possibility of dynamic change simulation by introducing virtual time (such as an urban area, a city, village or other settlement otherwise, but also an existing natural area in the past or future estimated to be). There, the immersion in interior spaces and the outer ones as well and interaction with the virtual scene components can lead to a perception and experience totally unique including cognitive aspect.

3 Main Types Of Equipment Recommended For Specific Virtual Engineering Activities

3.1 For design and functional simulation

Design work is typically conception and project activity including in wider sense functional and constructive design, e.g. [5].

For design we already use advanced software like CATIA, Pro-Engineering, AUTOCAD, SOLIDWORKS etc., that for certain issues can turn to specialized software such as the finite element ones: NASTRAN, PATRAN, etc., see Figure 2, e.g. [6].

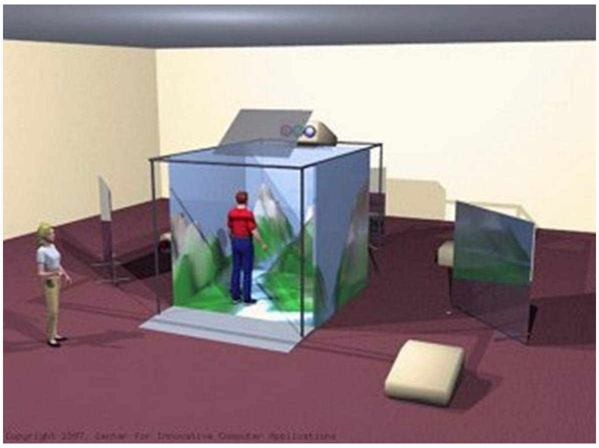


a

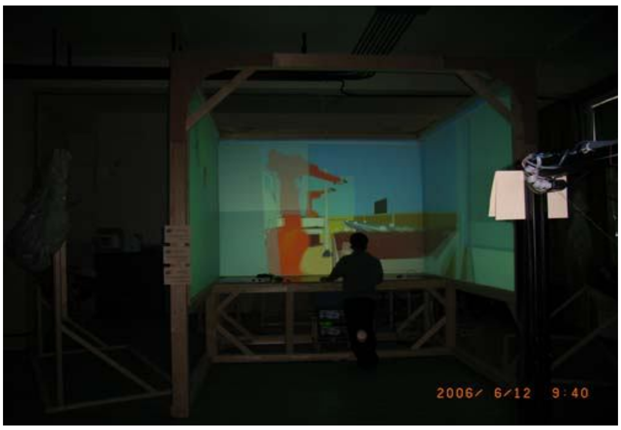
b

Figure 2: Virtual design: special device (a) and an example to use its (b),e.g. [6]

Functional simulation is even more significant as it can be with return of force and can use real virtual reality versions, as increased virtual reality or improved virtual reality.



a



b

Figure 3: CAVE equipment: general strucrure (a), e.g. [7] and used at robot simulation (b), e.g. [8]

Following these simulation we can make suitable improvement so that approximation of the optimal solution of the product or service should be maximum.

3.2 For virtual manufacture - virtual prototyping and testing

Production simulation can be fully realized in virtual environment, e.g. [9], [10], [11], [12], [13], [14], [15], [16], [17], [18], [19], [20]. The whole succession of technological stages, hence of the operation of handling and transfer and processing can be simulated in virtual environment, even if currently there are not performed simulations for all the physical-chemical processes specific to manufacture and transfer (see Figure 4).

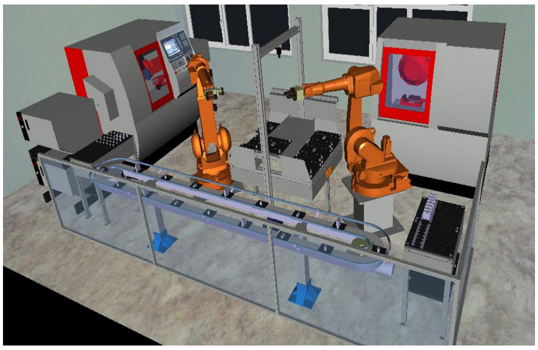


Figure 4: Virtual robotic cell for manufacturing and transfer, e.g. [21]

They are already solved and operational (virtual simulation can already be highlighted in the case of the physical and chemical process of a welding operation, namely electric arc cutting and processes specific to alloy casting). An important direction is the virtual simulation of the cutting processes (processing) of different metallic materials (turning, milling, drilling, threading, grinding, etc.), non-metals (wood, plastic) or composite materials, simulation of forging and hot or cold cupping etc.

Virtual simulation of most technological processes should be a priority for research in the next step.

Virtual testing is also very important view the high costs of testing of real prototypes, e.g. [22],[23].

In this direction, achievements are important as one can discuss complete virtual solutions for virtual prototyping testing like virtual cars(see Figure 5) from which solutions can be extrapolated successfully to other types of products and even services.

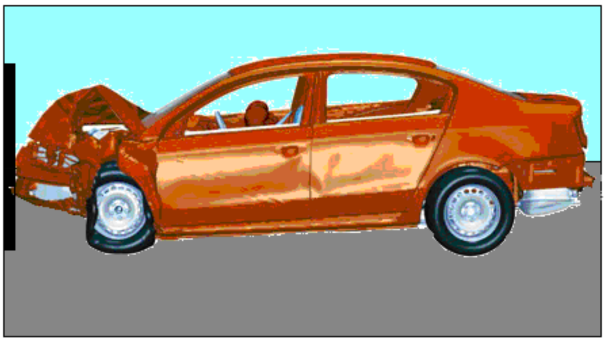


Figure 5: Virtual testing of the car

3.3 For maintenance

Having the virtual model of the product, all maintenance activities, including the replacement of defective parts can be simulated in the virtual environment. Even if current attempts have met some difficulties and led to some scepticism, solutions in the next period will successfully solve all the current problems. Thus, maintenance can be achieved on the virtual product online with the actual product (see Figure 6: an instructor can track all trainees in the field using a free view camera available as a window on the instructor station, e.g. [24]).

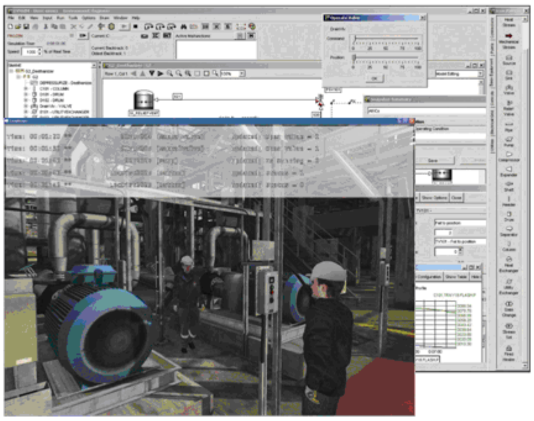


Figure 6: An example of virtual mentenance, e.g. [24]

It is similar to virtual remote surgery. This example is not exaggerated, view the maintenance, including in the case of equipment operating outside the Earth, such as satellites and circum-terrestrial stations, but they can operate as well in hostile environments, such as seas and oceans at great depths (e.g. interventions in the underwater infrastructure of a sea platform, aboard a submarine, etc.).

3.4 To promote products and services

Virtual promotion opens special perspective because the product can be presented fully in the work environment, but also in hypothetical environments and situations, and it may be presented possible alternatives, identifying specific advantages. It can be made available to interested parties by means of remote transmission of information.

One very important application is to virtual exhibitions e.g. [25], see Figure 7. The main advantages for virtual exhibitions are: modern promotional online method, for the first time in the auto parts sector, gives the chance to promote the products of each exhibitor , seeks to bring in contact the companies and the buyers, in an easy-to-use and direct environment, like the internet and everything about car parts, as well as the latest services in the automotive sector, presented in a single space, etc., e.g. [25]. The main objectives are: to stimulate the interest of the wider public, with its originality and innovation, to become the annual online meeting point and to support agreements conclusions between exhibitors and visitors, etc., e.g.[25].

For example the the first **virtual exhibition AutoP-Expo 2011** had host up to 500 exhibitors with products and services, such as: auto parts and systems, repair and maintenance equipment, lab equipment, bodywork and car painting, car washing, sound and accessories, IT parts and electronic management, environmental protection, energy-saving, new products, quality certification, banks, financial organizations, insurance companies, media, associations, etc.[25].

Figure 7: Virtual exhibition, e.g. [25]

Evidently, a virtual product in the future will be tested and used online for a limited period, including with return of power, remotely, similar to the current situation of trial use, after which the product may be returned. Evidently, a virtual product can be changed on demand and practically adapted to him/her as a customized product, with costs much lower than today for similar activities.

In this way, training activities, development and increasing of functionality and utility of products and services get a continuous character in a much more efficient way than today.

4 Conclusions

Based on the data presented in this paper, we can draw two important conclusions:

- Traditional engineering, particularly manufacturing, is in crisis despite the powerful promotion of simultaneous engineering and re-engineering;
- Virtual engineering in a global approach can be a viable solution to overcome the current critical situation, particularly of manufacturing engineering and new release of engineering. It is possible primarily by uncoupling steps to virtual prototyping from the actual production and the transition to a stage when interaction between the customer and the virtual product can acquire new meanings with optimization effects on functionality and efficiency of use in the case of financial resources, at occupational level, very important.

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