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INFORMATION-BASED DECISION MAKING IN ENGINEERING DESIGN PROCESS

Dr. Sc. Shaban Buza
University of Gjakova "Fehmi Agani"
Ismail Qemali, nn, 50000 Gjakova
Republic of Kosova

Dr. Sc. Kastriot Buza
Faculty of Education, University of Prishtina
Agim Ramadani, nn 10000 Prishtina
Republic of Kosova

ABSTRACT
The engineering design is a process that includes problem definition, synthesis, analysis, optimisation, representation and prototype building. The solving of problem requires creativity and science based knowledge of the engineering designers in finding, collection, selection and use of "right" information. Rapid development of computer science and information technology assist the solving of engineering problems with new computer-based design tools enabling quick execution of the design steps and on searching for the information.
Engineering designers use and repeat a series of design activities as many times as needed to create alternatives of solution according to specifications and constraints before making decision for "the best" solution.
A good decision in engineering design process is one that is "the best" solution for engineering designer from the alternatives he got, information he possesses and the preferences he assesses.
In the paper is elaborated an information-based decision making methodology in engineering design process through "FPU-Info" algorithm. This methodology helps selection of the best alternative from a step to step bringing to the best solution for the engineering design process as a whole.
Keywords: Engineering Design, Decision Making, "FPU-Info" Methodology

1. INTRODUCTION
In general design can be addressed as a process by which ideas and creativity are translated into objects or artifacts. Engineering design is multi-phases process with open-ended activity and many questions coming up one after another, starting from problem definition, process related directly to technology or science, representation and decision making.
Engineering designers through education programs and design experience get required knowledge, skills and competences on scientific and mathematical theory, engineering applications, design and problem-solving skills, communication skills, new technology applications…The development of design process and an understanding of design methods are of crucial importance for successful solution of a design task/problem.
In engineering design process, *Figure 1* the decision making can be regarded as the process resulting in the selection of "the best" solution among several alternative possibilities. Engineering designer selects "the best" solution based on information, criteria and constraints.
In this paper is introduced combination of two methodologies: TAEC - Task (T), Alternatives (A), Evaluation (E) and Challenge(C) methodology and "FPU-info" (**F**ind – **P**rocess – **U**se – **Info**rmation)

methodology that helps the engineering designer and his team to make accurate decisions on use of information at every phase of design process.
The combined TAEC + "FPU-Info" methodology is elaborated for two case studies: design and manufacture of Swing Seat for disabled children and design and manufacture of RobDet – a device for detecting of unexploded devices. Based on these case studies it is concluded the combined methodology can be used successfully and for other design cases.

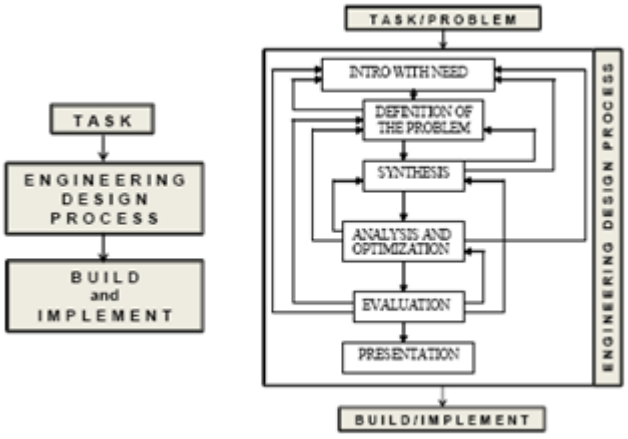

Figure 1. Engineering design process

2. DECISION MAKING IN ENGINEERING DESIGN

The quality of a decision rests on having framed the decision correctly, that is, answering the right question, understanding the issues (knowledge), what can be done (options), and what you want (desired outcomes) [1].

2.1. Decision making methodology – TAEC

The decision concerns on:

- Carefully definition of design problem
- Searching and generating for alternatives
- Selecting "the best" solution based on evidence and criteria
- Making sure "the best" solution has been chosen

This four concerns would be adopted respectively as Task (T), Alternatives (A), Evaluation (E) and Challenge(C) and would represent the adopted methodology named TAEC and will be used on elaboration and analysis of design process in two case studies.
Based on processed information on the task with this methodology engineering designer estimates what design procedure needs to follow to easy and successfully complete the process.

2.2. "FPU-Info" Methodology

Accurate information for the problem/task under design and information technology are crucial on selecting proper hardware and suitable software to aid the design process.
Based on such a concept is built "FPU-info" (**F**ind – **P**rocess – **U**se – **Info**rmation) flow algorithm, Fig. 3 to help the engineer – designer and his team to make accurate decisions on proper use of information at every phase of design process.
The process at the "FPU-Info" methodology shows four possibilities that a found or given information:

- Can be used as it is (same geometry, same material, same functionality and same constraints) without change – "existing" or "old" information (element);
- Can be modified to desire information (modified geometry, same or different material, same functionality and modified constraints) with modification that keeps same functionality for modified geometry and constraints and chosen material - "modified" or "adopted" information (element);
- Is not acceptable nor as it is nor as modified, it is needed to build new data/information (new geometry, new material, new functionality and new constraints) - "new" information (element);
- Or new information do not fulfils design criteria the new search for a new information will start at the certain phase of engineering design process.

In the *Figure 2*, is given combined methodology TAEC+"FPU-Info" that can be used at different phases of engineering design process or at process as a whole.

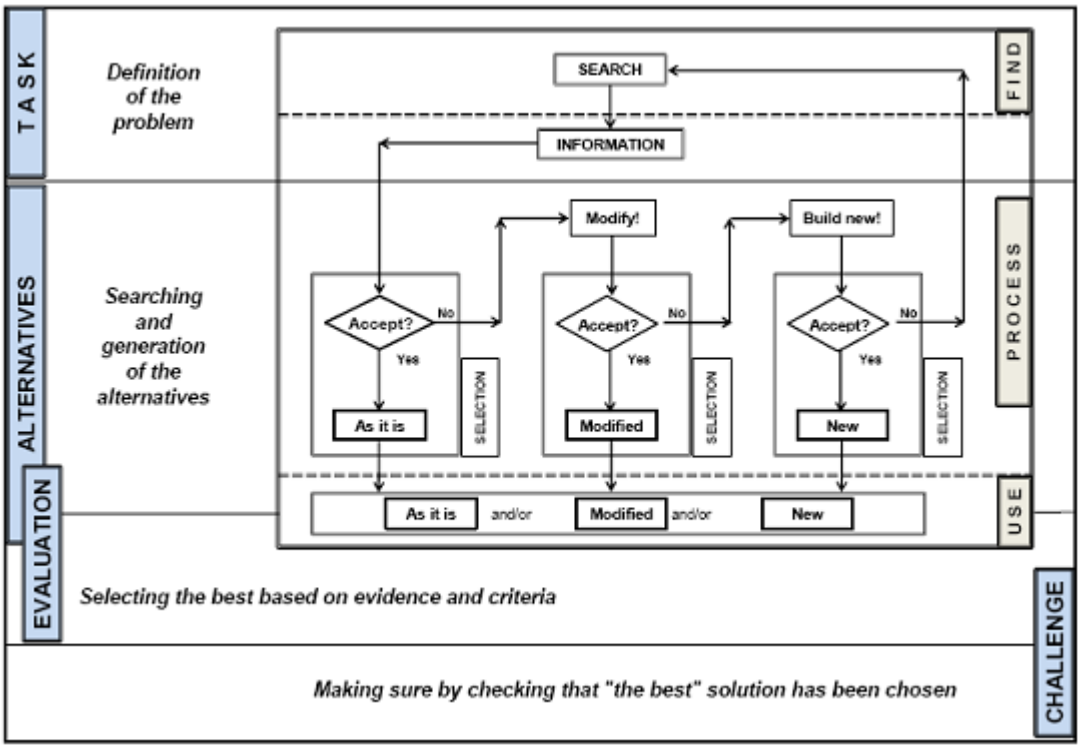

Figure 2. TAEC and "FPU-Info"

2.3. Information-Based Decision Making Methodology – Case studies

Methodology is used during the engineering design of the RoboDet (Robot for Detection of unexploded devices). In *Figure 3* is shown only the phase for design of wheels of RoboDet.

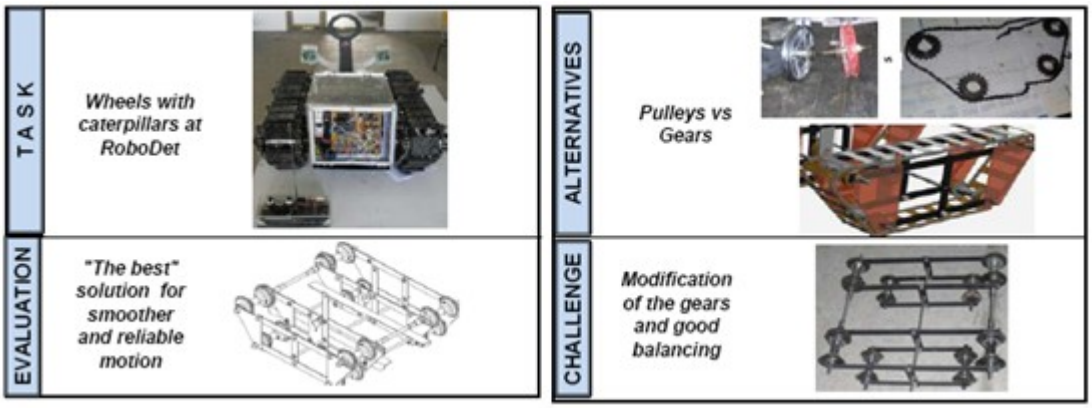

Figure 3. TAEC+"FPU-Info" methodology for RoboDet

Combined methodology is used during the design of the removable swing seat prototype for children with disabilities, from the idea to its final production, from the engineering design process as a whole, *Figure 4*.

Figure 4. TAEC+"FPU-Info" methodology for Removable Swing Seat

3. CONCLUSIONS

For accurate, efficient and successful engineering design process engineering designer/students need to use information properly, have interdisciplinary knowledge, skilled on modern technologies and suitable for teamwork.

To facilitate in the engineering design process it was compiled an methodology called TAEC+"FPU-Info", a combination of Design Making methodology TAEC and Information searching methodology "FPU-Info".

This methodology is used at each phase of engineering design process with respective outcome. It is clear that design outcome of the preliminary phase is input for the following one and it is subject of different information based on design phase activities. But, of course it can be used for process as a whole.

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