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DECISION MAKING FOR THE 'BEST' SOLUTION DURING THE OPTIMAL DESIGN OF THE ELECTROMOTOR

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ABSTRACT
The optimization of an electromotor as a very important part of a machine gives many solutions. Among many other challenges for an engineer during electromotor design is to choose the optimal or 'the best' solution. Engineer – constructor becomes decision maker.
The mathematic model of rotating shaft analyses deflection and stresses taking into consideration the influence of mechanical, electric and magnetic quantities.
Decision maker's task of choosing is of great importance during the optimal design of the adopted mathematical model of electromotor. Making a decision implies the consideration a number of constraints and criteria during the evaluation of the set of solutions.
In the paper, criteria and constraints has been elaborated in details for dimensions pre and after optimization enabling thorough analysis of the adopted model of standard T80 electromotor.
Key words: Electromotor, Decision Making, Rotating Shaft, Optimal Design, Criteria and Constraints

1. INTRODUCTION

The electromotor is a very important part of a machine which converts electrical energy to mechanical. Its design process presents a "provocation" and "challenge" for an engineer – designer/constructor, who among many tasks needs to make many decisions for getting "the best" solution.
The design is a process with many questions coming up one after another, starting from problem/task introduction, design process itself and those related directly to technology or science. The designer needs to think, wonder and decide when solving design problems. This complex task should be put through a procedure/methodology with certain stages that can be used during all design process with needed accuracy that will bring to successful finalization of the design.
In the paper is described the decision making theory and its appliance during the all phases of a design process. An adopted methodology of decision making has been adopted and applied in depth during the design process of electromotor, starting from the dynamic and mathematical model under relevant criteria and constraints, its simulation and optimization and analysis of the behavior of electromotor pre and after optimization.

2. DECISION MAKING IN DESIGN PROCESS

Solving the problem during the process of designing, for the designer arises a number of question such are:

- Where to start? What is the procedure?
- Is it new or former/existing design?
- Can be followed procedure from manuals or standards?
- What is a procedure for making a new design?
- How to define design problem and set design goal?
- What are quantities and what variables – free or dependent?
- How do we set constraints?
- How each item designed looks/should look in drawings?
- What shape and structure would have a product based on a design?...

These and many other questions are related to technology or science but most of them are about the design process itself.

Less "creativity" is needed if design problem is "old" or "former" design. In these cases start of design is known, only the "design procedure" needs to be followed and it easy to complete the design.

In creating the "new" design, there is no sample, no manual and no former design. The engineer – designer has to produce and decide on everything by himself. He must take into account geometry (dimensions, shape), structure (material), functionality and constraints (technical, economic, social, environmental, ethical etc.). So, the way how/what decisions are made are of most importance.

The decision concerns on:

- Carefully definition of design problem
- Searching and generating for alternatives
- Selecting the best based on evidence
- Making sure by checking that the best 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 of electromotor as a case study.

3. CASE STUDY: OPTIMAL DESIGN OF ELECTROMOTOR

The TAEC methodology on decisions is due to be used in all phases of the process of design presented in general form as in fig.1. It is understandable that engineer – designer must make a right decision at each phase before continuing to next one, otherwise must return back and do searching and checking for the reasons why phase solution is not the best or right one (iteration).

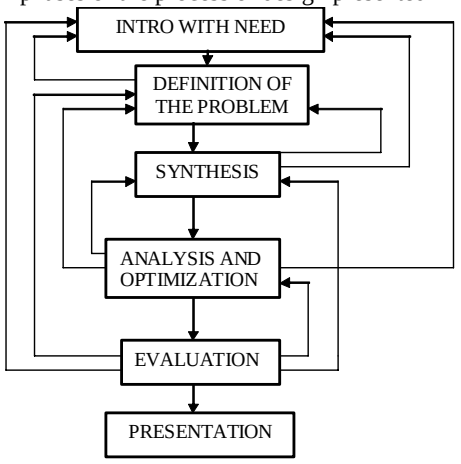
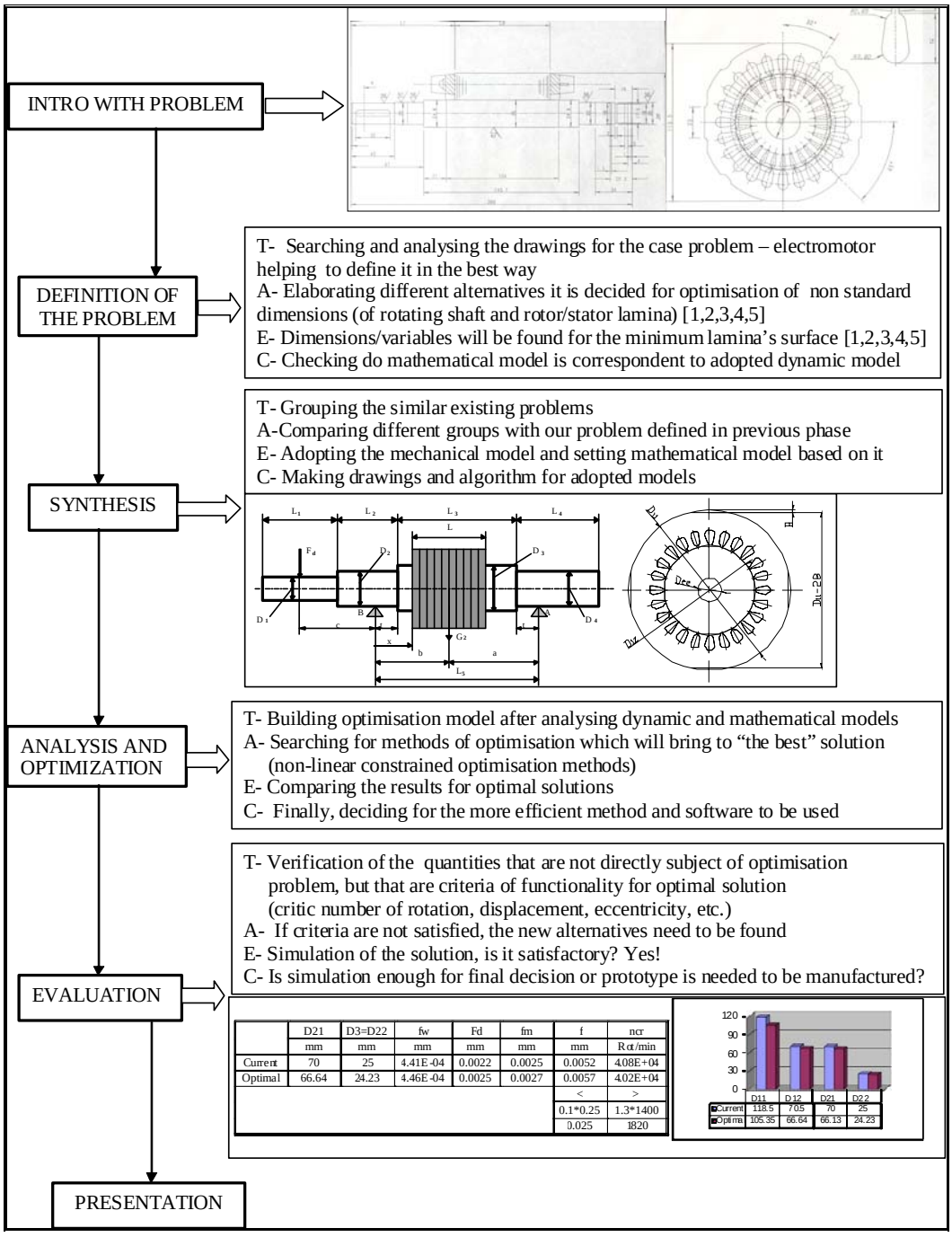


Figure 1. General design process

In this paper as a case study is elaborated optimal design of standard T80 electromotor. Knowing that standard motors have standard (fixed) dimensions, which cannot be changed for the certain type and quantities (dimensions) that can are changeable but must satisfy the criteria of exploitation, functionality and structure.

Based on decision making adopted methodology for decision making and above mentioned characteristics of the problem on case study, can be noticed that design process of electromotor can be modified to optimal design of electromotor, or as a case in which intention is optimization of some quantities or dimensions of the electric motor for adopted model under set criteria.



	D21	D3=D22	fw	Fd	fm	f	ncr
	mm	mm	mm	mm	mm	mm	Rot/min
Current	70	25	4.41E-04	0.0022	0.0025	0.0052	4.08E+04
Optimal	66.64	24.23	4.46E-04	0.0025	0.0027	0.0057	4.02E+04
						<	>
						0.1*0.25	1.3*1400
						0.025	1820

Figure 2. The TAEC methodology for optimal design of electromotor

The optimal design of electromotor does not present "a new" design, but it is based in existing type of electromotor. Despite that, a number of very important decisions need to be made during the adopting dynamic/mechanical model and as well as on building mathematical model (phases at fig.2), which

depends on a big number of constraints and criteria, taking into consideration rotating shaft's deflection and stresses, and the influence of mechanical, electric and magnetic quantities.

4. CONCLUSIONS

Based on theory of engineering design and of decision making at design engineering it is noticed that:

- The design problem/task needs to be clearly described (by drawings, technical data and demands) before engineer – designer decides to deal or not with it;
- The proper model for design needs to be build and search for similar model to specify is the design "existing" or "new", as a good base for further steps of design process and easy decisions;
- The right choice/decision at each phase of design process needs to be properly made; fig.1 and fig.2;
- Presentation of the solution, with results of analysis (of simulation or prototype) is of great importance to show that "the design is the best" solution for such a problem;

And analyzing results of design case – optimal design of electromotor with adopted the TAEC methodology for decision making based on previous theory, can be concluded that:

- Optimal design of electromotor is not entire new design process, but it needs a lot of creativity and proper decision, knowing that criteria of functionality, exploitation, sustainability and economic reasonability, among many needs to be taken into account;
- Proper adopted models (mechanical, mathematical and optimization) are good start for easier analysis;\
- Design case, described in depth in fig.2, proves that the TAEC methodology for decision making is good base for successful process;
- The results for optimal solution present a significant savings in material (rotor/stator lamina),, proving that decision making using the TAEC methodology during all phases of process design (especially at the phase of optimization as a direct task for the case of study) was proper.

Based on the outcome of the entire process can be concluded as well that the TAEC methodology presents a good base for using it in the other problems of engineering design.

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