ADAPTATION OF AN EXISTING SOLUTION FOR WORK IN NEW CONDITIONS – AN ANALYSIS OF THE METHODOLOGY

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Abstract: *The analysis of the problems to be solved in the engineering practice shows that the adaptation of an existing solution to work in new conditions is one of the most common design problems. For harvesting soybeans and other row crops in the country are widely used headers HPS produced by METAREM - AD Pavlikeni. They were created in connection with the introduction of technology for row harvesting of soybeans in our agricultural production, which is well known and widespread in the world practice. Through the analysis of the collaboration of TISEM - AD, Ruse and METAREM - AD on creating headers HPS, the contents of the engineering preparation for the production, is clarified. On this basis, a model (algorithm) to solve the engineering task of adapting an existing solution to work in new conditions is proposed.*

Keywords: DESIGN PRACTICE, HEADERS FOR HARVESTING SOY CROPS, DESIGN MODEL

1. Introduction

Using known methods for system design depending on the solved practical task is crucial for the convergence between theory and practice. The essential feature for the classification of methods for systems design in fundamental research that came out late last and early this century, is the level of innovation [6,7,8,9,10,11,12]. The systematization of methods for system design depending on the solved practical problem occurs rarely in scientific periodicals. The question for clarification and systematization of problems to be solved in the design process in terms of the companies has not found its common solution. Even a cursory analysis of this process shows that the design does not always begin from the "white sheet" and that in their practice design engineers solve problems of a varying scope and complexity.

As a result of earlier conducted studies it was found that in companies were solved three basic problems – an adaptation of an existing (turnkey) solution to work in new conditions, an improvement of a turnkey solution, a combination with precast or creating a new solution. On this basis a generalized model for the design of technical systems is proposed, which is obtained by combining (superimposition) of models (algorithms) for solving the defined four main problems of design [4]. The analysis of the tasks to be solved in engineering practice shows that the task of adapting existing solution to work in new conditions is one of the most common design problems. At the same time, a research on the content of this problem is also extremely rare in scientific periodicals.

For harvesting soy plantings and other row crops in Bulgaria headers HPS are widely used. They are manufactured by METAREM - AD Pavlikeni. They were designed in connection with the introduced technology for harvesting in rows of soy plantings agricultural production inland, which is well known and widespread in the world practice. Through the analysis of the collaboration of TISEM - AD, Ruse and METAREM - AD on designing headers HPS, the content of the engineering preparation for production, is clarified. On this basis, a model (algorithm) to solve the engineering problem of adapting an existing solution to work in new conditions is being proposed.

2. Design preparation for manufacturing of headers HPS

When harvesting soy crops using headers for cereals connected to self-propelled harvesters, huge losses of grain appeared. One way to reduce this is to use special headers. As a research result done by TISEM – AD, it has been found that in the world practice are used two types of headers for harvesting of soy crops - row type headers and headers for merged collection by a floating cutting apparatus. By research study it was found that row headers have a number of advantages over headers for merged collection. In addition to regular technology for harvesting soy plantings, in the conducted study in TISEM – AD, the structure and principles of the headers for row collection that are used most widely in the world practice, have been clarified. The study concludes with a recommendation that the engineering preparation of new production should focus on adapting of an available solution for operating in terms of Bulgarian agricultural production.

The introduction of row technology for harvesting soy crops inland is associated with the beginning of the collaboration between TISEM - AD and METAREM - AD for preparation for the production of a row header, by which simultaneously are harvested six rows of soy plantings planted at a spacing of 70 cm. The collaboration began with systematization of the specific requirements to be met by the row header after its manufacturing and defining limitations to the design. In this connection and in accordance with the current national regulations, technical assignment has been compiled and approved. Based on the technical assignment and the chosen strategy - to adapt an existing solution to work in new conditions, a suitable prototype has been selected. For the prototype additional information was gathered and tests have been conducted in terms of Bulgarian agricultural production. On this basis, changes in the design of the prototype have been marked out, taken into account in the compilation of the adjusted technical proposal.

Fig. 1 *Row header for harvesting soybeans HPS*

The design continues with development of the technical proposal to the level of detailed design work and to the development of complete technical documentation. Despite of activities duplication and multiple returns to the technical proposal, requirements and limitations to the technical assignment, in this

later phase of the design three stages can be specified – a development of a preliminary (conceptual) design, a development of a detailed design and a development of a complete technical documentation. Founding the design on a prototype significantly facilitates the implementation of the stages of the later phase of the design.

The preparation for mass production of the row header continues with production and testing of a specimen, design and manufacturing of technological equipment and production and testing of the zero series. Following the successful implementation of all stages of the cycle-preparation for production, the mass production of the family row headers for harvesting soy crops, has been reached by HPS METAREM - AD [2,3] (Fig. 1).

3. A model (algorithm) for solving the engineering task of adapting existing (turnkey) solution to work in new conditions

The analysis of the design cycle- preparation for the production of row headers for harvesting soy crops HPS is the basis of the proposed model (algorithm) for solving the engineering task - adapting of the existing solution, created earlier, to work in new conditions (Fig.2). The model is presented as a solved problem on the basis of previously created generalized model for designing of technical systems, obtained by combining (superimposition) of models (algorithms) to solve the four basic design problems. The generalized model itself is part of the developed models for the hierarchical comparison between the life cycle of the technical system, the technical preparation for production, engineering preparation of production, and design, resulting from earlier studies [1,5]. In a highlighted in dark in Fig. 2 are shown the steps forming the structure of the model (algorithm) to solve the engineering task of adapting an existing solution to work in new conditions.

The design process starts with the clarification and definition of the problem (Fig.2). The implemented activities for this stage of the four engineering problems from practice can be unified, as the choice of a strategy for solving the task is performed at a later stage.

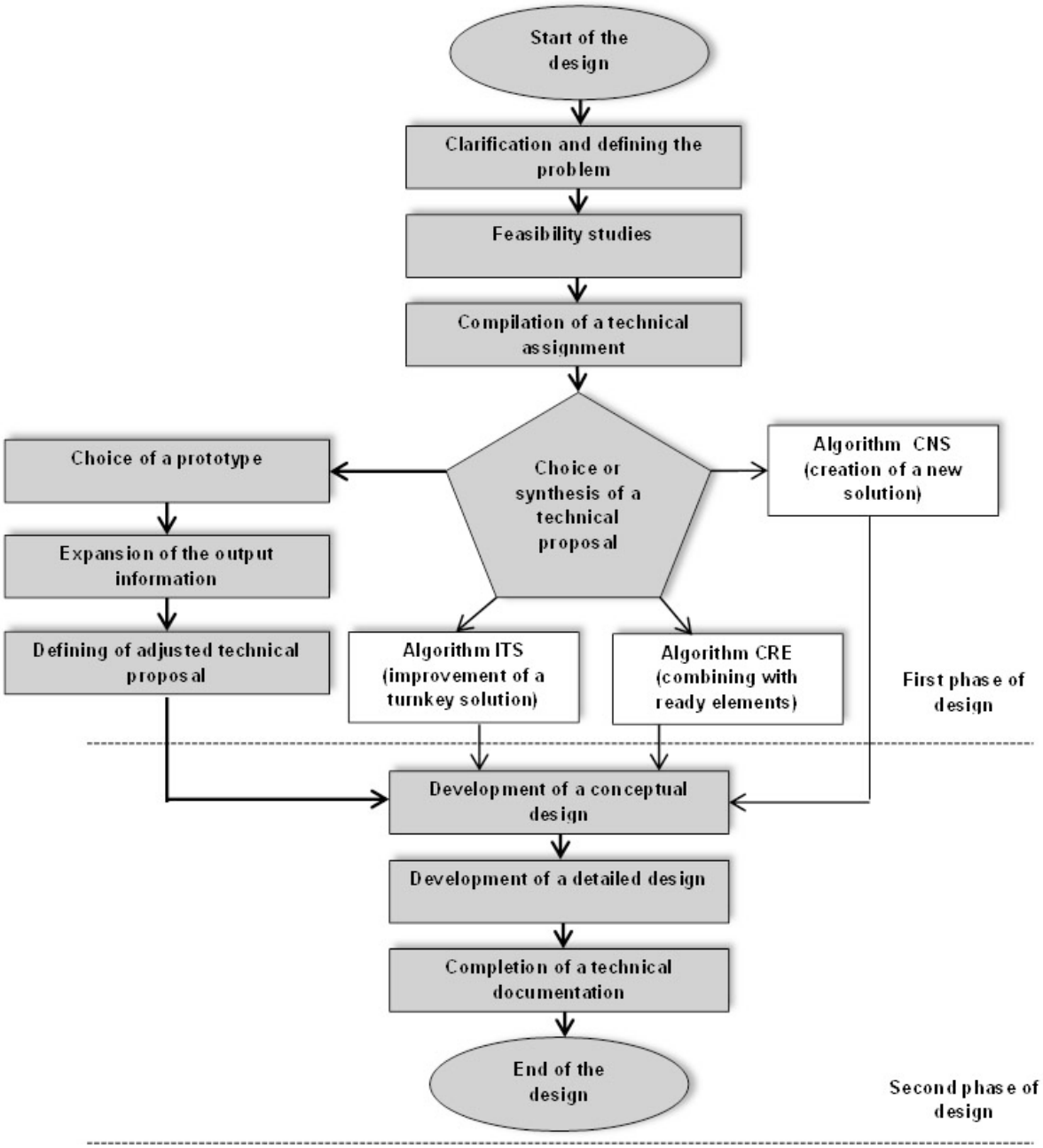

Fig. 2 *A model (algorithm) for solving the engineering problem of adapting of an existing (turnkey) solution to work in new conditions*

Feasibility studies are crucial for the successful problem resolving. The main part of the activities at this stage can also be unified. Based on the feasibility studies it should be answered the following two questions: which are the requirements and limitations to the problem solution and which of the four alternative strategies will be used to solve the problem. Requirements and restrictions to the problem solution are classified in the technical assignment. As it became clear with the performed analysis, the technical assignment for developing of row headers for soy crops HPS was developed and approved according the currently valid national regulations.

The main differences between the four defined design tasks are the optional activities for choosing or synthesis the technical proposal. The feasibility analysis, as a part of the cycle - preparation for the production of row headers for soybeans HPS, shows that the definition of the adjusted technical proposal for solving the engineering task - adapting the existing solution to work in new conditions, is preceded by choosing a suitable prototype and detailed output information for the selected prototype. Discovering the activities content for selecting or synthesis of a technical proposal, involved in solving other three design tasks can also be performed by an analysis of relevant tasks successfully solved by the engineering practice.

The activities performed at the second design phase, could also be unified regardless to the design problem - the solution returns to the base model (Fig. 2). Using a prototype for solving the problem significantly relieves the steps implemented at the later design phase. By developing a conceptual design a transition from the first design phase (the functional phase) to the second design phase (object phase) is done. The technical proposal is developed to a level of a complete preliminary design. Within the next stage the preliminary design is in turn developed to a level of a detailed design. Based on the clarified interaction and mutual disposition among the executive organs during the preliminary (conceptual) design, the development of the detailed design is transferred to a parallel design of components from different hierarchical levels. The complete design is reached after multiple calculations for strength dimensioning and defining the structural and functional interfaces between the components. The design ends with the completion of the technical documentation. The components of the different levels are represented graphically applying tools of the engineering documentation. By the means of the technical documentation the next stages of the cycle - preparation of production are completed.

4. Conclusion

Through analyzing the collaboration between TISEM - AD and METAREM - AD on developing headers HPS the contents of the cycle - preparation for production has been clarified. Based on it a model (algorithm) for solving an engineering problem - adapting of an existing solution to work in new conditions is proposed. The model is presented as a solved problem based on the previously created generalized model for designing of technical systems, obtained by combining (superimposition) of the models (algorithms) to solve the four basic tasks of the engineering practice – an adaptation of existing (turnkey) solution to work in new conditions, an improvement of a turnkey solution, a combination with precast or creation of a new solution.

5. References

[1] Angelov, B. , C. Haralanova S. Mateev . The preparation for production - the first stage of the life cycle of the new technical system. Mechanical Engineering and Mechanics, Varna, 2012, № 18.

[2] Angelov, B. , S. Entchev . An improved working section to headers for soybeans HPS-4, 2 and HS-8/12. Agricultural Engineering, S., 1998, № 3.

[3] Entchev , S., B. Angelov. Specialized Headers for Harvesting Soybeans HPS -4, 2 and HS-8/12 . Agricultural S., 1998 , № 3.

[4] Angelov, B. S. Mateev. General model for the design of technical systems - a step towards convergence between theory and practice. (in print).

[5] Angelov, B. About the Contents of Design Work in the Preparation Phase for the Production of New Technical System. International Conference MendelTech'2012, Brno, 2012.

[6] Birkhofer, H. (Editor). The Future of Design Methodology. London, Springer, 2011.

[7] Cross, N. Engineering design methods. Strategies for product design, Wiley, Great Britain, 2000.

[8] Hubka V., WE. Eder. Design Science. London, Springer, 1996.

[9] Koller R. Konstruktionslehre für den Maschinenbau. Berlin, Springer, 1985.

[10] Pahl, G., W. Beitz, J. Feldhusen, KH. Grote. Engineering Design-A Systematic Approach. Berlin, Springer, 2007 .

[11] Roth, K. Konstruieren mit Konstruktionskatalogen. Berlin, Springer, 1982.

[12] Ullman, D.G.The Mechanical Design Process. McGraw Hill, 2002.