

DECISION SUPPORT SYSTEM FOR MAINTENANCE OF AGRICULTURAL TECHNICAL OBJECTS

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Summary

The article presents computer advisory system (DSS) for the selection of repair method and repair material of parts, especially of agricultural technical objects. A concept of complex DSS based on integration of modern software technologies such as: data bases, expert systems and case based reasoning systems as well as hipertext descriptions of technology and making use of internet communication has been presented. Taking into account the specific character of machinery maintenance in national agriculture, there has been indicated a possibility of mastering the decision process by application of specialized computer software. In the recapitulation the possibilities of specific computer software have been introduced and the directions for further research have been suggested.

Keywords: maintenance, decision support system (DSS), internet.

KOMPUTEROWY SYSTEM DORADCZY WSPOMAGAJĄCY OBSŁUGIWANIE ROLNICZYCH OBIEKTÓW TECHNICZNYCH

Streszczenie

Artykuł prezentuje komputerowy system doradczy z zakresu doboru technologii i materiałów dodatkowych do napraw obiektów technicznych, szczególnie dla stosowanych w rolnictwie. System doradczy integruje w sobie różne techniki przetwarzania i prezentacji informacji: bazy danych, systemy ekspertowe, systemy oparte o przypadki oraz technologię hipertextu. Zadaniem systemu dostosowanego do specyfiki eksploatacji maszyn pracujących w krajowym rolnictwie jest doskonalenie procesu podejmowania decyzji inżynierskich. W podsumowaniu pokazane są możliwości doradztwa oferowane przez system oraz sugestie dotyczące kierunków jego rozwoju.

Słowa kluczowe: obsługa maszyn, komputerowe wspomaganie decyzji, internet.

INTRODUCTION

The majority of technical objects used in agriculture production are regenerateable. The poor maintenance conditions and inconvenient age structure in Poland make them susceptible for damages.

The progress in production technologies of technical objects, necessity of agricultural and food production costs limitation and growing ecological requirements make producers, services and users of agricultural technical objects, improve constantly their conditions of using and maintenance [3]. Particular conditions of machinery maintenance in agriculture, especially in national conditions [10,12] render difficult proper organization of their services and extend the number of institutions and persons, who are responsible for their reliability.

As a result of complex conditions of national agriculture development, two main strategies of agricultural machinery maintenance have been noticed:

- maintenance in service workshops officially authorized by agricultural machinery producers—expensive solution [11],

- maintenance by the users or by non-authorized service workshops – cheaper solution [6].

The observation of national maintenance system of agricultural machinery shows that there are real possibilities of it's improvement. There is a correlation between effectiveness of persons dealing with maintenance of machinery and using by them of computer advisory systems Computer Aided Maintenance Management Systems [15].

One of the three main ranges of CMMS operation is supporting restoration of technical objects operational properties. Perspective direction of CMMS development is “expert systems utilization for making rational selection of proper way of tasks realisation, which can be achieved in many ways [9].

In traditional approach to repairing processes teaching (instruction) the emphasis is put on technology of repair. The problems of selection of filler materials (welding, adhesion, regenerative composites) are presented by mechanical properties of each group of materials, usually without taking into account a quick progress setting in such group of materials. Tasks of acquainting users with filler materials properties are taken on by the producers

and distributors, leaving decision of using that or another product to the user, who takes responsibility for the repair results.

The aim of the study was building of knowledge base, which lets quick, as much as possible objective selection of materials and repair (regeneration) technology in the situation of territorial dispersion of agricultural machinery service workshops or for the repairs done by the users. Advisory system building involved some elements of methodology used by computer decision support systems for materials selection at the design phase.

1. COMPUTER METHODS OF THE SELECTION OF PRODUCTION TECHNOLOGY AND MATERIALS

The most popular system for computer aided engineering materials selection is CES system (Cambridge Engineering Selector) based on methodology of materials properties diagrams by prof. M.F. Ashby [1] and produced by Granta Design Ltd. Data bases of CES system contain seven mutually correlated tables, three of which: materials, production processes and shape of elements, constitute a group of the main selection. The selection of materials is done in some stages, there is a possibility of choosing selection method (numerical or graphic).

In spite of high renown of the system and its popularity all over the world, usually its applications do not go beyond the instruction of materials science. There are known attempts of Ashby's methodology application for optimization of selection production technological processes [13] and its adaptation to the production needs [2].

In Poland the problems of computer selection of engineering materials are dealt by a team of scientists from Silesian University of Technology in Gliwice. The computer system developed there and based on object data bases technology makes selection of material possible, which meets all active criteria according to their importance [5].

Because of complexity of processes taking place during bonding of different elements of materials and a wide offer of technologies and filler materials, computer support of welding becomes more and more significant in the process of design. The significant role is played by The Welding Institute in Abington with its huge data base of computer software on different aspects of connecting different elements of materials. Polish research studies are concentrated mainly in Cracow, Silesian, Warsaw, Wrocław Universities of Technology and Welding Institute in Gliwice. The computer system "Technologie napawania" is an example of Polish tool for supporting the selection of filler materials [14].

In The University of Natural Sciences in Lublin from the beginning of 1990s investigations have been done on computer aided selection of materials and technological processes of repair technical objects

applied in agricultural production and food industry [7]. Various types of computer software were used to build computer programmes, depending on needs and of computer technology advancement: from Turbo Pascal calculation software, through measurement software and data bases, to expert systems. Development of the Internet facilitating quick access to the knowledge and making more attractive forms of its transfer to the places far from the place of university (open learning), according to proposal of Dąbkowski and Molenda [4] resulted in directing of the investigations focus on building of multimedia system of aided learning, which integrates different methods of representation and presentation of knowledge.

2. METHODOLOGY OF ADVISORY SYSTEM BUILDING

The information of knowledge sources, methodology assumptions and a concept of advisory system have been published in [8]. Very important phase of the system building was constituted by structuring of the knowledge concerning the technology of repairs, i.e. decomposition and thematic grouping of information about individual technologies application possibilities, the properties of filler materials for repairs and setting of selection criteria hierarchy.

The adopted criteria of filler materials selection for welding and surface welding were: the type of original material, technology of repair (regeneration), more detailed type of original material and additional requirements, e.g. working conditions of machine elements, position of treatment, corrosion resistance.

For the selection of polymer – metallic or ceramic regenerative composites the selection criteria were: the type of original material, permissible working temperature, time for polymer setting up, machinability after setting up, possibility of contact with drinking water and food.

Because of lack of standards for some sorts of filler materials for repair, the catalogs, other information materials from producers and users' opinions, were used for comparing them.

The advisory system was implemented as an element of didactic sever of Chair of Bases of Technology University of Natural Sciences in Lublin. HTML editor and NetObject Fusion software were used to build www pages. Advisory part of the system was written in the environment of object software Visual Basic and with shell Expert System software Polshell (Aitech). Some graphics and animation elements of web pages were reached by downloading them from free of charge web pages. Some graphical elements were done individually with the help of COREL Draw software. Pictures procession was made with Corel Photo Paint.

3. THE STRUCTURE OF THE SYSTEM

The architecture of the system has been designed in a way that gives possibility to the user of quick access to information selected by him. The whole system has modular structure, which is presented on Fig.1. Main page of the system shows essential functions of the system and by means of virtual buttons the access to each subject pages is possible.

The system has other possibilities of it's application:

1. Optimal selection of repair method and sort of material for given by the user sort of wear, for specified (according to the repair method) repair criterion – tool: Expert System,
2. Optimal selection of filler material for specified by the user technology of repair – tool: Visual Basic language,
3. Technology of repair review, their advantages and application limitations,
4. Review of filler materials and their properties,
5. Review of cases of successful repairs with their description and picture documentation,

6. Review of the links to internet pages of repair devices producers and repair materials,
7. Index of terminology connected with repairs.

4. SUMMARY AND FUTURE WORKS DIRECTIONS

The advisory system presented in the article can help the user to learn basic terms connected with repair of technical objects, especially applied in agriculture. Descriptions of each technology are completed by some practical examples of repairs with regard to the results of repair – Fig. 2. The system gives the information of filler welding, surface welding materials and based on adhesion technology.

The usefulness of the system is defined by quantity, quality and actuality of information contained in it. That is the reason of possibility of putting of current knowledge for actual needs. The works have been continued on integration of the system in environment of integrated system of artificial intelligence SPHINX v. 4.0 (*Aitech*).

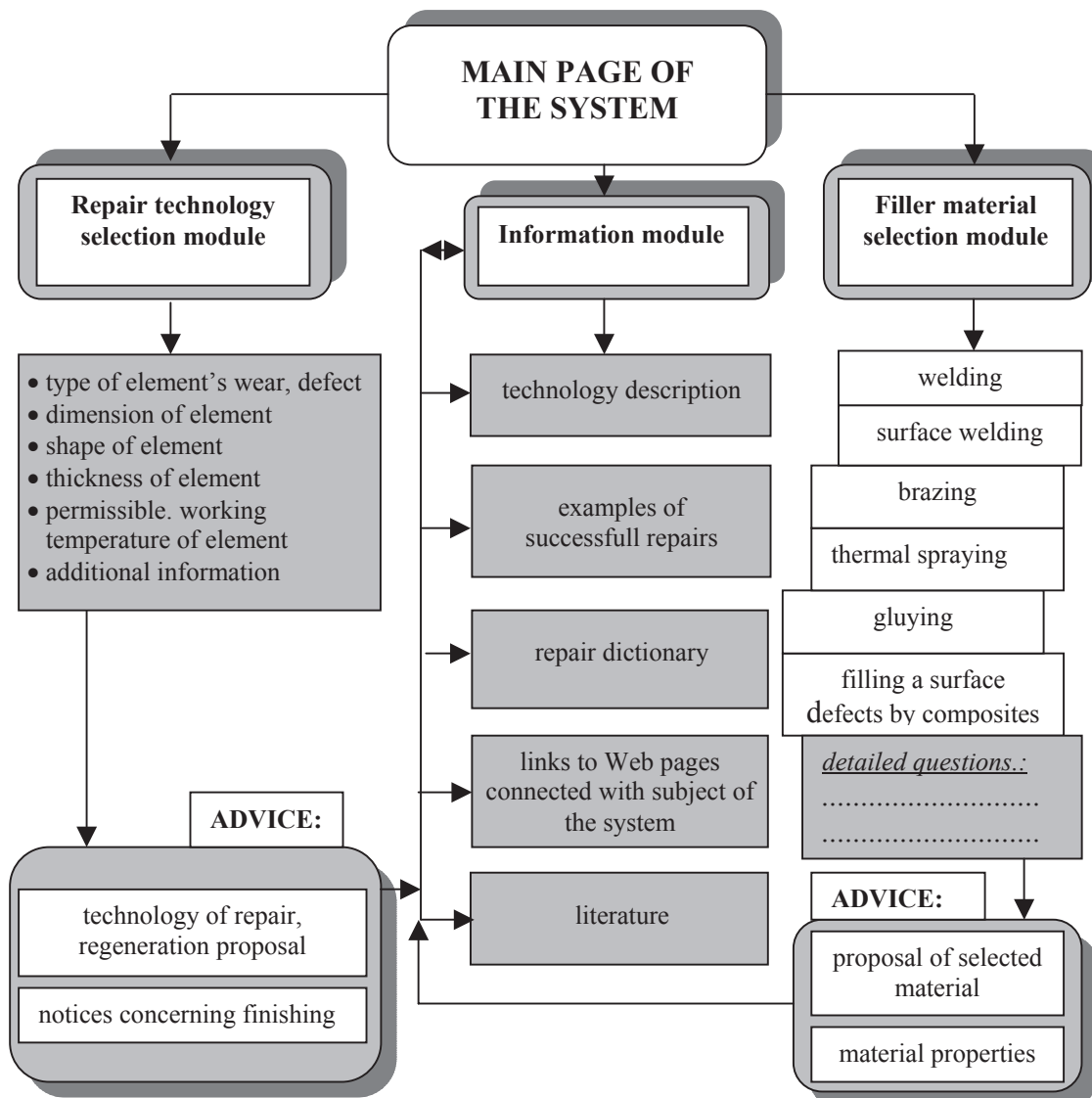


Fig. 1. A block diagram of the system for the selection of repairing materials and methods

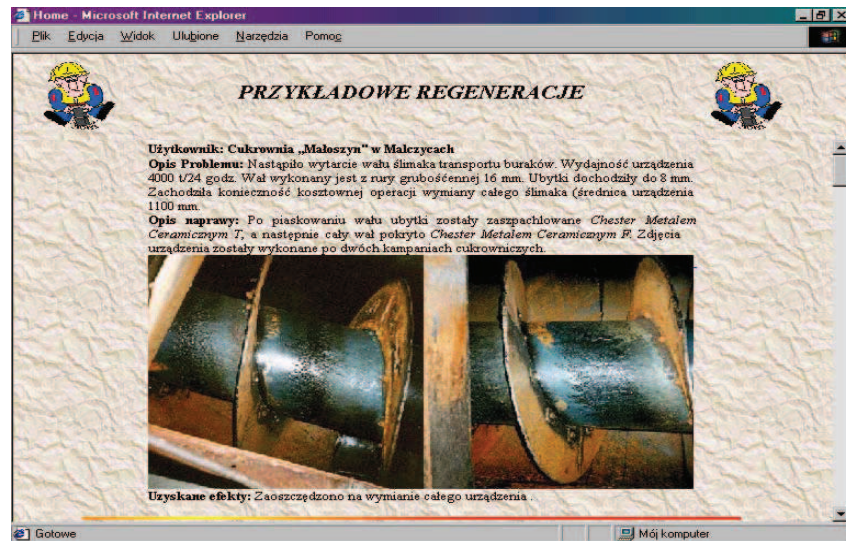


Fig. 2. An example screen of presented system

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