

## CONTRIBUTIONS TO CUTTING TOOLS DESIGN USING WEB FACILITIES

Paul Dan BRÎNDAȘU, Livia Dana BEJU

**Abstract:** Within the globalization context, the current development of Information Technology and its required hardware support lead to a one-way road focused on e-design and e-research, a road of minimal costs and efficient resource usage. The paper aims to bring contributions to project management development and long-distance research, a required step in the tough competition that is to come. A new notion is introduced, that of e-creative design – meaning long-distance design using creative methods and techniques.

**Key words:** e-learning, e-design, e-research, e-creative design.

### 1. INTRODUCTION

In order to remain competitive in the research and design field, today’s specialists and researchers must collaborate more and more at national and international level. This can be done thanks to the high complexity of the studies and modern research results which are possible because of ICT (Information Computing Technology). The collaboration means sharing materials, time, work and financial resources beyond the organizational borders through information exchange and operating methods elaborated for common purposes. The potential of ICT offers opportunities to exchange resources more easily; so a team can work together even if their members are far away, have different specializations or they are from different universities, companies or research centers.

The specialists’ ability to access data, information, and research results, the ability and capacity to work together and to co-operate online must be activated and developed significantly. This is recognized in the developed countries, which took significant measures in order to activate and encourage the use of ICT in research.

The next necessary step is e-research, together with the globalization and activity efficiency processes.

There are some countries which are the starters in this competition and try to think up “the structure and the rules of the game” – USA, UK, Australia, etc.

After a first analysis, some exceptional advantages of specialists’ cooptation become apparent; we can solve important issues on-line and with low costs; we can use the knowledge network in a superior way no matter how far we are geographically. This way PhD theses elaborated in co-tutelage can be defended online by using network labs and different specialists.

### 2. THE CURRENT STATE IN EDUCATION, DESIGN AND LONG-DISTANCE RESEARCH

As long-distance learning developed and the need for qualified company specialists increased, the e-learning has gained ground.

This learning method has a huge potential such as:

- the possibility of a continuing education;
- a closer attachment to the consumer;
- a fast adjustment to market demands.

In a large sense, e-learning defines the whole educational situations, where IT&C instruments are used on a large scale.

In a narrow sense, e-learning represents a distance learning method (even in the same institution). In a dynamic way, it provides educational materials in a sequential and logical order to be assimilated by the students in a proper way [5].

Worldwide, there is a continuous growth of the e-learning process [1].

Classical teaching remains the most used method, followed by e-learning.

E-learning market has developed more slowly than foreseen a few years ago: current values lead to 30% a yearly average growth. There are strong differences between market segments and between countries.

However, 30% is an important growth rate (Fig. 1), because the schools, companies, universities and public administration learning departments form the target. The fact that ICT is used in these sectors is very encouraging.

Beginning with 2007, EU proposes to extend e-learning, so far used only in universities, to the other parts of the learning system [3].

The components of the educational process are (Fig. 2):

- the actual training (theme presentation, demonstrations, online exercises, documentation, links, virtual library, etc),



Fig. 1. E-learning market growth [3].

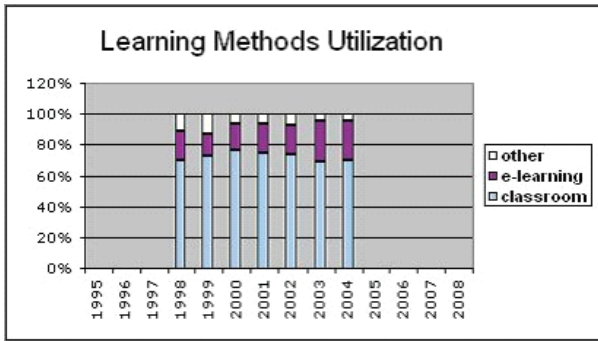


Fig. 2. Educational methods [3].

- “discussions” (group discussions, studies and group projects, chat, etc),
- applications (simulations, interactive projects, web projects, virtual laboratories),
- evaluation (preliminary tests, evaluations, diploma, online certificates).

In Romania there are a few e-learning portals (leducat.ro, e-scoala.ro, cursuri-online.ro) and sites (www.academiaonline.ro) that offer free or paid online lessons. We can say there is an insufficient offer. Its development is welcomed, especially in a creative development way and not in a repetitive way. In this area, the researchers from the Polytechnic University of Bucharest (www.sun.efic.pub.ro) [4], the Technical University of Cluj (www.eteach.org) and the Technical University of Sibiu have approached e-learning in the simulation of technological systems, metal cutting and assembling areas (knowledge, virtual manufacturing and assembling) yet in a classical manner.

The teaching model must contain the administration-educational model (catalogues, reports, etc.), the material distribution instruments model and the content model.

Regarding the e-design notion (Fig. 3), this is used for website design and in arts and architecture. In the equipment area this approach has not been used yet.

E-research gives the possibility of a brand new research.

The e-research includes the research activities that use a large spectrum of ICT advanced capacities and contains the new research methods that appear as a result of the access to:

- broadband communication networks, research instruments and facilities, sensorial networks and databases;

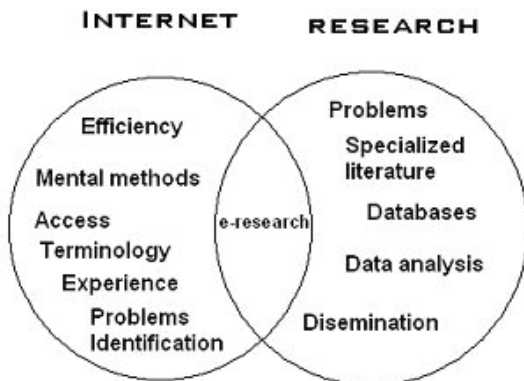


Fig. 3. Components of e-research.

- software services and infrastructure that permit connexion and interoperability in a secured way;
- application instruments that include the specific instrument for each discipline and the interaction instrument.

In Romania, collaboration resources are currently available to a small number of researches and some resources like digital databases are in different development phases. Many researches don't know how to access the resources, because e-research abilities include interdisciplinary abilities that make the connection and cover the relevant research area and the ICT [7]. E-research abilities include traditional research abilities and computerized science abilities, informational sciences, computerized mathematics and engineering abilities. Collaboration by creating virtual organizations and using common resources represents the highest opportunity for researchers in order to use the advantages of the most modern ICT system. E-research will allow new knowledge and discoveries and this will bring economic and social benefits.

Together with e-research, e-creative design is an important field which aims to develop a platform that will integrate in a compact and dynamic way through Internet design distributed objects and engineering instruments, thus assuring the collaboration in the e-design area between the involved parts, the interoperability between far and heterogeneous systems, the measuring, extensibility and portability of engineering instruments [8].

### 3. THE USE OF CREATIVE METHODS AND E-DESIGN IN THE CUTTING TOOLS AREA

The subject of the paper aims at new discoveries in this area and the implementation of technological applications – particularly for cutting tools.

This way we can obtain:

- the accomplishment of an e-learning and e-creative design system in the technological equipment – cutting tools field through the adjustment of distance design creative techniques and methods and the drawing up of explanatory materials and knowledge tests in the field, based on a discovery system and not on a copyright system, thus meeting the field objectives, i.e.;
- the development of a conceptual-theoretical and methodological frame of information and communications technologies;
- the generation of new instruments, technologies and networks for specific applications;
- the fulfillment of compatibility demands for Romanian integration into the social/ economic European environment, defined through the knowledge society and ‘e-Europe’.

As a result of the analysis of the existing information, less explored areas can be marked as well as limits of the approached problem:

- e-learning and e-design don't regard the cutting tool field unless usage and operating examples are given;
- the didactic tools are not adequate for learning through the discovery method, but through the copyright method and transformations for an adequate use are necessary;

- the creative methods are not adapted to the e-learning concept;
- e-design concept is not used in the proposed area and even less in a creative way;
- access limits because of the absence of logistic support (computers, the Internet, appropriate didactic tools).

That is why the software proposes elements which will exceed some of the existing limits. The grant theme is about the development of several work procedures and the support which would permit the creative design of the cutting tools, using the Internet (e-creative design). In order to acquire that, we must follow some steps.

The work algorithm consists of the following steps:

- The development of the e-learning support in order to be accessed by those who don't have the required knowledge in order to design the product (cutting tool). here we have two situations: working with students and working with specialists, where we may need the bringing up to date of the constructive solutions or some research.
- The implementing and testing of the e-learning support in the internet network. we need a work collective that will verify the learning system, will make observations, which must be also verified. afterwards, we can implement the support for general use.
- The adjustment of creative methods and techniques for the internet network.
- The development of a support which will help in developing creative methods in an e-learning system.
- The implementation of the creative methods on the internet requires a testing team and repeating the previous procedures.
- Finally, the materials regarding tools knowledge and the creative methods evolution methodology will be the basis of the e-creative design platform.

The presented work steps, which will be a part of the proposed objectives and activities, attempt to exceed the limits of the current state (Fig. 4). Therefore, the devel-

opment of creative lessons for the cutting tools area needs a new concept, with object-oriented databases, combined with relational databases and a suitable testing. Moreover, the Internet support must be created.

Certain creative methods which can be used on the Internet will be adapted, re-built and a long-distance learning material will be created.

The e-design and e-creative design concepts must be formulated for the chosen area.

The acquisitions, together with the existing equipment, will permit a suitable access to didactic materials and the Internet.

A permanent objective in the program will be the bringing up to date of the information regarding the subject.

Finally, the activities of the grant must permit a quick, logical and efficient learning process (as in the figure).

Therefore, after the group is formed and the theme is announced, a testing of the participants takes place. If they are not prepared enough, they have access to knowledge about cutting tools and creative methods.

After they are accepted, the creative design meeting can begin. The solution they find must be modeled, verified and adopted.

As regards the interactive sessions, the best example would be the San Francisco method.

After the topic is announced, each participant is invited to find 3 solutions in a repeating cycle. Thus, a large number of ideas can lead to an original solution.

#### 4. THE ADJUSTMENT OF CREATIVE TECHNIQUES AND METHODS ON THE INTERNET NETWORK. THE IMPLEMENTATION OF THE MORPHOLOGICAL ANALYSIS METHOD

Starting from all the combinations including the known, unknown, compatible and incompatible ones for a specific cutting tool – through the morphological analysis (Fig. 5) adapted for the Internet we can generate and

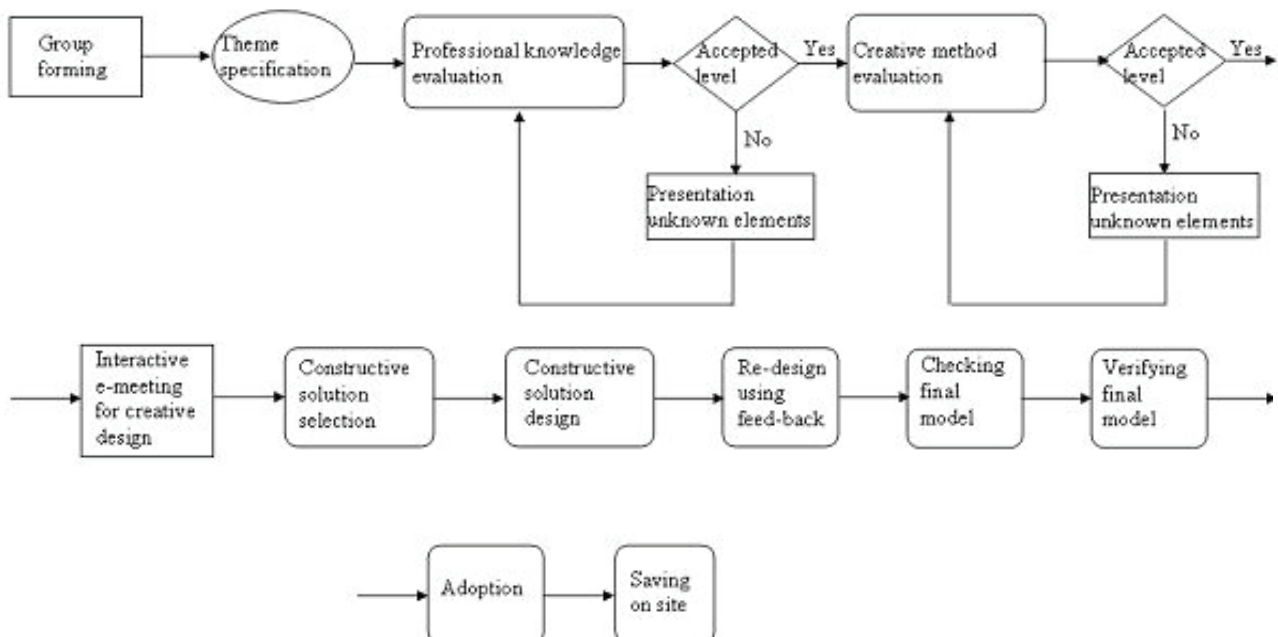


Fig. 4. Steps of e-creative design process.

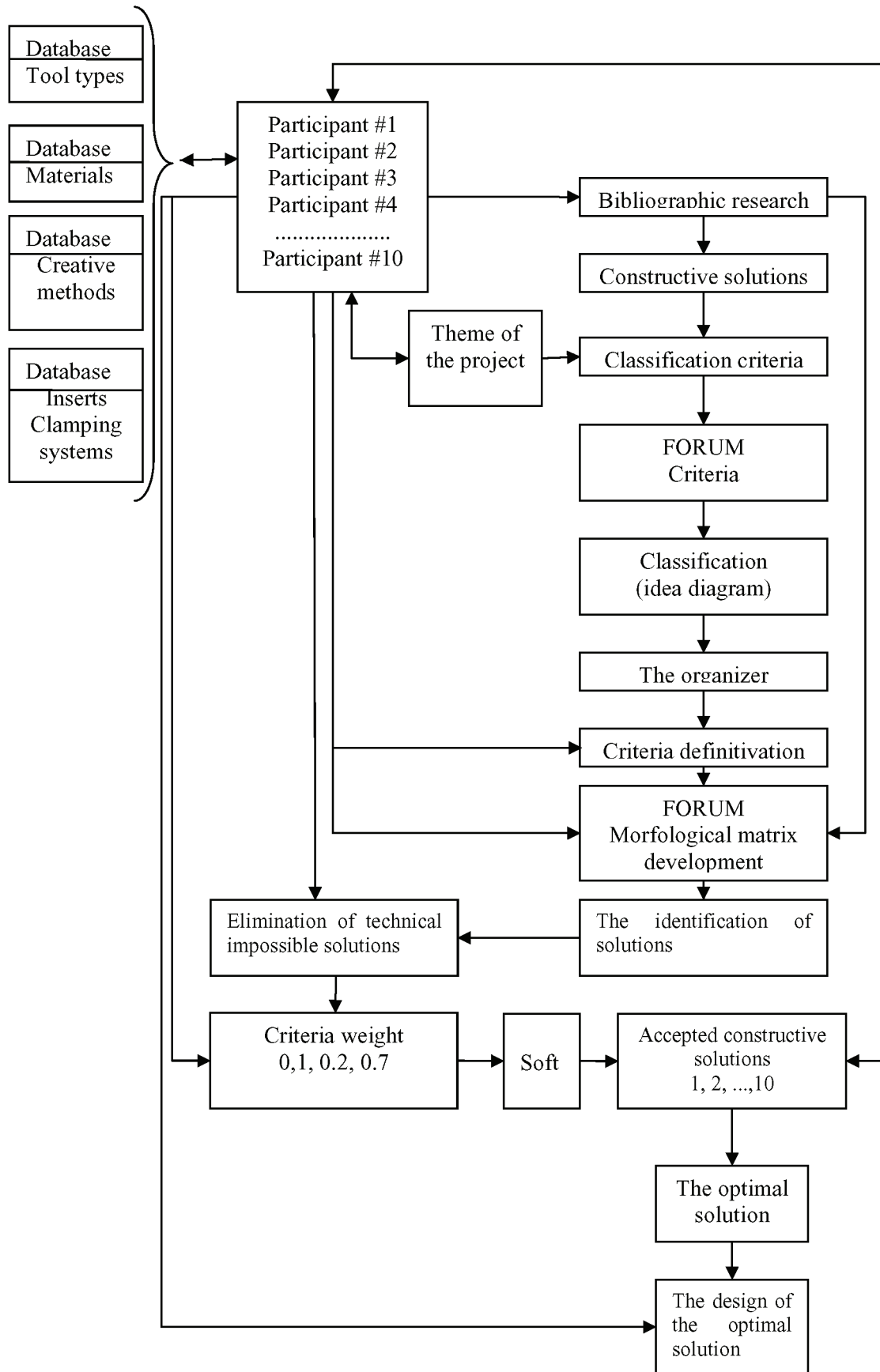


Fig. 5. Morphological analysis matrix.

establish a new solution for a reamer tool, for example. The analysis phases are the following:

- the presentation of the sites, working area databases, courses and books;
- the identification of the criteria for making a product. these criteria are proposed by each member of the collective on the website – on the working forum. the organizer will study the proposals and will present the criteria list for approval to the other members;
- each member of the team completes constructive solutions regarding their materialization. No cancelled solutions are allowed (Fig. 6);
- the construction of multidimensional matrix with axes as team criteria;
- the generation of all possible solutions;
- the cancellation of technical impossible solutions;
- the determination of criteria weights (value analysis) by the team;
- the hierarchy of the solutions;
- the analysis of the first 10 solutions;
- the visualization of the constructive elements for the achievement of each product solution/function;
- the proposal by the team members of the most advantageous solution; after the access into the databases with components for each parameter;
- the final solution.

## 5. THE MANAGEMENT AND THE IMPLEMENTATION OF E-CREATIVE DESIGN AND E-RESEARCH METHODS

An important issue is the financial problem of the investments – the correlation of the public and private

finance of the research; the public one should align to the methods and directions of the research and the private one should anticipate the market opportunities. Thus, collaboration is necessary – this will reflect the financial priorities. In order to get people ready for e-design and e-research there is need of:

- encouragement of collaboration and multidisciplinary education instead of traditional disciplines;
- an effort of the higher education system to increase the number of ICT graduates and ICT professionals;
- training and support for researchers and specialists in informational management in order to acquire the necessary abilities.

While studying the problems that appear, a few strategic directions can be elaborated: to inform the community about the big potential that e-learning, e-design and e-research offer; to concentrate efforts and follow a politic of secured access to information; to give opportunities regarding the design collaboration and research between universities, centers and companies; to expand the ITC availability and to increase the number of specialists in information management area.

Regarding the required human resources, the necessity of skills development and the use of more efficient information and knowledge management must strive to national standards; this will permit a fast accommodation to market demands [1].

In order to have a better access to the data we need: data management, easy access and storage for the data, a perfect security and standardization for the system.

The data must be well-managed so that can be in the optimal usage mode today and in the future. This means

The screenshot shows a forum thread with the following posts:

- Admin** (May 05, 2006, 06:15:38 PM): "Please think creatively in order to design a milling tool with different insert positioning types."
- Participant #1** (May 16, 2006, 08:34:31 AM): "I'm thinking of a milling tool with wedge-type intermediate element where to place a star-type insert with many cutting parts."
- Participant #2** (May 16, 2006, 08:49:04 AM): "You mean inserts like the ones in this figure?" (Image of a star-shaped insert)
- Admin** (May 16, 2006, 08:50:19 AM): "Interesting... what type of insert clamping do you have in mind?"
- Participant #3** (May 16, 2006, 09:32:55 AM): "The intermediate element (in the figure) can be modified so we can place a star-type insert." (Image of a modified intermediate element)

Fig. 6. On-line forum for solving technical problems in a creative way.

the preservation of data and quality control. The objective is to create a management methodology and operating cycle for the data from acquisition to storage.

Another important aspect is the change of the organizational culture [2]. A management change process is necessary for universities and research centers, as regards the attitude towards e-design and e-research. An important role is played by the leaders who must encourage cooperative behavior and e-research and must bring about cultural change. Reward mechanisms should be created in order to reward the people who obtain good e-research results.

## 6. STRATEGIC DIRECTIONS

The following strategic directions are proposed in order to establish a program for the e-research expansion:

- the development of a communication strategy by universities and companies would approach the needs of the researchers;
- the identification of adequate responsibilities in order to develop common facilities like a web information system which will contain information from different sources and will permit the development of a central learning resource for a national e-research expansion program;
- the development of organizational structures in order to improve the abilities using expertise from universities and companies, together with the provision of quality – this would assure the efficient on-time development of e-research abilities for a wide users area;
- the encouragement of the project managers from e-research to develop promotional materials about their projects, to disseminate the information and to behave like champions who can inspire other researchers to adopt new methodologies and research instruments. This would create a large example and case study database that could be used by other researchers in order to learn and improve their own practical applications.

## 7. CONCLUSIONS

The Romanian researchers must be encouraged to participate in the transformation process which is possible thanks to ICT. This offers the possibility to enhance the

current research, work in collaboration, work globally and achieve results which were impossible to obtain before. A collective effort is necessary in order to develop a strategic framework for the implementation of e-research. This gives the possibility of maximum ICT use for researchers, bringing about advancement in their field.

Processes and technological equipment are less explored through e-design and e-research.

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### Authors:

Prof. PhD. Eng. Dan Paul BRÎNDAȘU, PhD, “Lucian Blaga” University of Sibiu, Chief of Manufacturing Science Department, E-mail: dan.brindasu@ulbsibiu.ro

Prof. PhD. Eng. Livia Dana BEJU, PhD, “Lucian Blaga” University of Sibiu, Manufacturing Science Department, E-mail: livia.beju@ulbsibiu.ro