E-Research Centre and E-Creative Design new Trends for E-Activities Platform

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Abstract: - In this paper the author introduces the concept of E-creative design, which refers to the use of methods and techniques (modify for internet application) for stimulating the individual and group creativity in a design session using an e-research center for the researchers in the field of mechanical engineering sciences as well as its development and integration in the existing national and international infrastructure. The goal of this center is to include as many researchers from our faculty initially, then from our university, our geographic area, our country, from all over the world. To this purpose, the center sets itself to promote and support new e-research projects, to encourage the building of multidisciplinary groups that should cooperate among themselves and share resources and infrastructure. One of this is E-Creative Design. The E-Creative design methodology is presented first, step by strep in the pseudo code language. In order to use creative methods on internet, the morphological analysis and "San Francisco" creativity methods were presented from this new perspective.Finally the main functions of a research-design platform were elaborated. An example of E-creative session on Internet in cutting tool area completes the presentation.

Key-Words: - e-research, e-science, cyberstructure, midleware, virtual centre, e-design, grid.

1 Introduction

The Research is a human process that manifests itself differently at a certain age. The Cambridge dictionary defines research as "a detailed study of a subject that is aimed at discovering new information and understanding new meanings about an entity." The use of the Internet adds intrinsic values in order to increase the quality of research. The Internet can offer new opportunities for increasing the quality of research and for introducing new problems and challenges. The Internet contains a medley of data. In general, e-research helps us convert data in information and disseminate this information along channels that allow their transformation into knowledge and information by researchers for their sponsors and the public at large. The quantity of information associated with the speed at which it may be accessed, filtered, sorted, leads to various opportunities.

E-research is more than a set of new research techniques[4]. The Internet researcher may be considered a web component. Web researchers design and create tools for the analysis and conceptual understanding of the human environment. In many cases the e-research scientist is the external assessor and in a different context he can be both practitioner and researcher. The researchers are members of the Internet communities; thus they introduce their knowledge and experience through Intranet links either individually or collectively. E-research has its place beside e-commerce and e-learning. It is a new way

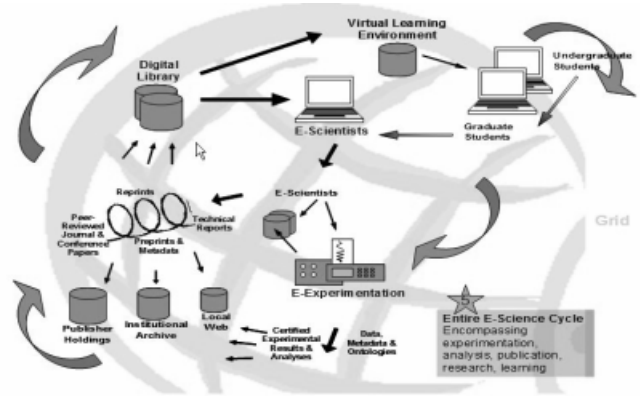

Fig. 1

of understanding and building information in the current society that uses network technologies. E-research introduces new tools such as "asynchronous voice conferencing" and "video capture" that allow a complete multimedia interaction. Moreover, e-research uses distributed data and data processing capacity on the Internet. The e-research centre will offer original elements in the field of e-research in direct connection with

other concepts such as e-Science, Cyberinfrastructure, Grid Computing.

E-Science is the term that is given to large scale science that is increasingly being carried out through distributed, global collaborations, enabled by the Internet and related technologies[2].Typically, a feature of these collaborative scientific enterprises is their need to access very large data collections, unique scientific facilities, very large scale computing resources, and high performance analysis, modelling and visualisation by scientists (figure 1).

Virtual research combines different types of activities, which helps people to learn continuously and generate new ideas [8]:

- the actual training (theme presentation, demonstrations, online exercises, documentation, links, virtual library, articles, possible documentation, on line publication, new-groups etc)
- "discussions" (group discussions, studies and group projects, chat, workshops etc);
- applications (simulations, interactive projects, web projects, virtual laboratories)
- evaluation (preliminary tests, evaluations, diploma, online certificates);
- research personalized plan based on necessary and existing knowledge;
- services for documents editing useful for the research daily process;
- services for research management, measuring the research progress etc with high security level.

The major objective of the future Virtual Research Design Centers will be the improving of the performance through the international information exchange [5] [7]. The paper presents a proposal for the organization of a research design center in Manufacturing Science area, more precisely in Cutting Tool area using the E-creative design concept.

Another important aspect of thislarge-scale research is the high value placed on cross-fertilisation of ideas through collaboration between researchers and across disciplines.

E-Research is the more general version of e-Science and includes non-scientific research, such as humanities and social sciences, and is also characterised by the need to use distributed computing resources for collaboration and sharing of knowledge.

Grid Technologies play an important role in the development of e-Science and e-Research. In much the same way that consumers and businesses are able to access their electricity supply, *Grids* enable researchers and research institutions networked access to distributed data repositories, specialised scientific equipment, knowledge services, and computing power in an 'on demand' way. They enable flexible, secure resource sharing and coordinated problem solving amongst dynamic collections of individuals, institutions and resources – often referred to as Virtual Organizations[6].

2 Cyberinfrastructure

Cyberinfrastructure is an essential concept on whose basis e-research is developed [3]. One of the most important organizations in this interest field is NSF (National Science Foundation). One of the main aspects pointed out at the last NSF conference entitled "Cyberinfrastructure Vision for 21st Century discovery" in January 2006, was "the national and international, public or private partnership, which integrates CI (computing information) users and which academic communities and researchers affiliated to NSF can benefit from. Ardent Bement, manager of NSF, stated in his speech that Cyberinfrastructure would allow exploration of new horizons for research and education (figure 2). Researchers can now study the ways in which students can learn online or in which online education allows decision making or runs businesses[1]. These interest fields are not accessible to the researchers who are not connected to the Internet. We are positive that the network societies are not a whim and that we are at the beginning of a new era of the human activity. The

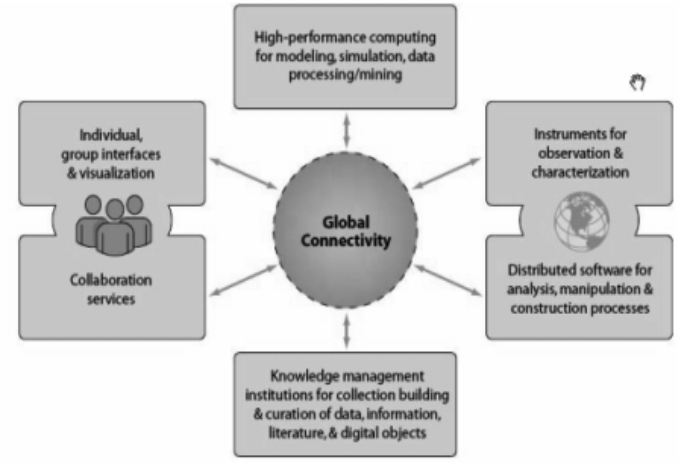

Fig 2

computer network has now become an essential component for many activities, so that it is inconceivable to use tools that are not part of a network. Moreover, it has become very clear that the new ways of patterning and communication cannot exist without a computer network. That is why the goal of e-research is to extend these entities to new levels unattained yet.

3. E-Research models

There are several models for an e-research system structure. The history of these is presented in figure 3. The model developed in Great Britain is the most efficiently focused on international initiatives. It is made up of three main components:

- The Open Middleware Infrastructure Institute (OMII);
- A Grid Support Center (GSC);
- Regional centers.

OMII and GSC work together to assist the purchasing, coordination, development, and integration of the program depending on the requirements of the e-research community. They support the pilot projects of the researchers in the local areas that use Middleware products and the GRID network. All tools and resources provided by OMII and GSC are used by the regional centers.

Three important initiatives have been developed in this field in the USA:

- NSF Middleware Initiative;
- Internet 2 Middleware Initiative
- DOE Science Grid

Alongside of these initiatives, there are several important projects such as:

- NASA Information Power Grid;
- Grid Application Development Software, etc.

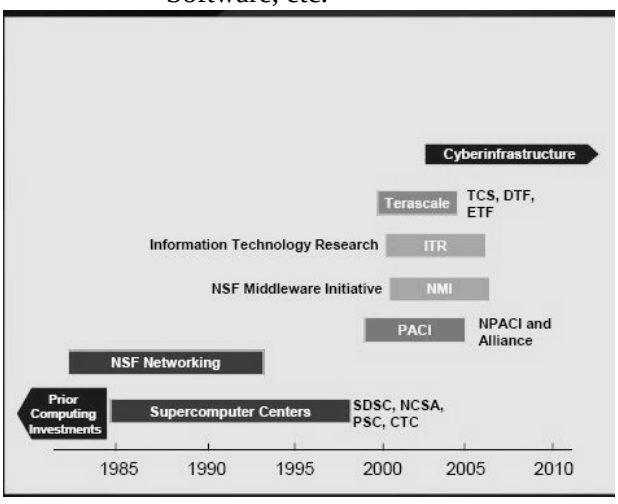

Fig. 3

In accordance with the information existing at NSF Advisory Committee for Environmental Research and EducatioN, NSF Middleware Initiative (NMI) appeared in 2001 to define and develop a Middleware infrastructure on a national level. One of its main goals is to explore the ways in which the e-Research concept can be introduced in student hostels. NSF has also founded NMI Integration Testbed made up of eight universities that evaluate NMI together. The testbed sites use and assess the software, services and architecture that grant access to the electronic resources for faculty and campus projects.

Internet 2 Middleware Initiative (12-MI) is a consortium made up of 206 universities that work in partnership with the industry and government in order to develop advanced applications in a network. Every sector of activity has a manager who is responsible for the actions in his own field of activities.

The guiding principle of DOE (Department of Energy) Science Grid is to build a type of cyberinfrastructure with certain standards of permanent users who are on the DOE projects. This information can found in:

The EGEE (Enabling Grids for E-Science in Europe) project aims at integrating national, regional or topic area Grid efforts with a view to building a unitary Grid infrastructure for e-Science research. This infrastructure will be built on the basis of European Research Network EGEE sets itself to use and coordinate the existing national programs without replacing them. The project has two important aims:

- To discover the Grid levels, their essential elements which are ductility, endurance, resistance to destructive factors and a strong security system. Scalability is equally essential for rapidly absorbing new resources and for ensuring a viable long-term infrastructure;
- To harness a strong effort in the training activity which can direct the GRID services towards new communities of researchers in the academic or industrial milieu. This will entail further clarification in the field of e-Science.

In order to secure an efficient management the European Grid community is divided into ten regions: CERN, Central Europe, France, Germany/Switzerland, Ireland/UK, Italy, Northern Europe, Russia, South-East Europe, and South-West Europe.

Japan prides itself on The National Research Grid Initiative (NAREGI). This is a project launched by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in Japan in 2003 that contains a significant number of grid initiatives. NAREGI is not a project that develops grid products. It is directed at developing certain projects in various fields such as simulations in the science of materials, nanotechnologies, chemistry, etc.

4. E-Creative Design in Cutting Tools

E-creative design concept was introduced by us and means the use of creative methods in the research and design on the Internet network. 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:

- an e-learning and e-creative design system developed for cutting tools field;
- very efficient research and design teams because of the huge work market in this area;
- 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'.

In order to use the creative design methods on internet, some working standards must be establish in order to allow a quick and innovation design and to make easier the design work of the engineers. In figure 4 is presented an algorithm of an E-creative design activity. The algorithm is done with the help of pseudo-code language.

On the following, we shall present some characteristics and adjustment of creative techniques and methods used on the Internet network. The creative methods that can be adopted for E-creative design are analytical (the tree diagram and the morphological matrix) and/or intuitive (Brainstorming, Sinectics, 6-3-5 Method or San Francisco Method, Phillips 6-6, Panel Discussion).The paper will present the Morphological Matrix method and the "San Francisco" method used in E-design activities. Some images from a creativity session performed by students during a project class are presented in figure 5.

5. The Morphological Analysis Method Used On The Internet Network

Starting from all the combinations including the known, unknown, compatible and incompatible ones for a specific cutting tool – through the morphological analysis (fig.2) adapted for the Internet we can generate and establish a new constructive solution for a tool. The intermediate results can be known tools, new solutions or technical impossible solutions. The analysis phases are the following:

```
ESTABLISH the design topic;
ESTABLISH the E-design virtual group members;
DO WHILE the E-design group members is
complete
   CONTACT the E-design virtual group
            member;
   IF the person accepts to participate
      THEN
         EXPLAIN the working principles;
       IF the knowledge level must be
          verified
          THEN
             The person COMPLETE a
               test;
             IF the test is good
               THEN
               ACCEPT the person as a
               E-design group member;
               ENDIF
          ELSE
             ACCEPT the person as a
            E-design group member;
      ENDIF
   ENDIF
ENDDO
COMMUNICATE the design topic to the E-design
group members;
ORGANIZE an E-session for establishing the
analysing criteria. Each member can propose one or
more criteria. Each member will note all criteria. A
specific soft will determine the most important
criteria and their weight;
ORGANIZE an E- creative session in order to
develop new constructive solutions from the design
topic and in concordance with the criteria
established before – use a specific E-creative
method;
ORGANIZE an E-session in order to analyse the
existing constructive solutions from the design topic
and in concordance with the criteria established
before; Analyse all combination variants –
Morphological Analysis Method;
ORGANIZE an E-session in order to adopt the
optimum solution;
    COMPARE the solutions;
    NOTE each solution with note numbers for all
    the analysing criteria perspectives. Each
    participant does the noting process;
    COMPARE the best solutions;
    ESTABLISH the optimum solution; all the
    team members participate; Through an
    adequate soft each person can do modification
    on the image of the optimum solution;
ADOPT the final solution.
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Fig. 4

Fig. 5

- The presentation of the sites, working area databases, courses and books etc.

- The presentation of the criteria for making a product. These criteria were 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. Examples of analyzing criteria in cutting tool area are: inserts type, inserts position (radial, tangential), clamping system etc.
- Each member of the team completes constructive solutions. No cancelled solutions are allowed;
- The construction of multidimensional matrix with axes as team criteria. For three criteria the matrix can be presented as in figure 6. The solutions are obtained through a combinational process. Each solution will have a code that specifies its main characteristics;
- The generation of all possible solutions;
- The cancellation of technical impossible solutions;
- The determination of criteria weights (value analysis) by the team. Each constructive solution will receive notes from all criteria points of view, by all team members). A software will compute the solution "note";
- 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 optimum solution.

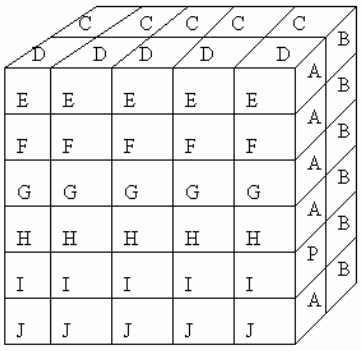

Fig. 6

6. "SAN FRANCISCO" Method

The "San Francisco" Method is a team creativity method. At the original method each participant notes on a sheet of paper, three ideas for problem solving. On the next step, each participant gives the paper to the mate paced on his right and received the paper from the mate placed on his left. Each participant completes, improves, establishes details, changes or writes his opinion about the first three ideas. The papers move until all the initial ideas pass to all the team members. In order to use this method on Internet some changes are done. The necessary steps are:

- Each participant will receive a code (P1, P2, P3, P4, P5, P6);
- Knowing the problem, each participant will write three proposal for the problem solving on the computer;
- Send the file to the participant with the following code;
- Complete, improve, establish details, change or write the opinion about the first three ideas until all he ideas are discussed by all the participants (Table 1);
- Analyze, group, compare the proposals (value analysis by giving notes to each solution, for all the criteria, by all the team members);
- Establish the best solution;
- Preliminary design of the best solution;
- Analyze these solution by all the team members;

Participant	Proposal1	Proposal2	Proposal3
Pi			
Pi+1			
Pi+2			
Pi+3			
Pi+4			
Pi+5			
i=1…6; IF i+j>6 THEN i+j :=i+j-6 (j=1…5)			

Table 1

Establish the final, optimum solution. All the participants note again the solution. In order to adopt it, generally, five from the six-team members must give the maxim note. If not, the process begins again until the best solution is obtained

7. E-RESEARCH AND E-DESIGN PLATFORM

In order to apply the creativity methods in research and design we want to build a software platform having these functions. First we analyzed the main functions and components of such a platform (fig.7). Each E-research and/or E-design activity needs a preparation period, planning activities, specific activities for stimulating the creativity in

research and design area and finally results evaluation [6]. In figure 8 there are presented some results obtained in a creativity session based on Brainstorming principles focused on face milling design – establishing variants to active part criterion [5].

VIRTUAL ENVIRONMENTS – INTERNET/INTRANET

GLOBAL WEB INTERFACE

RESEARCH-DESIGN ACTIVITY COMPONENTS

User personalization

Organization personalization

PREPARATION	ACTIVITIES PLANNING	ACTIVITIES DEVELOPMENT In collaboration	RESULTS EVALUATION
- market study - domain analysis - resolved research themes - necesities - new ideas - beneficiars - documentation - util links	- research theme - assign objectives - estimated results - quality standards - laboratory network - abilities (specializations) - research activity : actions, resources (human, materials, time, financial) - team formation (collaborations) - sides agreements - project management	- revise objectives - research development - group discussions - chat - group studies - forum (group project) - research monitoring - periodical meetings	- obtain results - compare performances - chat - forum - verify standards (quality, environment) - dissemination - accreditation - implementation - reports

Fig 7

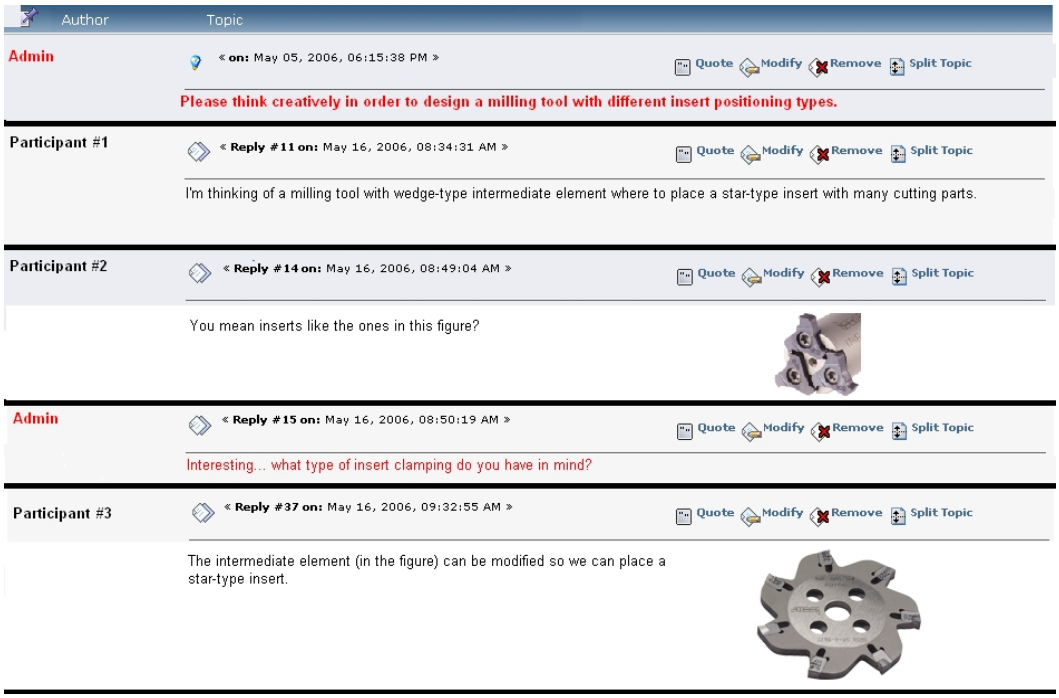

Fig 8

8. E-Research Centre Presentation

The topic of the centre fits very well in the priority field: Information and communication technologies, meant to open new horizons of knowledge and to implement applications in the field of research and education;

Implementing the results:

- building an e-research center in the field of mechanical engineering as well as drawing up the explanatory materials and the knowledge tests in the field;
- eveloping the conceptual-theoretical and methodological frame of the information and communication technologies;
- building new instruments and technologies for specific applications;
- providing compatibility requirements for Romania's integration in the socio-economic European environment, defined through the knowledge society and "e-Europe";

The specific fields in which this e-research centre will operate will be the verify of geometrical specifications (GPS and the integrated systems of production. Multidisciplinary team work on the Internet by using specific ways and methods is essencial in the integrated systems of production, where integration with the help of electronic ways used for calculation of the domains CAD/CAM/CAQ is dominating. Applying the concurrent engineering waystands methods, the teams realise common projects by the superposition of some activities which lead to the achievement of some reduced livration terms and on this way the productivity of some speciffic activities will rise. Using the PLM concept – Product Lifecicle Management, the activities from the products designing domain and technologic process, the ones from the analysis domain and optimisation with the method of finished elements, theones from the fabrication domain and the ones from the mentenance domain are conducted threw SMARTEAM and ENOVIA modules that work together with CATIA V5. The program pack AUTOFORM and DELMIA is used for the operation and products checking and simulation. The first one realises the operations optimisation at the pieces of sheet for cars industry and the second realise the mechanical working operation simulation on the tools cars with CN.With the help of Internet facilitie the teams work situated at a distance can communicate and realize a project that includes the projecting-analysis-fabrication-logistics, threw manipulation not only of the alfanumeric data files (technological dates, business data) but also graphic dates from the databases. The access to different programs is made on access levels and at the same time with these utilisations there can be made a making topical of the databases. E-Research in the mechanical engineering domains allows the achievement of a competitive product, but also the implementation of technological modern process for its fabrication.

Moreover, courses and training will be initiated in this field. Researchers in the academic milieu, in industry, doctoral students, Students will be involved in the research activity. E-research, e-Science, cyberscience, cyberinfrastructure are terms that refer to the scientific effort developed on the basis of ICT (Information and Communication Technology) using a huge amount of data. The relationship between the e-research center with other existing infrastructures will have as effect the development of new research paradigms, with new scientific methods there being no danger of parallelism among them on an international level.

Conclusions

The topic of the e-research centre is meant to develop working procedures and support that would allow research in the mentioned fields using the Internet. In order to accomplish this it is necessary to follow certain steps, through which part of the previously mentioned limitations can be surmounted.

The working algorithm for building the center requires several steps:

- development of the necessary e-research support so as to be seen by the people who are involved in research There may be two situations in this case: working with students who need more information and working with specialists in which case an updating of constructive solutions or research is needed;
- implementing and testing this support on the Internet For this process the center will develop two main departments namely the Steering Department and the Managerial Department. The Steering Department will be responsible for the setting up and functioning of the center; it will have an essential role in establishing the development strategy of the center. The Managerial Department will be responsible for supervising the setting up and functioning of the center made up of a steering committee that will decide on the

budget and will ensure liaison with the academic and technical groups in the faculty and outside it. The center will be made up of the following departments: The Leadership of the Center; Department of academic assistance; Department of technical assistance; Department of member support of the e-research center; Department of coordination of the researchers teams; Department of development and coordination of infrastructure; Department of education and training.

- creating portals and chat forums for researchers;
- creating databases for memorizing the research results;
- developing software programs for research related to the mentioned fields;
- developing software programs for education and training in the mentioned fields.
- developing software programs for education and training in the mentioned fields.

The paper presents a new notion "E-creative design"and its meaning and importance. 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.

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