A MEDIEVAL TRYPTICH, CAMEOS AND BOOKS: INNOVATIVE CONCEPTS FOR FUTURE ATM SCENARIOS

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Abstract

The work presented in this paper is an early and far term research sponsored by Eurocontrol HD within the CARE Innovative Action Programme. It presents innovative concepts for future ATM scenarios that have been developed applying CREA!, a methodology for creative design in complex systems. CREA! is based on the idea that original and innovative outcomes are not accidental but can be generated as the product of a collaborative social process of co-construction of knowledge and meaning negotiation within multidisciplinary teams. CREA! sustains an approach to innovation that overcomes problem solving and integrates methods and best practices borrowed from artistic domains. In the paper we illustrate the methodology and then present in detail a number of innovative concepts/tools for future ATM scenarios developed applying CREA!.

Introduction

The CREA! (Creative Research Environment for ATM) methodology is an inter-disciplinary approach to design in ATM that encourages intersections between art, design and technology borrowing from each discipline practices, methods and experience for the definition of innovative concepts. The approach is innovative and challenging since the exploitation of design practices and methods from disciplines different from engineering and human factors is largely unexplored in ATM. All innovation in such domain is constrained by a problem solving view, neglecting other factors like aesthetic, affective, cultural and emotional aspects of human cognition. CREA! leverages creativity in action in artistic domains and offers a process model to integrate a variety of suggestions into integrated solutions. Our research is directly inspired by Cultural Historical Psychology [1] in its attention in the study of practice to understand creative activities. The central theme of this approach is that creative activities are social and thinking is not confined to the individual brain/mind. The construction of knowledge is embedded in the cultural and historical milieu in which it arises. Differently from classical cognitive approaches like Creative Cognition [2] that have concentrated on information, its mental representation and propagation; we are concerned with the study of creative activities which involve the mastery of external devices and tools through social collaboration and co-construction of knowledge. Whilst the cognitive approach focuses on the development of conceptual schemes to describe a multilevel information processing that can explain the basic functioning of creativity, we are interested in the analysis of the social dynamics that develop in processes of collaborative meaning building. Our interpretation of creativity indeed is mainly a social process of co-construction of knowledge through the negotiation of meaning and the collaborative creation of design visions tools.

The current state-of-the-art

Creativity is a topic of interest of educators, psychologists, artists, historians of science and more recently designers of new technologies. It is a so articulated area of research that has generated a multiplicity of approaches, theories, methodologies and techniques. In what follows, we limit our analysis to methodologies that have been purposely developed for creative design in complex systems, and two case studies related to the development of innovative concepts for ATM. For a thorough analysis of the different approaches to creativity see CARE/Innovative Action - CREA Project Deliverable 4.1 Report on critical survey [3], available at www.dblue.it/home/projects/crea/CARE-CREA_DB_WP4_D4.1_V1.0.pdf

Creative design in complex systems

As stated in the introduction, the most popular methodologies for creative design in complex system are based on problem solving. Most of the effort is devoted to the problem definition; then a set of techniques is proposed to solve the problem within the boundaries defined by the initial analysis. These methods put emphasis on analysis and problem solving rather than on design. The development of innovative outcomes is regarded as an activity of searching for alternative solutions within the constraints of the problem analysis. Examples of this approach are TRIZ, a problem solving methodology based on the exploitation of best practices in creative technological innovation, and MindLink, a methodology based on a package of tools for idea generation.

"Theory of Inventive Problem Solving (TRIZ)" has been developed and systematized since 1946 in ex-USSR and has become known to the western countries after the end of the Cold War as a new methodology for technological innovation. It claims that creative ability can be increased by extracting, systematizing, and learning the essences of real cases of creative technological innovations. It is a technology oriented methodology that does not rely on theories of creativity but on the collection of best practices from cases of technology development. It is a collection of “principles of invention” applied to a three steps process: problem definition, problem analysis and solution generation. Altshuller [4] extracted 40 "Principles of invention" through his semantic analysis of patents world-wide. A key aspect of TRIZ is the use of the Contradiction Solving Matrix. Altshuller analysed the cases of technology innovation recorded in the patents; he classified the problem of each case on the 39 x 39 matrix and expressed the essence of the patent solution in terms of the 40 principles of invention. Accumulation of these analyses of patents has lead to find frequently-used principles of invention for each section of the matrix; top four principles have been listed for each section.

MindLink is a package for creative thinking and idea generation that includes a set of exercises and creative thinking tools. It can be used for a variety of application including new product development and creative writing. The program is the computer-based implementation of a creative process developed by an international consulting firm, Synectics. The package is composed of a vinyl pocket, a bag of toys and objects that is used to facilitate the creative process. There are four sections to the Problem Solver, and all are accessed through a Hypercard stack. The Gym is a place to develop the mental skills necessary for creative idea generation. Here it is possible to practice mental imaging, connecting divergent ideas, recalling events and experiences and learn to control your urge to suppress unconventional thoughts. Idea Generation is the place to begin the process of creating ideas about your problem. Each idea generation 'card' has three sections: an area to name the problem, a space to describe the problem and a place to record your thoughts and ideas about the problem. Guided Problem Solving, the third section, is a structured walkthrough that teaches the problem-solving process articulated in wishing, generating ideas, listing pluses and concerns about the idea and developing potential solutions.

TRIZ and MindLink are representative of a generalised approach to creative design in complex systems in which the development of innovative outcomes is regarded as an activity of searching for alternative solutions within the constraints of the problem analysis. Our CREA! methodology questions this approach giving prominence to creative thinking beyond the boundaries of “problems to solve”.

CORA2 and SectorLess: two case studies

In literature, there are only few examples of well documented innovative design processes in ATM. This is partly due to the fact that historically, the design of tools, technologies and procedures in this domain has been advocated to engineers and human factors experts who interpreted the development of new concepts mainly as a problem solving activity. All solutions in the years have concentrated on a progressive transformation of the radar screen, considered as the main “space for design”. Attention has seldom been devoted to exploit other areas of human perception and cognition and most of the solutions neglect factors like aesthetic, affective, cultural and emotional aspects of human cognition. Furthermore, there are no concrete examples of development of new methodologies for creative design that are not constrained by a problem solving view. However, some underway projects show that a different orientation to innovative design is being attempted.

The EUROCONTROL Conflict Resolution Assistant (CORA) Project aims to produce a controller-centred approach to conflict resolution [5] , [6]. The requirements engineering process is seen in the project as a creative process in which stakeholders and designers work together to create ideas for new systems and then to express these ideas as requirements for a new system. In this process, creative thinking is encouraged in design workshops, the purpose of which is to set up creative environments where people with different expertise and background work together.

The SectorLess project aims at developing a new concept of trajectory-based individual control as opposed to the airspace-based, sector control currently used. The initial effort of the project was mainly concentrated on the definition of the concept and at present interaction design solutions are being investigated. A significant part of the project was devoted to problem setting and on the evaluation of the cost-benefit analysis of the proposed solution (trajectory-based control) with respect to the current one (sector-based control). Most of the design activities are therefore oriented to analyse the problem and compare concurrent alternatives rather than to envision new ideas apart from the problem analysis. The design philosophy of the project is more inspired by problem solving approaches like TRIZ, where the problem domain is precisely defined from the beginning, and concurrent alternatives are evaluated in comparison with operational scenarios.

The CREA! methodology

The CREA! methodology is being developed as integral part of the CREA! project, sponsored by Eurocontrol HD within the CARE Innovative Action Programme. The project both intends to develop the methodology and to experiment it in the generation of innovative concepts and tools for future ATM scenarios. The methodology proposes an inter-disciplinary approach to design in ATM that encourages intersections between art, design and technology borrowing from each discipline practices, methods and experience for the definition of innovative concepts. The CREA! project is based on a co-evolutionary process where concept design, technology design and activity design are carried out in parallel so that each strand of the process can inform the others. The process is articulated in two main phases: divergence and convergence. Divergence includes *inspiration* to get insights from the application domain (user and domain understanding); and *elaboration* to develop concepts from the perspective of single disciplines (music, architecture, interaction design, visual design, human factors). Convergence includes a phase of *sharing* to present and confront concepts elaborated separately during the divergence phase (concept testing); and *production* to evolve single concepts in integrated “concept scenarios” (scenario testing and briefing). The process is co-evolutionary since it allows sub-processes (user understanding, briefing, concept testing…) to evolve in parallel and converge to share, refine and develop integrated concept scenarios. In the project we implemented such process through workshops, organised as a collaborative environment where artists, designers and domain experts worked in brainstorming sessions. The design team that executed the first trials was composed of artists and designers representative of a range of disciplines from visual and multi-media arts with a focus upon music, architecture, visual design and interaction design. The team was also supported by human factors and domain experts. They all worked as equal partners in the envisioning of innovative concepts and media for ATM.

The CREA! concepts

The project has developed five main concepts/tools [7]. The *Flag*, a public display that can be used to extend the action/communication area of the single user and support awareness by visualizing ongoing processes. Indeed it can work in conjunction with the *Tritticos* (figure 1), multifaceted radar displays, to provide both controllers or external observers (e.g. the supervisor) with a view of the process (what is going on in the airspace managed by the control centre - ACC). It can even work in conjunction with the *HardBook* and the *Cameo*, personal tools that allow to manage individual tasks, to display the activity that each controller is carrying out and to share visual information between different workplaces. The flags can be used for enhancing the single workspace but also for creating some independent common spaces for the representation of the processes (both procedural and metaphorical representations).

Figure 1: Flags

The *Trittico*, the main interface for the operational work integrated in a table/desktop that constitutes the main interface for the operational work (figure 2).

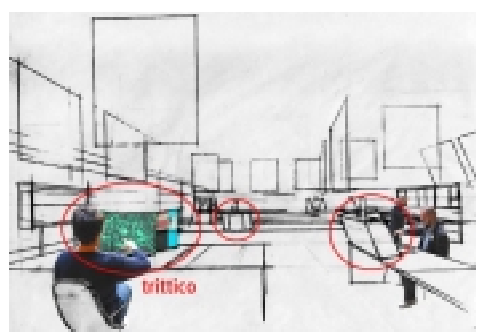

Figure 2: Tritticos

It is composed of revolving flat screens and a position tracking device. It is an interaction space based on the combination of different displays that can be configured in order to visualize, like in a medieval triptych, spatial relations and hierarchies between contents related to the air traffic control, including the visualization of aircraft in a specific air-sector, the tracking of the communication process, the flight plan etc. The physical relation between the different monitors and their manipulation defines by analogy the logical relation between the audio/visual information. The Trittico can be used by controllers to organise their "space of work": the main central area can display a "clean" radar screen whilst the lateral areas can display portions of the main area with different visualisation of data; e.g. a 3D representation of the holding area, temporal ordering of flights passing from the same fix, safety nets etc.

The *HardBook*, a personal tool that permits both to focus on specific processes and to share information and activities with others (figure 3). The hardbook is a book-like device whose pages are composed of a combination of physical consoles corresponding to different features of the tool. The first layer is a touch sensitive screen for pen-based interaction, a second layer contains the commands for communicating (contacting, storing etc.), a third layer is used to organize information, a fourth layer for tracking and monitoring etc. The hard book is used mainly in combination with the trittico but it can also be used in stand alone mode for personal data management. The hard book is a personal device but the information it contains can be shared. The interface is both physical and virtual: each page can have a screen, real buttons, printed areas and a manipulation model that mixes moving pages (to add or change the information layers) with more classical input devices, such as buttons or sliders.

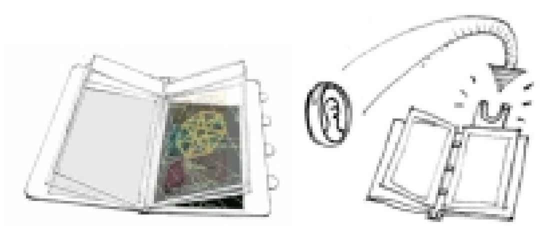

Figure 3: HardBook and Cameo

The *Cameo* a personal ID tool that allows both to set up the system according to the individual preferences and to manage the communication processes (figure 3). The cameo allows to set up the environment and its soft qualities (sound, light etc.) according to personal preferences. The vocal profile of the user is sampled and downloaded into the Cameo. The Cameo becomes the audio key to access the system and at the same time it can be used to access the whole control room. The Cameo can be an activator for the hard book or it can directly communicate with the other devices, Trittico and Flags.

The *Osmosis Skin*, flexible and adaptable partitions to organise working and resting areas. The partition defines the borders of the control room maintaining permeability with resting areas. Partitions allow different levels and points of view to support different kind of activities: the supervisor can benefit from a more general view crossing super-elevated areas and looking at the flags. Transit areas become spaces where people can rest, or work on collateral tasks.

From an early trial of the methodology, initial concepts/tools were evolved and consolidated by a constant assessment with air traffic controllers, and represented through mock-ups of the physical tools. In the following we describe in detail two of the initial concepts: the trittico and the hardbook. For each of them, we developed functional specifications and a benchmark to assess the technological solutions currently available to implement the tools.

The CREA! system

At the state of the art, the CREA! system is characterized by the convergence of the features of the initial five tools (Trittico, HardBook, Cameo, Flags and Osmosis Skin) to a restricted set of tools, basically Trittico, HardBook and Flag, that maintain all features and functionalities of the previous tools but in a more integrated way. These tools have been mapped on the air traffic control activity to assess their level of support. Three main phases of the air traffic control activity have been identified with the help of air traffic controllers:

- **acquisition**, the phase in which the controller accesses preliminary information about the traffic in the area of competence (sector-s),
- **management**, the phase in which the controller manages traffic in a specific area of competence (sector-s),
- **debriefing,** the phase in which the controller elaborates information related to the previous activity, shares this information with other

controllers, uses recording of activities for training purposes.

Currently design solutions and technological tools exclusively support the management phase, mostly ignoring the other two phases of information acquisition and debriefing. To date the **acquisition** phase is very demanding and onerous. It consists of collecting and processing information, and memorization of relevant data to be used during the operational work. "*Today when there is something new to learn, like new regulations, we receive a paper folder to study. If there are changes to the initial prints, a notice is posted on the bullet board and we have to go and ask for the errata and then add it to the initial folder*"- controllers explained. The air traffic **management** phase is mostly supported by tools integrated in the controller working position and in particular by the radar screen, which unfortunately is overloaded by visual information. Regarding the post-operational phase, that we called **debriefing**, there are no tools or devices specifically devoted to support it. Currently air traffic controllers can access data records of a previous turn work, but such access requires long procedures, so that it is seldom used. Nevertheless it could be very useful for personal reflection, and post analysis to store data and access them at any suitable time (free time, on road to work, dedicated hours in working time…). Part of the debriefing phase can also be considered as a continuous learning activity which at present is structured in training courses controllers have to attend on a regular basis. Each tool we developed has a specific focus in supporting these phases. In the following we concentrate on the two main tools of the CREA! system, the HardBook and the Trittico, describing their *look&feel* and their role in supporting the three phases of the air traffic control activity.

The HardBook

The HardBook is a book-like device whose structure is made of two touch sensitive screens and whose pages are made of physical frames corresponding to different features of the tool. Browsing the pages permits to activate the correspondent functional layer and to interact with the system through a pen-based interface (figure 4). The first layer permits to set up the system according to personal and/or activity related preferences and to interact with the Trittico to select and organise information. The second layer is used to access and browse activity related resources. The third layer contains the commands for communicating (calling, archiving communications, etc.). A set of devices to be used with the HB provide specific features: the Pen is used for text input and as a pointing device, the Memory Cards for storing and exchanging information, the Cameo for personalizing the features and preferences of the system, revolving Speaker and a Microphone for audio capture and play-back. The Hardbook indeed contains a simple software for audio editing allowing the user to collect, store, access data. This makes possible the recognition of specific points in the communication proceeds. Among parameters: volume (dB), speed, rhythm of sentences (sound/silence).

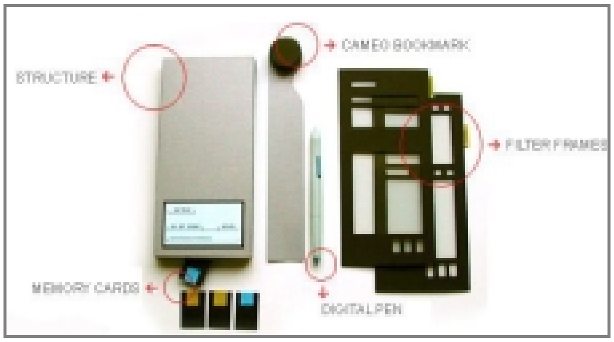

Figure 4 The HardBook mock-up

At the current level of system specification the Cameo is physically hold in the HardBook, once it is located into the Cameo Holder (figure 4), it activates the personal tool, defining which work station will host the controller, which sector s/he will control, the turn shift and all personal preferences saved as desired configurations (e.g. default information display on the Trittico). The HardBook has a crucial role in every phase of the air traffic controller activity, from acquisition, through management up to the debriefing phase.

Acquisition

Activation through the Cameo logs the HardBook to the information system of the ACC: logging to the system indeed establishes the relation between a single individual and a specific activity in relation to her/his role and turn shift. Once the controller has activated a HardBook through the Cameo (figure 5), s/he will be able to acquire all relevant information, that to date are available on bulletin boards, manuals, *errata* to manuals.

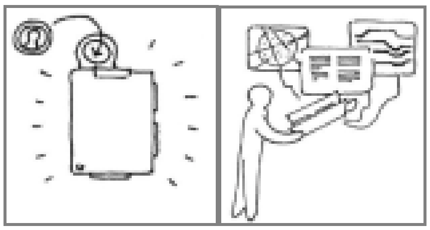

Figure 5 Logging the HardBook

If the controller is close to start a work turn s/he will also be able to download general information pertaining the sector and the air traffic flow s/he is going to manage. The activation with the Cameo does not represent a responsibility shift with other controllers. It simply enables the passive acquisition of a range of relevant information. When a controller is getting in turn, the HardBook displays the working position to reach and allows to *passive listen* what is going on that working position (figure 6). Transition from the pre-operational and the operational phase is thus supported by an effective device sustaining incoming controllers to get into actual traffic flow.

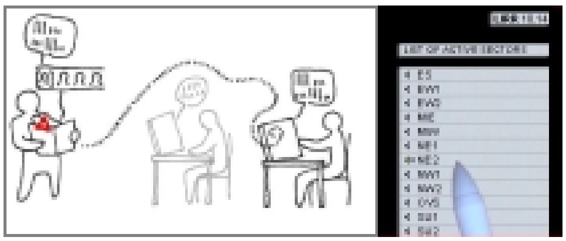

Figure 6 Passive listening

During the acquisition phase the HardBook supports the controller in the acquisition and storing of relevant information ensuring updated information situation awareness.

Management

The actual turns shift is enabled by the exchange of the sector smart card, so that in no case two executive controllers can be in charge of the same air space (figure 7). Only when the switch has taken place the incoming controller is allowed to operate on the radar working station.

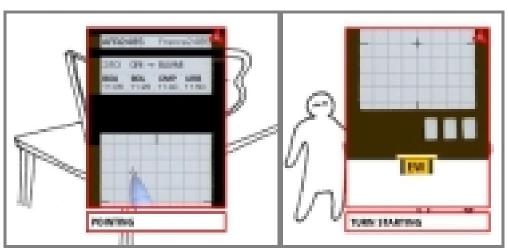

Figure 7 Turn shift

As previously mentioned, the HardBook interacts with the Trittico through a Digital Pad and Pen. Digital Pad and Pen allow to manage traffic, to select information, to activate or highlight information items. The HardBook supports quick information browsing, since the activation of one node of information (for example a callsign) spreads over the available layers of information. For example when the controller selects a flight from the Digital Pad, details on selection are activated on the main interaction page, and, contextually, if the controller turns a page of the HardBook and access the communication pages, the previously selected flight is by default activated on the communication modality. Information browsing is therefore implemented through the metaphor of turning pages of the HardBook.

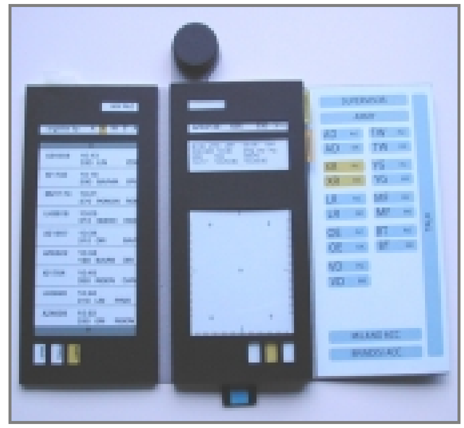

Figure 8 Configuration of the management phase

Moreover, HB manages communication flows during the operational phase: an enhanced AUDIO LAN is integrated in the tool and is always available as shown by figures 8-9.
Communication resources of the HardBook include messenger functionalities to receive and store textual and audio messages and to reply in both audio/ textual mode. It also allows to record air-ground communication to listen again and visualize unclear communications.

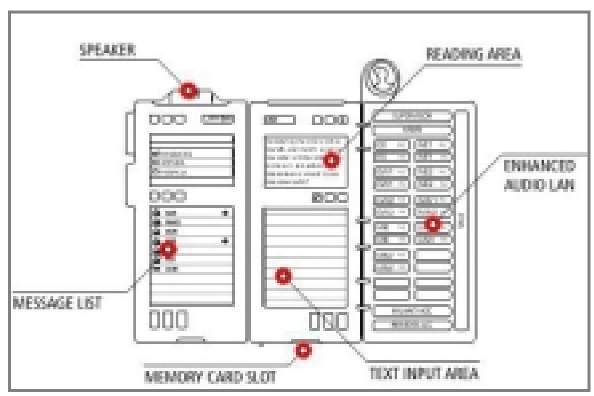

Figure 9 Communication functionality

Debriefing

The debriefing phase refers to a rather heterogeneous set of scenarios, from turn shift and peer-to-peer collaboration to continuous learning and post-work analysis of potentially interesting situations. To support this phase the HardBook implies a system of smart cards that allow to archive and manage information, and to share them with colleagues or young controllers during training.

A key aspect of the smart card system is the possibility of nomadic use of information that is not constrained to the working position. In this respect, the HardBook is designed to support a smooth transition from the working environment to the private life and vice versa.

Trittico

The Trittico is a multiple display tool integrated in a table/desktop that constitutes the main interface for the operational work (figure 10).

The interaction metaphor for the Trittico is called View With Context: the content displayed in the central screen determines the type and quantity of related information to be displayed in the secondary screens (figure 11).

Figure 10 The Trittico mock-up

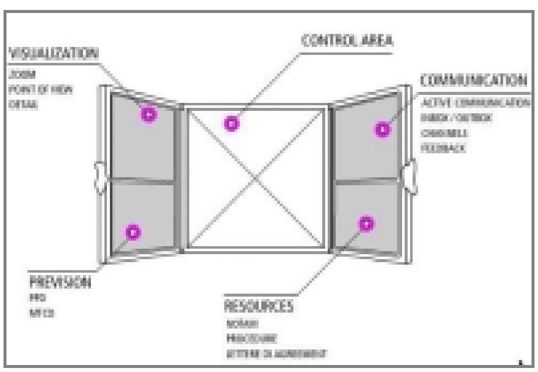

Figure 11 The multiple screen display

The central area of the Trittico is basically dedicated to the radar but can be used also in different situations for activities focused on the features of the secondary screens like communication, access to resource, multiple visualization and prediction (e.g. TLS or MTCD). The interaction space of the Trittico, based on the combination of the three displays, can be dynamically configured in order to visualize, like in a medieval triptych, spatial relations and hierarchies between contents related to the air traffic control, including the visualization of aircraft in a specific air-sector, the tracking of the communication process, the flight plan etc. The physical relation between the different monitors and their manipulation defines by analogy the logical relation between the audio/visual information. The Trittico-Table can be disposed in different configurations allowing the creation of single/multi-user working spaces and can be used also in the vertical position like a sort of white board. An audio environment supports sound spatialisation allowing to establish an intuitive relationship between the flight route and the pilot's voice in communication with the controller.

As mentioned before, the Trittico dialogues with the Cameo and the Hardbook which allow the customization of user preferences. The controller can configure the working position (both) setting preferences and orientating the screen of the Trittico. The Trittico indeed can be completely opened to display an enlarged radar screen to share the visualisation with other controllers or to view the situation at a wider scale. It can also be closed creating an immersive environment that supports controllers concentration and isolation (Figure 12-13)

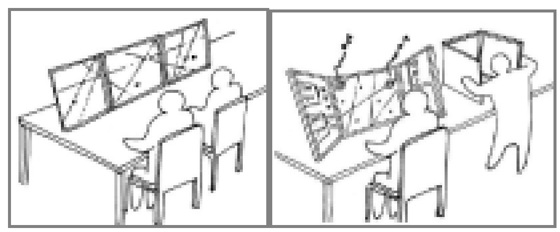

Figure 12 Different configurations of the Trittico

The open configuration of the Trittico sustains the transition from pre-operational to operational activity, enabling the acquisition of information on the traffic and current situation. The incoming controller can observe and passively listen air-ground communication (Figure 6).

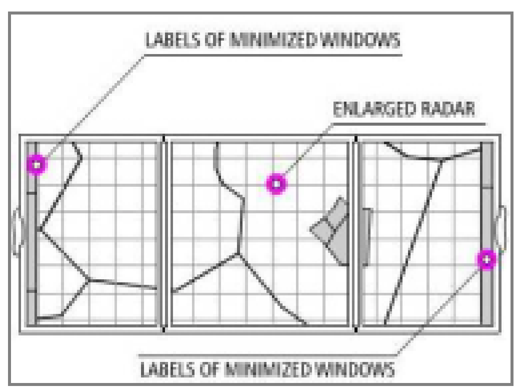

Figure 13 Enlarged radar screen

Management

The central area of the Trittico is the main interface representing the radar screen. Information visualisation can be customised but the contents are fixed and are related to the role played by the controller and to the correspondent tasks. The peripheral areas are temporary workings spaces: the controller can set both information contents and presentation, although information is set by default to current management situation (Figure 14). This visualisation technique is called "view with context" meaning that starting from a primary information that corresponds to the "view", a set of secondary correlated information is displayed providing the "context".

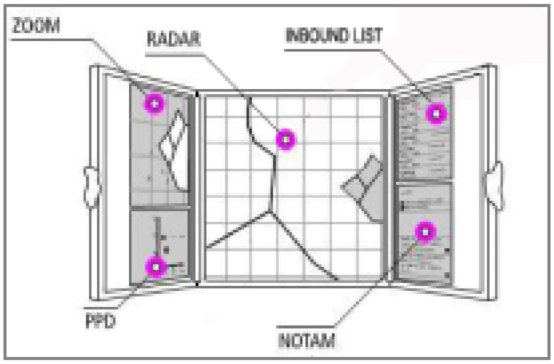

Figure 14 View with Context

The radar control activity is augmented by sound spatialisation which gives the impression of directionality of incoming calls from pilots (Figure 15). This feature supports the controller in a quick identification of the calling aircraft on the radar screen, and it is particularly effective with the enlarged radar screen configuration.

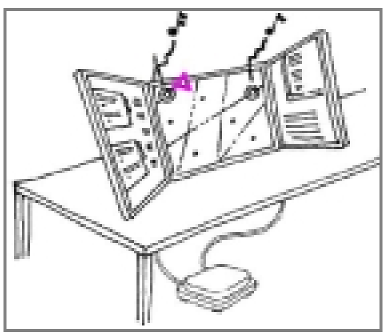

Figure 15 Sound spatialisation

Sound spatialisation is only one of the elements constituting the Advanced Audio Environment which constitutes a distinctive trait of the multi sensorial quality the CREA! System. For example, audio features have being studied to provide the separation of the control rooms in smaller working areas. "Sound pillars" can support a clear projection of sound on certain areas so that audio messages can be heard exclusively by the person working on that specific area.

Debriefing

In the debriefing phase the Trittico can be used to access saved files (particular traffic situations, case-history etc.), to visualize textual information (regulation, manuals…) as shown in figure 16. In such a modality the Trittico has a function of supporting customized training on the job, including simulation activity.

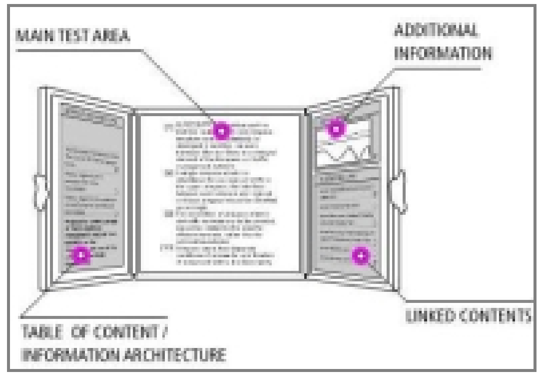

Figure 16 Textual information on the Trittico

Concept evaluation with end users

All concepts developed in the CREA! project were constantly evaluated with air traffic controllers to assess their potential level of support. One of the methodological problems we faced in evaluating the concepts was the difficulty in making material and concrete very high level ideas and completely futuristic scenarios. Our problem was to represent high level design concepts in physical and tangible objects and to simulate scenarios of usage.

The approach we adopted was inspired by "discount usability engineering" [8]. This approach suggests to adopt cheap, fast and easy to use methods that still achieve the goal of designing effective solutions, that affect human activity providing added value. These techniques include brainstorming, focus groups, mock-up development, storyboarding, scenarios, walkthroughs and heuristic evaluation.

The initial concepts were presented in brainstorming sessions where we illustrated the main ideas on the basis on animated presentations and storyboards. Afterwards the main tools were developed in form of physical mock-ups, cardboard objects reproducing as much faithfully as possible their *look&feel* (size, weight, components, colours, information contents). Therefore a set of scenarios were developed , each one containing a rational and a description of a specific situation to manage. Representing the use of the system with a set of user interaction scenarios is particularly effective since it makes that *use* explicit, and help designers to focus attention on the assumptions about people and their tasks that are implicit in system [9]. Scenarios indeed emphasize and explore goals that guide users in their actions, so that these descriptions of usage situations impels designers to consider system requirements in relation to motivational and cognitive issues that underlie users' actions. Scenarios have the plus of not only exposing system functionalities, but to be able to convey a clear grasp about how the user will access those functionalities, and what s/he will experience in doing so. In other words this technique allows to embed reflection in the design process, without postponing it to an ancillary phase of evaluation. Being both concrete and rough scenarios make explicit the design goal of specifying tasks and functions in greater detail.

Five controllers were involved in this activity and we meet them on a regular basis. All sessions were video recorded and analysed to collect feedback. During the brainstorming, controllers were asked to play the role described in the scenario and to pretend to manage the situation using the mock-ups. The designers made the situation more dynamic by substituting the paper sheets on the trittico to simulate the evolution of the situation and the visualisation of information of the cardboard displays. At the end of the scenario, controllers were involved in a debriefing sessions to discuss problems and envision solutions. The reactions of the controllers were extremely positive, in particular they appreciated the HardBook and the Trittico as tools that can have the potential to truly improve their work. All the comments received from controllers were used to redesign parts of the tools and to consolidate the concepts. At the state-of-the-art, the project is developing functional specifications of the CREA! system and a technology benchmark to select enabling technologies for implementing the tools. The project will finish in February 2004 and will develop low-fidelity prototypes of the tools for demonstrating design concepts.

Conclusions

The design of innovative concepts in complex systems is a challenging area of research. Standards, regulations and the difficulties of envisioning truly futuristic scenarios often constraint creativity and orient towards conservative solutions. In the paper we presented innovative concepts for visionary ATM scenarios that offer sustainable solutions for improving the quality of life in the work context. These scenarios take into account a wide unit of analysis and span from an alternative use of the physical space, to the distribution of media in the context of work, the exploitation of sensorial paradigms for interacting with technologies, the definition of media for sharing memories and support the life of the community. The concepts have been developed applying CREA!, a new methodology for creative design in complex systems that, by exploiting techniques and best practices from artistic domains, claims that creative design cannot be confined to a cognitive activity of looking for functional answers to given problems. Very often indeed, a creative output comes out from the redefinition of the space of the problem. The process of creation goes beyond the simple addition of new information onto the pre-existing information, most of the times being based on a redefinition of the reasoning premises themselves [10].

Inspired by the Cultural Historical Psychology, we are defining a methodology that encourages intersections between art, design and technology actually starting from a redefinition of the conceptual space of the problem fostered by the divergence of each of these disciplines' practices, methods and experience. Approaching the conceptual space from divergent perspectives obliges to negotiate the construction of a shared meaning. The result of such negotiation process is the envisioning of innovative concepts.

The CREA! approach is also reinforced by the theory of multiple intelligences [11] which does not consider creativity as an intelligence itself. Indeed it treats creativity as a wave through the different kind of intelligences, which do not operate individually, but are used together. Indeed our methodology is an example of interaction among the "owners of the different intelligences" in order to emphasize the value and richness of each single discipline coming out in a totally new creative product that is a creative synthesis of the different field's peculiarities. Finally it is important to highlight that the CREA! both relies on social processes of co-construction of novel ideas and on the social judgment of its results. In agreement with Csikszentmihalyi's [12] and Gardner [11], we reckon the importance of the role of field gatekeepers selection for inclusion into the creative process. Indeed a crucial phase of our approach to innovation consists in collecting feedback from the field, in the specific case of the project, through focus group with air traffic controllers to assess the values of the proposed solutions. In this sense, the creative process is a social process whose product is recognised as creative and new by the community of practitioners.

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