

# **COSTART: COmputer SySTems for Creative Work: An Investigation of ARt and Technology Collaboration**

## ***Summary of the Project and Outcomes***

*February 2003*

### **Background**

This report provides an overview of the objectives and outcomes of the COSTART project and identifies ongoing research activities. The COSTART project addressed the design of computer systems for creativity support. The focus for this project was the visual arts, where the capabilities embodied in the new media afford significant opportunities for the generation of creative works. Phase one, the feasibility project (UK EPSRC Grant GR/M/14517/01), took place over eighteen months during which seven artist-in-residency studies were carried out. From this project, a number of research questions in the areas of opportunities for developing innovative digital technologies, support environments for technology development and user learning and creative cognition were identified. The work provided a framework for COSTART 2, in which a further ten studies were undertaken, and is documented in the book "Explorations in Art and Technology" [1]. The outcomes of the COSTART project are significant contributions to the emerging research area of computation and creativity. The research results are documented in 10 journal papers and 20 refereed conference papers. International presentations and invitations indicate the strong international context in which the project sits. Exhibitions and performances were important outcomes that reflected the overall approach in which the co-evolution of research and creative practice was a corner stone.

### ***International Context***

In the mid 1990s, the importance of providing computer support for creative practice was identified within the EPSRC Human Factors Programme. At about the same time, the Technology Foresight initiative identified Creative Media as a strategically significant area and recommended activities such as artists-in-residency programmes to develop and promote both technological and organizational initiatives. This project, and the feasibility study that preceded it, has redefined the creative practitioner residency as a vehicle for research. In both phases of the COSTART Project, a Creativity and Cognition Conference was held at C&CRS Loughborough University in the UK [2]. This conference series is sponsored by the Association of Computing Machinery Special Interest group for Computer Human Interaction and is a gathering point for key researchers in computer systems for creativity. It also brought together key figures across the disciplines that inform and extend the study of creativity and creativity support tools. Creativity and Cognition, as a field of research, has evolved and matured since the starting points in the early 1990s. It offers much that is relevant to the development of the new HCI and its application to IT artefact design. The conference series is continuing to provide a means to strengthen and extend the international community of researchers who are delivering new interaction tools for creative users and extending out understanding of the role of such tools in creativity.

### **Presentations at international conferences:**

- *CHI Workshop 2001* "Tools, Conceptual Frameworks, and Empirical Studies for Early Stages of Design"
- *CHI 2002 Introduction to Closing Keynote Address*: The performance artist, Stelarc, gave the address introduced by Ernest Edmonds. Stelarc contributed to the COSTART book and gave a keynote talk at Creativity and Cognition 1999 when he became better known to the HCI community in the USA and Europe.
- *Information Visualization 2002 Keynote, London*: "Visualizing Correspondence in Art and Music" was presented by Ernest Edmonds
- *Consciousness Reframed, the Fourth International CAiiA-STAR Research Conference, 2002 in Perth, Australia*: Three COSTART papers were presented by Ernest Edmonds and Linda Candy.
- *CHI Workshop April 2002* "Creativity and Interface" Edmonds participated and presented COSTART work. From this, a special section of CACM arose in which Edmonds and Candy were invited to contribute papers.
- *International Convention on Technologies for Music, Paris, October, 2002*: A presentation entitled "Max/MSP and its use in the COSTART Project" was given by Sandra Pauletto.
- ISEA, Nagoya, Japan November, 2002 : A COSTART paper was presented by Ernest Edmonds.

### **The following invitations to perform his work were made to Mark Fell:**

- *Activat*: Electronic Art Festival, November 2002. Pamplona, Spain.
- *Radar*: Festival Of Music And Digital Art, September 2002. Copenhagen, Denmark.
- *Bios*: History And Aesthetics Of Computer Games, April 2002. Athens, Greece.
- *Game On*: Opening Event Computer Game Retrospective, April 2002. Barbican, London
- *NOTO* event: Festival of installation art, Raster Noton artist Carsten Nicolai. June 2002. Chemnitz, Germany
- *Mutek*: Montreal Festival Of Music Technology, June 2002. Ex-Centris, Montreal, Canada.
- *Frequencies/Hz Audio Visual Spaces*: Sound And Audio Visual Art, February 2002, Frankfurt, Germany.

## **Key Advances and Supporting Methodology**

The COSTART project took place at the Creativity and Cognition Research Studios (C&CRS). The main purpose is to bring together expertise and common interests deriving from prior work in Human Computer Interaction, Creative Media and Digital Art Practice. The project used the facilities of C&CRS as its base-line provision for exploring a specific research agenda. The infrastructure that supported this process was extended and adapted to meet the needs of user goals and a diversity of technical requirements. Technology to support the rapid prototyping of distributed, multi-user support systems was used to enable creative exploration by artists in collaboration with technologists.

The aim of the second phase of the project was to extend the studies of artists in residence carried out in the first phase in order to investigate specific questions about the characteristics of collaboration between artists and technologists. The approach adopted was to investigate the creative practice of visual artists and to establish conditions for exploring and observing the implications of, and for, new digital technology. The specific objectives were as follows:

- To conduct studies of the processes by which artists develop new creative media in collaboration with technology experts during a series of residency programmes.
- To test and extend the process models of creativity, building upon an existing criteria-based model developed by the applicants from studies in design and science, and testing its general applicability.
- To develop and promote practice-based research in computer supported collaborative creativity.

The last objective, although not explicitly listed in the original proposal objectives, is implied in the general aims. In practice, this proved to be vital to fulfilling the achievements of the project. The planned tasks undertaken in order to achieve the objectives fell into four primary areas. These were: a review of the outcomes of phase 1 of COSTART, a new set of artist-in-residence studies, a set of context studies that gave a broader perspective to the work and some significant dissemination actions that covered both phases of the research.

At the outset of the second phase, extensive discussions based on some key questions that were identified in feasibility study, took place with the artists from the earlier artist-in-residencies. A one-day workshop was organised in January 2001 sponsored by the Collaborative Arts section of the Arts Council of England in which twenty artists and technologists from C&CRS participated. The issues discussed included a number of questions that had remained open at the end of the feasibility study. Some of the artists who had been involved in that project had already embarked upon new technology-based projects. The discussion was reported to the Arts Council and published in Whale [10].

Ten case studies of art and technology collaborative creativity were carried out following the approach developed in the first phase of the project. The methodology of practice-based research was developed further [4, 5]. The aim was to apply lessons from the first phase about achieving successful partnerships and to study the way the collaborative process developed. In assessing the level of success compared with the first phase studies, there was a similarly high degree of satisfaction amongst the artists. One test of whether or not the approach was successful is in the number of projects that were exhibited in one form or another at the Creativity and Cognition 2002 exhibition just two months after the period of residency. In the short time available, the outcomes ranged from a near exhibition ready interactive installation to new grant proposals for acquiring funding for further work. As this report is being written, development work is ongoing such is the interest and enthusiasm for collaboration of this kind. In respect of the process aspects of the collaborations, a number of issues have been identified which provide insight and understanding about the collaborative creative process and technology. The data gathered comprises a set of verbal protocols kept as sound files and text transcripts, interim experiments i.e. images, sounds, prototype systems, etc, as well as still and video snapshots of the collaborative work in progress. These formed a set of data showing the progression for the work throughout the residency time. In the two phases of the COSTART project, a total of 16 residency studies were carried out.

The project has produced immediate outcomes for public dissemination as well as research results that are intended to have more general relevance. The results of the collaborative projects, the art works and art systems were presented in a public exhibition at the ACM SIGCHI conference, Creativity and Cognition in September October, 2002 [11]. The COSTART data analysis is an ongoing process and preliminary results are currently being prepared for publication in reports and papers. Initial findings have been described in a paper to be presented at the international conference HCI International 2003 [12]. The rich set of material that has been acquired will provide a basis for further research into collaborative creative practice and computer support starting with a sponsored PhD programme to commence in March 2003. Further publications are planned for a special issue of the International Journal of Human Computer Studies and it is also anticipated that a book length publication about the art-technology case studies will be forthcoming.

Several strands of research were undertaken in order to establish a broad understanding of the field and its context. The state of the art investigations provided a sound basis for the identification of suitable technologies to meet the requirements of the collaborative art-technology projects. An account of how the technology was developed to meet the needs of creative practice is provided. The research into the general context of art and technology-based creativity comprised: on-line creative communities, interactive art environments and systems for enabling sound and visual correspondence. The results appear in three reports [7,8,9] and are summarised below.

The report on online communities in support of creativity attempts to expose some of the differences between these virtual communities and our conventional real-world communities. Dreyfus [13] suggests that the way that we relate to

other people and events in the virtual online world is not the same as the way we conduct ourselves in the physical world. While embodied interaction with others involves some personal risk and therefore requires a degree of personal commitment, in the virtual world we can, within just a few minutes, leave (or be ejected from) one community and join another. This impermanence and abstraction in our involvement in online communities leads us to behave in a different way in the virtual world. Of course, our physical interaction with others is also very different when it is mediated by digital technology. Mamykina et al [14] emphasize the importance of free flowing communication as a 'necessary condition for reaching a creative vision' and other research findings such as those of the COSTART project [4] bear this out. Even using the latest videoconferencing technologies, for example, communication with a remote collaborator is not the same as a face-to-face discussion and the report investigates the significance of this [7].

In the work on interactive environments, the debate about interactive art is placed within a wider and problematic context that both constructs and explores relationships between technology, culture and creativity. The area covered by this report is considered to be a small part of this overall picture. The report shows how many of the themes raised in a study of interactive art can be applied to wider debates about technology, creativity and culture, and to show how such a model is flawed. Similarly, interactive art practice is placed within a framework of other artistic practices such as digital art and time based media [8]. The report classifies the interactive 'object' into spatial, tactile and physiological, causal and semantic, geographical distributed and centred, multi/single-user categories with examples of works from the COSTART artist in residency studies. The potential for interesting and challenging areas for further research is highlighted. Technical methods and procedures are outlined and categorized.

Another area of research explored is that of image-sound systems in art and technology. The report includes both the historical background and the state of the art of the subject [9]. Two factors are the main motivations for such a research. The first is based on the recognition that new digital technology has given us, for the first time in history, the means for technically "equating" the visual and the aural world by mapping both sound and image to digital information. The research addresses the question of what are the consequences, both in art and technology, of this "equation" and if it is possible to consider the audio-visual field as a whole rather than the combination of two different artistic and sensorial fields. In almost all of the COSTART studies, both sound and image were used, indicating that the integration potential of digital technology is vital to innovative creative systems: examples are direct mapping between sound and visual parameters, algorithmic composition of audiovisual animations, non-linear editing, etc.

For the future technology requirements task, investigations were carried out in response to identified artists' needs. Technology development was undertaken both before and during the residencies and followed up afterwards for the length of the project. The outcomes appear in a report [15] that describes the technology developed during the COSTART Project, the collaborative projects and their influence in the creative process.

In order to meet the requirements of artists to integrate sensor systems and methods of embodied interaction into their artworks, a hardware device, the 'Sensor Box' was created. This device avoids the need for building specific hardware and software solutions that is normally outside the expertise of the artist. The goal was to interface directly with popular environments that are used by artists, such as Max/MSP [16]. A first version of this system was employed and tested during the COSTART residencies and used in some interactive works during the C&C Conference Exhibition. This experience has proved very useful for identifying the final specifications of the system and for initial testing [17].

In the research into creativity, earlier work was confirmed and two particular aspects were developed further. The follow on research brought a rather new perspective to visual art practice. The model that best fitted the work observed was more similar to film production than to traditional artwork. The team-based processes of film making require not only different roles, but also specialized expertise that is dedicated to achieving specific outcomes. In the technology-based creative process, there are similarities. The matching of one to one participants was not the only form of collaboration that was necessary. The project partners were working within a larger context of other available expertise and this proved to be a contributor to the success of the work for both artist and technologist. The total collaboration was close to the heart of the creative process aspects of the work and not just in production. Another issue, that of *Flexibility*, which had been identified in the COSTART phase one project, developed into a very specific concern for the inter-relationship between the creative process and the software tools employed in that process. In particular, visual programming environments, and Max/MSP in particular, turned out to be significant in enabling a flexible development process and encouraging close collaboration at every stage between technologist and artist.

The findings from the COSTART2 project are described in detail in a number of reports and papers as follows:

- The approach developed for practice-based research into co-evolution in art and technology [3].
- Selection criteria, procedures and artist-in residence data documentation and analysis [4,5,6,18]
- Support for creative communities through WWW technologies [7].
- Interaction environments for creative practice [8,19,20]
- Image-sound systems in digital art practice [9, 20]

*Revised May 2005: The number of publications for this project as follows: journal papers-10 refereed conference papers-20, authored book-1. (see full publications list on web site)*

## Research Impact and Benefits to Society

The COSTART research model was influential in the creation of the joint AHRB/ACE research programme based on artist in residence studies. Applications for funding for directly related work have been made to EPSRC, AHRB, the IAP-IST programme in Australia (jointly with IBM, New York) and the Australian Research Council. A EU FP6 project proposal is under development, which includes BT and the Tate Gallery, London as partners. The importance of innovation and creative life in society today is increasingly understood to be of both cultural and economic value. The COSTART research is contributing to enhancements of our understanding and ability to employ technology in this context,

The project has led to the production of thirty refereed papers, a book and eight other publications.. The ACM SIGCHI Creativity and Cognition Conference and Exhibition (October 2002) were, in themselves, also significant outcomes [2]. The research will continue through a range of international projects, some of which have already been funded and some for which applications have been made as well as through agreed collaborations and further funding proposals. The outcomes of the two phases of the project are significant contributions to the emerging research area of computation and creativity. The work is prominent internationally. Westminster University is employing the methods developed within COSTART, as is the University of Technology, Sydney. Other research groups, for example, at Goldsmiths College London, are in discussion about doing the same.

## Expenditure: Contributions and Sponsorship

### *Sponsorship by collaborating parties*

The organizations that collaborated with the COSTART project include the Association of Computing Machinery (ACM), The Arts Council of England (ACE).

#### *ACM sponsored:*

- o Conferences: Creativity and Cognition 1999 and 2002

#### *Arts Council of England sponsored:*

- o Media Centres Workshop to discuss organisational issues, 2000
- o Workshop to discuss artist-in-residence research processes, January 2002
- o Artists' special projects sponsorship to supplement support for artists in residence

### *EPSRC sponsored events*

- o EPSRC sponsored Panel: Research Agenda for Creativity and IT: Panellists: Steve Benford, Bronac Ferran, John Gero, Kumiyo Nakakoji, Ben Shneiderman: Sponsored by the Engineering and Physical Sciences Research Council of the UK

## Further Research or Dissemination Activities

There are ongoing plans for further work related to this area of research. These are summarised below.

### **Creativity and Cognition Conference Series**

In both phases of the COSTART Project, a Creativity and Cognition Conference was held at C&CRS Loughborough University. This conference series is sponsored by the Association of Computing Machinery Special Interest group for Computer Human Interaction and is a major gathering point for key researchers in computer systems for creativity. It also brought together key figures across the disciplines that inform and extend our understanding of creativity and creativity support tools. Leading figures in their fields who gave keynote papers at Creativity and Cognition were: in 1999, Marvin Minsky (AI), Ben Shneiderman (HCI), Stelarc (Performance Art) and Harold Cohen (Art); in 2002, Brent McGregor (Art History), John Gero (Design), Nigel Cross (Design) and Jack Ox (Art). The conference series will continue; the next one is planned to take place Sydney in 2005. A smaller, intermediate, international meeting on the nature of expertise in creative design will take place in November 2003.

The success of the foundation work of COSTART is indicated by the ongoing research grant proposals, collaborations and post-graduate research programmes that have arisen from the work. A research grant proposal for a Centre for the Study of Digital Arts Processes has been submitted to the Arts and Humanities Board. The C&CRS Loughborough involvement arises directly from the COSTART project. The work proposed will involve six projects with an overarching ethnographic study using the COSTART methodology. The duration proposed is five years. The partners are the Universities of Westminster, West of England, Sheffield Hallam, Dundee and Loughborough University The total amount for the Loughborough contribution is approximately £140,000.

Interdisciplinary Research in Digital Technologies for Creativity is to be continued with the establishment of a Creativity and Cognition Research laboratory at the University of Technology, Sydney, Australia, led by the Loughborough C&CRS founding director, Professor Ernest Edmonds, who has agreed a collaboration to continue the work with Dr Roger Knott of Computer Science, Loughborough University.

A number of EU Framework VI proposals are being developed in which the COSTART work is being used and are

planned to be extended further. To take one example, BT Exact Technologies (Future Content) are working with (in the UK) Goldsmiths College and the Tate Gallery towards a bid that will develop the artist-in-residence model applied to interactive and web-based environments.

Two research grant proposals have recently been made by Ernest Edmonds to Australian bodies in order to extend the COSTART further. In both cases strong collaboration with the UK is planned and at least one further proposal to the EPSRC is anticipated. A EU project proposal is under development led by the BT Future Content Research Group. Developments of the work in Australia include collaboration with researchers at IBM Thomas Watson Research Centre, New York and with the Powerhouse Museum, Sydney.

There were several post-graduate programmes that drew upon and extended the research areas under investigation in the COSTART project. All students were funded independently. One of the project research associates was given time to pursue his research which provided a valuable contribution to the outcomes. Arising from this work, a further nine PhD research proposals have been developed and will commence March 2003 at the University of Technology, Sydney (UTS) and supervised by Ernest Edmonds. Five of these have been sponsored by UTS. In the UK, Sandra Pauletto was appointed as a research assistant in the Electronics Department of the University of York where she will be working on an EPSRC project from April 2003 when she will also begin her PhD studies [21].

The establishment of sustainable collaborative relationships was an aim of the COSTART work and a number of the projects are ongoing. George Saxon and Mark Fell will continue their work in interactive video installations. They plan to exhibit new work this year. Yasunao Tone and Mark Fell are continuing their collaboration with a trip to New York to progress the work. Dave Everitt, an artist from the first phase COSTART residencies, and Sandra Pauletto, research associate and technology collaborator in COSTART 2, are collaborating on the Sonification of Data at York University. Sandra and Adriano Abbado who worked together in COSTART 2 will also continue their collaboration on interactive sound and visual correspondences begun under COSTART 2. In the collaboration between artist Ray Ward and technologist Alastair Weakley further work has taken place and a system is under development. Ernest Edmonds and Mark Fell, both on the research team, have continued to collaborate on a number of visual-sound art works which have been exhibited in conferences and galleries internationally.

The future of C&CRS at Loughborough University is uncertain at this time. In order to continue the research, Dr Roger Knott of the Department of Computer Science has an agreement to collaborate with Professor Ernest Edmonds, the founding director. With the latter's appointment to a research chair in Computation and Creative Media at the University of Technology, Sydney (UTS), a parallel operation has been established which can provide a basis for continuing collaboration. There are nine new PhD research programmes arising from the COSTART research that will commence at UTS in March 2003. This will ensure the continuity of this fertile and innovative area of research. Future projects look promising and Edmonds has a remit to develop international collaboration in the area that includes existing and planned European partnerships, including UK universities.

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