# Collaborative Expertise for Creative Technology Design

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The paper draws upon studies of technology experts working as partners in creative art collaborative projects. These studies form one aspect of a larger and broader investigation by the authors into the nature of creativity, collaboration and computer support. The particular issue of expertise in creative collaborations provides the focus for this discussion. The subjects discussed are team building, the role of the "new" and learning in creative technology design as well as the use of computer based shared language representations. Finally, the human qualities in relation to collaboration that are needed beyond raw subject domain expertise are discussed.

When experts choose to collaborate, the incentive to do so may spring from different sources. In many organizations, the expert's role is to provide a specialised contribution to a complex project in which there may be several other contributing disciplines. An expert's brief is to show the other project members what his particular expertise can offer to the whole enterprise. Experts identify potential problem areas and bring forward solutions to these in advance of the physical realisation of the product. In large-scale projects involving major safety and cost implications, such as a public building, it is vitally important that expert opinion is brought in early to examine and interrogate the conceptual design for potential pitfalls in order to avoid less than optimal, or even disastrous, outcomes. The acoustic engineer, for example, has to establish whether the noise levels of the proposed building surfaces in heavy rainfall or high winds are too high for the public address system to be heard: the implications of external noise for transmitting emergency calls must be understood well in advance. The role of expertise in these situations is to advise and alert. In this paper we consider such expertise applied in creative contexts together with the nature of expertise in collaborations in which the sharing and exchange of information and ideas is itself an expert process.

As part of an extensive artist-in-residence based research programme, a number of studies of digital technology experts have been undertaken. The scenarios of expertise in collaboration from which this paper springs, took place in the COSTART project (Candy and Edmonds, 2002a). Collaborative projects between artists and technologists were initially established on the basis that the technologist's role was to provide answers and solutions to specific problems arising out of a proposal determined by the artist partner.

Experts with specific skills areas were identified and matched to the people and their projects. It was discovered that the characteristics of experts best suited to working collaboratively in creative contexts extended well beyond having deep knowledge of the field, in this case digital technology. The expert as "solution finder", whilst highly appropriate for traditional consultation and advisory roles, has its limits when he or she ventures into the creative space as a "problem finder" with altogether different demands upon professional expertise.

Reporting on earlier work in the COSTART project, the notion of the artist as an expert in the creation of new interactive digital works was considered by Hewett, (Hewett,2002). In this paper, another role, that of the expert technologists, in collaborative creative work is considered. The term "technologist" is used to designate the role of designer and implementer of the interactive tools, systems and installations that were developed in the COSTART Art and Technology Projects. These experts were not purely technologists. They were expert in the development and application of various digital hardware and software systems in art and design. They each had their own specific area of expertise within that scope but shared the skill of technical problem solving in such domains.

Figure 1 – a COSTART collaborative discussion

## 1. Expertise in a Collaborative Context

Being an expert implies having a kind of knowledge that gives that person the status of being an authority within the social group of concern. The expert is most often called upon to provide insight and analysis based upon an ability to draw rapidly from up to date and pertinent information that can provide appropriate solutions to specified problems. The expert is a specialist rather than a generalist and as such the expertise is based upon recognised strategies, skills and methods that have been developed and honed with experience. In the review by Glaser and Chi (1988), expertise is perceived to be domain specific and whilst experts are good at perceiving large patterns in their own domain and applying the knowledge very quickly, this is for routine work only. Hewett relates some of the known characteristics of expertise to that of the artist embarking on an art-technology work (Hewett, 2002).

When people collaborate they usually do it because have something to gain from working with others. If the collaborative purpose is complex and involves difficult tasks, it makes sense to collaborate with someone who possesses complementary knowledge and skills. The basis of collaboration is often difference. Where the context is a creative one, the nature of the creative vision and aspirations play an important role in defining and shaping the role of the expert.

Bringing expertise into a collaborative situation involves a particular kind of process that is different to commissioning expertise as a specific contribution to a problem situation. Using expertise that takes the form of consultation, make take the form of a written report following a single visit or series of visits which the recipients use to gain better understanding of the problems they are addressing. Expertise in collaboration is a different experience to that if the typical situation because it involves developing relationships between the participating parties. Expertise applied in creative contexts requires a degree of motivation and commitment that is intrinsic to the activity as distinct from being driven by extrinsic factors such a financial incentives.

Nickerson makes recommendations for improving the creative process that include a number of factors which could apply equally well to the development of expertise (Nickerson, 1999). These are:

- Establish Purpose and Intention
- Build Basic Skills
- Encourage Acquisition of Domain-specific Knowledge
- Stimulate and Reward Curiosity and Exploration
- Build Motivation
- Encourage Confidence and Risk Taking
- Focus on Mastery and Self-Competition
- Promote Supportable Beliefs
- Provide Balance
- Provide Opportunities for Choice and Discovery
- Develop Self Management (Meta-Cognitive Skills)
- Teach Techniques and Strategies for Facilitating Creative Performance

## 2. Practice-based Research in Collaborative Creativity

In order to understand more fully the issues discussed above, a research programme has been undertaken that is based upon a series of studies of artist-in-residence projects. Thus, the ideas in this paper arise from a practice-based research process in which observation of collaborative creative design processes plays a central role. The process was developed as part of a strategy for co-evolving creative practice and participant research. The research aims were to identify the key activities of the creative process and to understand the nature of collaboration in design and development of interactive technology.

The practice-based research process involves forming collaborative multi-disciplinary teams, gathering evidence from direct observation of events, collating and analysing the protocol data and disseminating new knowledge from both technical outcomes of the creative work and the research analysis. The approach springs from ethnographic research where the aim is to carry out investigations in as authentic a situation as possible given the constraints imposed by the need to monitor and record events (Crabtree, 2003). The domain is the design and construction of interactive systems for creative uses, the artists are the clients and the technologists are the designers. In both cases, they may also be the users of the technological systems.

The first step towards collaborative work was the formation of a core team with specialist knowledge about technology and creative practice. The technology team had expertise in many forms of computer systems, programming languages and devices as well as personal involvement in music and visual arts practice.

The practice that was the basis of the research, in this case, nine artists' projects, provided different challenges for both the technology development and the artistic visions. The particular conditions of these studies were influenced by the requirements of the research project in the following ways:

1. the projects selected had to provide a sufficient challenge in respect of the technology brief to identify future requirements
2. the type of projects had to be within the scope and resources of the existing facilities
3. the candidates had to be supported by appropriate collaborating parties on the team and within reach.

The research team, comprising the technology experts and researchers, used its collective knowledge of the area to identify people and projects that met the selection criteria. It was able to draw upon its knowledge of the key players in the art and technology field who were required to demonstrate evidence of public recognition e.g. commissions, exhibitions and support from funding organizations. Once prospective participants were identified, they were invited to submit a preliminary project proposal and attend an orientation workshop where they met the team. The team then carried out feasibility exercises and the technical requirements, where known, were matched to the existing resources. This was a process whereby the expertise of the team was crucially important. At an orientation workshop the participants discussed their work and outlined possible activities for the residency. The technologists described their work and interests. From this, collaborative pairings were established.

The artists' proposals outlining initial ideas and intentions were used as a baseline for the developing technical work. A number were concerned with real-time interactive works and audience participation. Some projects examined the correspondences between sound and image whilst others concentrated on the interaction possibilities of sensor systems. The technology team carried out feasibility exercises drawing on its existing knowledge of the domain or field and, where necessary, conducted additional research into how to meet the requirements.

All participants, artists, technologists and observers, kept a daily record of events as they happened. Images and prototypes of work in progress were kept for reference and illustration. Experiences were recorded about what was proposed, discussed, carried through, what stumbling blocks arose, how they were addressed. Perceptions as to whether the ideas were workable, interesting, challenging were noted and whether the collaboration worked well or not. Reflections about whether the technical solutions worked well, or not, were recorded at the time and in follow up interviews and meetings.

The data gathered consisted of a full set of records produced by all participants. The many types of data about the activities and outcomes of the art-technology collaborations were assessed. Diaries kept by artists, technologists and observers were collated into a single transcription record for each case. Transcriptions of key meetings and the final interview were documented in a data repository as sound files and text records. The data was compiled and structured in chronologically ordered transcription records for each case. This provided the primary evidence for the extraction of features and descriptors of collaboration and was carried out by different research analysts in order to arrive at independent viewpoints.

After the main study when each project underwent a concept through to implementation phase of prototypes and final systems, further development work took place. The team continued to work after the completion of the residencies in preparation for the exhibition of works for the Creativity and Cognition exhibition (Candy and Edmonds, 2002b).

## 3. Expertise in Collaboration

In collaborative work, expert skills are essential contributions to the process and provide the basis for the choice of collaborating parties. However, in creative collaboration, those specialised skills, whilst essential for certain tasks, are not enough unless they are combined with other attributes. Being an expert in the conventional sense of the term, i.e. a specialist who has significant levels of knowledge about a well-defined domain, could be a negative thing for creative collaborative work if it acts so as to inhibit contributions from the team. Where the project is of a creative and high-risk kind, expertise that is used only to provide answers and solutions to given problems, can be inadequate if it is not combined with other kinds of personal characteristics. From the studies undertaken, we have identified a set of individual characteristics and other collaboration elements that are necessary for the effective conduct of collaborative creative projects.

### *3.1 Characteristics of team expertise*

In the studies reported here, the technology experts were selected on the basis of their existing knowledge about various forms of digital technology that had relevance to creative work. It was also the case that they were already furthering their expertise for personal development. The range of areas of expertise included design support systems, music analysis and production tools, sound and vision systems as well as a number of programming languages.

The technologists had foundation skills ranging across a number of different disciplines: music, graphic design, product design, business etc. from which they had developed their interests in using and developing digital tools for creative purposes. Education and training reflected considerable diversity and no single subject discipline dominated. With employment and further education all were involved in migrating existing knowledge into new areas.

In one case, both collaborating parties had a high degree of background education, knowledge and experience in common and both were qualified in different areas of music with a mutual interest in electronic music. The technologist was also formally trained in classical music and was able to link music and technology through the skills developed in her music degree.

> *"I always wanted to do music and when I chose to do physics, it's because to do music and physics for me was the possibility to link them … there was an easier transfer between physics and music technology"*

It was an important selection criterion that the technology collaborators were able to demonstrate openness about artistic work and, therefore, evidence of personal creativity was an important factor. The person who was, on the face of it, the least involved in creative work initially adopted a supportive but artistically detached, approach. That position proved to be hard to sustain and changed as the work developed and the technical challenges grew.

The processes of collaboration depended on the artist as well as the technologist and in some cases that encouraged more creativity on the part of the technologist than others. In one case, it was noted that the technologist felt concerned that his own creativity might be seen as interference in the artist's process. It was not clear, however, that the artist necessarily agreed. So in that sense, an opportunity for personal creativity in a collaborative team can be quite a complex issue.

It proved to be important to ongoing commitment for the technologists to be engaged in something they respected and enjoyed doing. All had different initial reactions to the artistic work itself. In one case, there was an explicit wish to have active engagement with the conceptual basis for the work from the start. In the other two cases, there was a growth of interest during the development process and a wish to be engaged with the ideas behind the work as well as its technical implementation. Where this was achieved there was greater commitment to the fulfilment of the project goals. In a certain sense, this implies a need for a kind of "ownership" of the project.

### *3.2 Expertise in Creative Task Context*

The ability to learn new techniques in very short time scales was important. The basis for that learning rested in existing skills that were readily transferable. Learning how to use a programming environment such as Visual Basic competently in a matter of two or three days was relatively easy for someone who already knew the C and C++ programming languages. This also applied to knowledge of software applications: for example, using two types of music analysis software could be combined quickly to support experimentation with ways of developing the synthetic language that was the main goal of the artist. These transferable skills were useful in finding practical ways of moving forward in order to progress difficult and ambitious goals. Being able to offer such skills facilitated exploration and discovery in the creative process.

A striking concern that is shared by all of the three technologists discussed here is an interest in learning and discovering something that has not been done before. Learning is a central motivator and projects that do not require it tend not to be very motivating. This is significant when considering that expertise might be thought of in terms of possessing something that can be applied or passed on. In the cases discussed here, the collaborative experience was often explicitly used to throw up new problems or situations that brought with them the need to learn a new technique. Sometimes it was even the case that the unexpected, and perhaps unwelcome, interventions of others, actually stimulated what was seen as the most interesting event.

> *"… but the other interesting thing is that in Athens, without my knowledge the people who organised it put a video camera behind my head and projected it on my screen. And I thought – I didn't know this and I thought I'd played a really rubbish set I was really unhappy with it, the sound was terrible, in fact it did sound terrible it was a lot worse than anywhere else I'd played but the audience loved it, people even*

*came round and said wow that was brilliant and it was because they could see the screen and they could see what I could see which was all the patterns shifting and all the things changing and I had a visual kind of representation of it and which I thought was interesting"*

*"Yes, so I'm hoping there'll be some new aspect to it.*
*I'm quite keen to learn something new as well.*
*You find out something new that's the exciting bit "*

The unknown, the new and the challenging tasks seem to be the ones most likely to motivate the expert. In the cases reviewed here, it was the artist's tendency to generate such problems that often gave the collaboration its life and interest to the technologist. Learning new things is inherently interesting to the expert despite their presumed significant existing knowledge.

### *3.3 Creative Spaces for Experts*

When the technologists were reviewing the collaborations some weeks after the event, the discussion turned to whether the work they had been doing was "new" or not. The question as to whether the work mainly involved reinventing technology or developing variations on existing technologies was debated. Someone with a product design background thought of "new" in terms of inventions that had never been made before. However, the work on programming interfaces was not perceived to be "earth shatteringly" new, although the parameter data transfer techniques between a whiteboard and a programming environment had never been achieved before. In the end, it was the combination of visual programming language and user interaction device that was seen to be the creative idea. The attraction of doing something that has to be done to achieve a result is not the main driver, but it clear from the discussion that being involved in doing something for which there are no ready made solutions is part of the inherent interest in such work. It was also clear that different participants had different views about what constituted something 'new'.

*"What did you have to do which was new to you?*
*Oh everything!"*

*"But the thing is I could use a cricket bat to prop a door open which it's never been used for before but I haven't invented the cricket bat."*

*"…but it's a new combination of cricket bat and doors – that's a creative idea.*
*How you get there is using existing technology in a new inventive way.*
*I think we invented lots of stuff but I also think we just used a lot of stuff in a very utilitarian way, just for the purpose that it was intended to fulfil."*

Again, as above, exploring the new was important but it is interesting to see how, from different points of view, different challenges were seen to be “new”. The expert needed a relatively new problem to solve, perhaps, to justify their role.

### *3.4 Tools and Representations for Sharing Expertise*

Whether collaborating about the design of an object or a computer program to control an object, the design intentions and options have to be described and shared amongst the team. Identifying acceptable ways of doing this is important. In the cases under review, computer software was at the heart of each project and so one issue was the representation used for that software.

One issue for shared representations arises from the desirable practice of generating software prototypes that the user (in our case the artist or designer) can evaluate. The prototype is typically not something that can or does evolve into the delivered system. It is built in a fast development environment that does not attempt to offer all of the functions or performance desired. Instead, it allows something that looks rather like the intended end result to be made quickly – and then thrown away. The issue is to ensure that a good looking prototype does not lead the user to believe that the work is largely completed when, in point of fact, it has hardly started. One approach is to use an evolutionary approach by working in

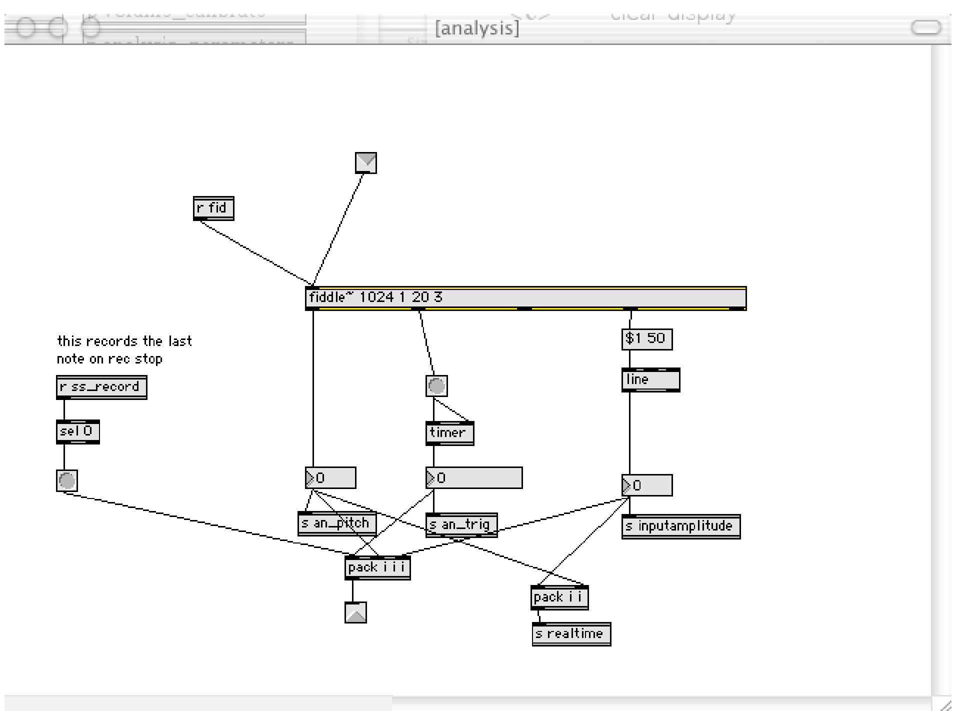


Figure 2 – An example of Max/MSP program code

software development environment that allows rapid change and also provides easy to read representations of the code.

In the cases discussed here, the system most often used was the graphical programming language Max/MSP, see figure 2, in which the program is developed and inspected through a graphical representation of program objects, control and information flow links (Cycling74 Max/MSP). The origin of Max/MSP is in electronic music studios and the forms used are quite easy to understand for musicians who have worked in that context. It turns out that artists working in visual interaction sometimes also find Max/MSP quite understandable without much training (Edmonds et al, 2003).

In the cases described, Max/MSP, with its graphical representation, was seen to be helpful as a shared form to facilitate the collaboration. The software being developed could be discussed and considered in itself and its definition as well as in terms of simply what it put into effect. However, there is a disadvantage to the use of such shared representations. One of the technologists did not find Max/MSP a representation that gave him sufficient information about the details of what the computer was going to do. That was offered in a more acceptable way by languages such as C or Java. These languages, on the other hand, are quite inappropriate for using as shared representations in multi-disciplinary teams as we find here. Thus we see a tension between the preferred shared representation and the preferred technical representation. One answer, not explored here or more generally to any great extent, at this time, is to facilitate multiple views of the same code. One example that is somewhat in this direction and can be sited is the alternate views of html code in web development environments, such as Dreamweaver, see figure 3, where the user can switch between looking at the web page design, as it will appear to the user, and the code that generates it (Macromedia Dreamweaver). They may also see both views side by side.

> *"it is often easy to make a prototype which looks a bit too good – looks better than it really is and then people are a bit surprised when it doesn't work properly."*

Agreeing on the tools to be used was another issue. In one project, this process included showing how the Max/MSP environment might be used and offering a direct comparison with the facilities that the system that the artist was familiar with, Director (Macromedia Director), offered. Floor pads were the sensors available at the time and the questions raised were; are the floors pads the right sensors to use and is Director the best application? In fact, the pads were not the best option because they required more walking movement rather than gesture movement that was better provided by proximity sensors. In the end, the team used Max/MSP instead of Director, largely because of performance issues (speed/response time). The artist had initially preferred to use Director because he was more familiar with it but was convinced that Max/MSP was better having seen the comparison in performance. He was also interested in learning to use MaxMSP as a new tool to add to his repertoire. Again, we see learning as a motivating factor.

During one project, a number of systems that were only obliquely related to his proposal were investigated. It was the discussions which ensued, though, which led to a clear understanding between both parties about, on the one hand, what was required and, on the other hand, what sort of things could be done. A note from the technologist's diary illustrates the process:

> *"...after I showed him the ID Studiolab colour database thing we came back to that- a discussion of the people in a orchestra moving about according to some rules- when one moves that causes the others to move in response.*
> *In this case, it was possible to implement some parts of the newly emerging concepts as the week progressed and this helped the two parties to develop a shared understanding of, and a shared language for describing, the problem at hand."*

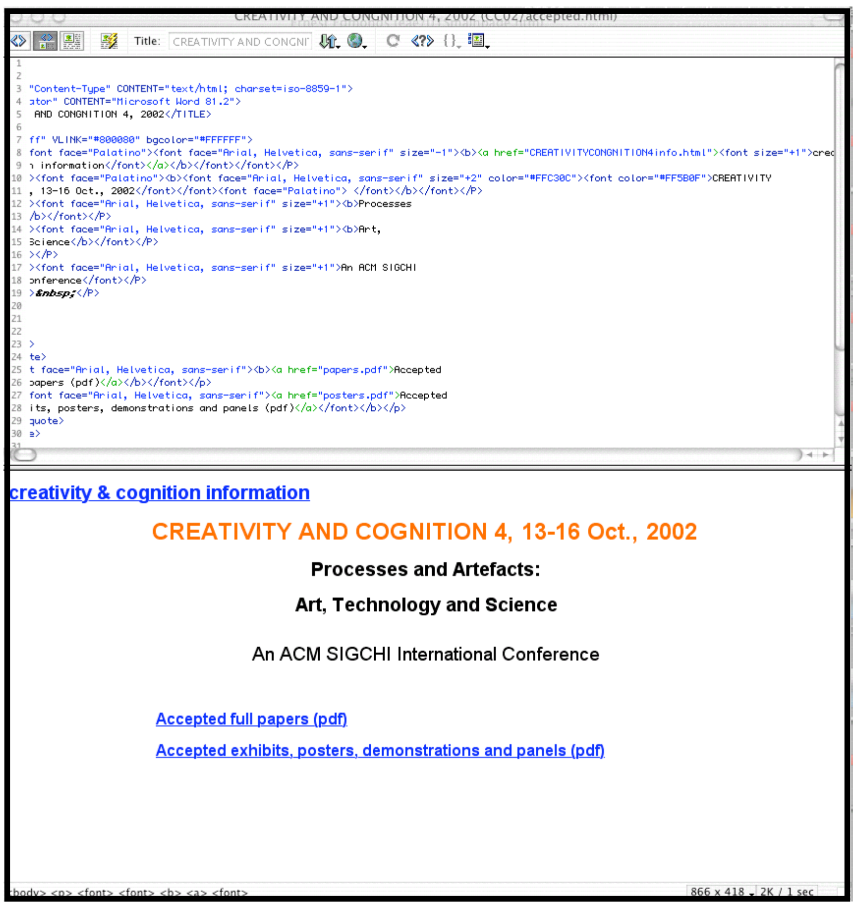


Figure 3 – Design and code views of the same data in Dreamweaver

The need for a shared language in support of collaboration has a very particular implication for complex projects that include significant software development. For the technologist, the implementation language is often very important and it, or something close to it, is treated as if it was also the description of the design and specification of the system being constructed. Hence, we often see a need for the programming language also to be shared. In this context Max/MSP, a graphical and relatively easily understood language, is attractive. A variation on just using visual representations is the possibility of having the same code represented from different viewpoints in different notations for the different collaborators.

## 4. Reflections on Collaborative Relationships

Having discussed several issues about expertise in collaboration, the nature of the human relationships in such collaborations can now be considered. We see that the quality of the relationship may be as influential upon success as the knowledge that is applied.

The existence of professional detachment is required for collaborative projects to succeed; in particular, this applied to those collaborations in which the technologist had less engagement with the work itself. This seems to imply that for the partnership type of collaboration (Candy and Edmonds, 2003c), the level of commitment is the key to success whereas for the support or assistant type, professionalism is a more significant factor. In all cases the particularities of the relationship between the technologist and artist and the finding of roles was seen to be significant. It was interesting to see how the technologists reflected on these issues in their reports on the projects.

> *"Throughout the process it was clear that some decisions should be taken jointly, or individually. And in some cases I felt it was not appropriate for me to comment. I think we understood each other's positions and where we were coming from."*

> *"At the start of the week we had some very rough ideas about the kinds of things we would like to explore. These were mainly themes that were common to both out previous works and also to attempt to combine our approaches to developing works. Here then there was a different kind of collaboration, not only did the two individuals know each other on a professional level as well as an informal level, also of importance was the fact that things had not been previously defined. Here ideas were left open to development. For example there was no real sense of one being a technologist (as we both had complementary technical skills) and one being an artist (as again we seemed to have complementary artistic ideas)."*

> *"Clearly the influence of the technologist in both processes was to bring to the attention of the artists technologies which they might not otherwise have been aware of. One might say that this, along with the provision of carefully considered advice about which technical direction to take in each project, was the point of the inclusion of a technologist in this process. Nevertheless, there must always come a point where the technologist, having reached the limit of his or her expertise, is, perhaps*

> *unknowingly, presenting suggestions which are opinion rather than fact. This may have the effect of directing the project towards a fruitless end"*

Who takes responsibility for the decision making about choice of technology? Lack of information from the artist can force the technologist into making unwelcome decisions or not being able to do the required work. This may be a matter of artistic control or it may be a matter of artist uncertainty. If the artist has a familiarity with the technology and seeks only a service role from the technologist this allows maximum control. However, when the artist ventures into new areas and unfamiliar techniques, there is a need to be more open about the artistic concepts so that the technologist can play a more useful part.

One of the technologists noted a conflict …

> *"between adopting a passive or active role in revealing new technical options. There is a temptation to introduce many new gadgets and techniques which influence the artist's approach. Remaining purely responsive to the artist's demands is quite difficult especially in cases where they do not have much knowledge of what is available or possible. This has implications for the issue of who has control over the process and the outcomes: the technologist with the critical knowledge has the power to decide over the artist who is dependent upon that knowledge. When a technical solution is chosen because it involves less work or is a personal preference of the technologist, this is not necessarily deliberate but may become apparent on later reflection. The inevitable result is that when a particular solution is proposed by the technologists, the onus is on them to make it work. Making proposals that you favour brings with it responsibility and that can be a considerable influence on the sense of ownership and commitment."*

How can the artist derive more from the technologist? The specification of a problem by the artist that is then handed over to the technologist to implement is not likely to engage that person strongly in the work itself and hence encourage more commitment to its success. Involvement at the concept development stage is crucial: this is where the important creativity takes place. If the artistic concept is very well formed and advanced there is little room for significant creative input from the technologist. This is to limit what the technologist can offer.

The issues discussed above are comparable to those found in a standard software design life cycle in which the user provides the client requirements definition which is carried out by the software development team, the results of which are then evaluated by the user, feedback given and a new version created in response to that feedback. Because the requirements definition is usually very general and the software team has to make design decisions that are interpretations of the stated requirements, many of the creative decisions are in the hands of the software developers rather than the user. Whilst the user retains general control of the concept, its actual realisation as a detailed specification may introduce changes and compromises that were not originally foreseen. The importance of rapid prototyping for defining and refining the specification of user requirements has long been recognised in HCI and Software design. The style of prototyping that the language used enables is significant.

A key issue, however, is being clear about just what can be done and what is beyond the technologist's or the technology's capability.

> *"In a creative collaboration, it is possible to keep detached from artistic goals but it is nevertheless necessary and important to understand where they are coming from if anything is to be achieved. This does not imply imposing any form of critical viewpoint but is a necessary part of engaging in collaborative work. A key concern of a technical advisor in this type of process must be to present the truth: they must always say 'I can't do that' rather than 'it's not possible', except where it really is impossible. And there lies the problem for the technologist: they may know of a way to produce something which is nearly like what the artist has in mind and, thinking that this is 'close enough', they might try to steer the project towards that."*

A further note from the technologist's diary illustrates the issue:

> *"It seems clear that this is not a good way of measuring movement- I suggested that maybe he would like to think about making a 'drawing' of the person's motions rather than the positions of their hand over time. We could represent an aggressive or flamboyant motion (gesture?) differently from a gentle one.*
> *Clearly, I've suggested this because I'm unable to do what he would really like with the equipment we have (and the skills I have- or haven't!)- it will be interesting to see what he says tomorrow."*

Clearly, the technologist is attempting to influence the project here: knowing that he is unable to produce the required results he puts forward a pragmatic solution.

The value of the expert's knowledge to the project is strongly dependent on issues well beyond that expertise. The value depends on a range of human relationship issues concerned with control, trust and openness.

## 5. Conclusions

The paper has reported on studies of technology experts working as partners in creative art collaborative projects. These studies form one aspect of a larger and broader investigation by the authors. The particular issue of expertise in creative collaborations has provided the focus in this discussion. The subjects discussed are team building, the role of the "new" and learning in creative technology design as well as the use of computer based shared language representations. Finally, the human qualities in relation to collaboration that are needed beyond raw subject domain expertise were discussed.

Being a successful expert means having the expertise to share knowledge appropriately as well as to posses it. Hence, the research issue of identifying the precise nature of expertise in collaborations is seen to be important and worthy of considerably more study.

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