European Cooperation in the field of Scientific and Technical Research
- COST -

Secretariat

Brussels, 5 December 2006

COST 314/06

MEMORANDUM OF UNDERSTANDING

Subject :	Memorandum of Understanding (MoU) for the implementation of a European Concerted Research Action designated as COST Action IC0601: Sonic Interaction Design

Delegations will find attached the Memorandum of Understanding for COST Action IC0601 as approved by the COST Committee of Senior Officials (CSO) at its 166th meeting on 20/21 November 2006.

MEMORANDUM OF UNDERSTANDING
FOR THE IMPLEMENTATION OF A EUROPEAN CONCERTED RESEARCH ACTION DESIGNATED AS

COST ACTION IC0601

Sonic Interaction Design

The signatories to this "Memorandum of Understanding", declaring their common intention to participate in the concerted Action referred to above and described in the "Technical Annex to the Memorandum", have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 299/06 'Rules and Procedures for Implementing COST Actions', or in any new document amending or replacing it, the contents of which the Signatories are fully aware of.

2. The main objective of the Action is to foster research on the multifaceted sonic aspect of interactive artefacts. This can be achieved by building a strong European network in the field which can give rise to future EC funded projects. The effort requires the establishment of a community where psychologists, cognitive scientists, acousticians, computer scientists, designers, and artists can talk and understand each other, under the common objective of understanding sonic interactions and designing future artefacts that exploit the auditory communication channel at the functional, informational, and aesthetic levels.

3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at approximately 18 million EUR, in 2006 prices.

4. The Memorandum of Understanding will take effect on being signed by at least five Signatories.

5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of the document referred to in Point 1 above.

COST ACTION IC0601

Sonic Interaction Design -SID'

A. ABSTRACT AND KEYWORDS

Sonic Interaction Design is the exploitation of sound as one of the principal channels conveying information, meaning, and aesthetic/emotional qualities in interactive contexts. The Action pro–actively contributes to the creation and consolidation of new design theories, tools, and practices in this innovative and interdisciplinary domain. While being advanced through a few sparse projects, this field relies on the COST – SID Action to strengthen the links between scientists, artists, and designers in the European Research Area. The COST – SID platform stands on four legs: (i) perception, cognition, and emotion; (ii) design; (iii) interactive art; (iv) information display and exploration. These are each supported by the research and development of the requisite new interactive technologies. Due to the breadth of its application spectrum, the COST – SID Action has the potential of affecting everyday life through physical and virtual interactive objects, as today there is the possibility to design and actively control their acoustic response so that it conveys an intended aesthetic, informational, or emotional content.

Keywords: Interaction Design, Auditory Display and Sonification, Sound and Music Computing, Sound Modelling, Sound Perception and Cognition.

B. BACKGROUND

Thinking back to Edison's phonograph or, more recently, to the mp3 craze, one may well say that music has been a driving factor for technology. But, can the same be said for sound in general? So far, non–musical sounds have been accepted as by–products of technologies rather than being exploited for their intrinsic value. As a result, an acoustically polluted world is what most people have been experiencing since the industrial revolution.

A striking example is the typewriter. The most direct predecessor of Remington typewriters was the "cembalo scrivano" by Giuseppe Ravizza, whose name expresses the legacy with musical instruments very clearly. Although in typewriters sound production is not the ultimate goal, their introduction at the end of nineteenth century dramatically contributed to shaping the office soundscape. In the last century, mechanically–moving parts have been gradually replaced by electronics and by computing facilities, which are inherently silent. It was soon realized, though, that silence is not necessarily the most desirable acoustic status, as sound carries information that is perceived and exploited, often unconsciously, by human beings. Going back to the typewriter example, sound can not tell what is being written, but it is certainly an indicator of the typing skills of a person and of the degree of activities taking place in an office. With animate -as opposed to mechanical -sounds the acoustic information is even richer and full of nuances, as it comes from gestures that are continuous and expressive. A well-studied example is that of walking sounds, which can tell a lot about the person who is emitting them [22, 10].

Nowadays, the ubiquity of computing and communication resources allows thinking about sounds in pro–active terms .A fraction of the computing capabilities of appliances can be devoted to synthesise their "acoustic appearance" and sonic behaviour. Communication networks can be used to "orchestrate" multitudes of artefacts in time as well as in space. Sensor networks can be used to make the sounds responsive to changes in the environment or to human behaviours. Recent knowledge about animate sounds can help shaping the expressive character of object sounds.

Times are mature to think about sound as one of the main design dimensions of everyday objects. That means overcoming the sound–as–noise cultural barrier and promoting a sound–as–information attitude. This tendency is already visible in the market where new or forthcoming products exploit the tight coupling between sound and gesture in interaction. For instance:

- Mighty Mouse by Apple (http://www.apple.com/mightymouse/). This pointing device incorporates a piezo speaker whose only purpose is to emit the "sound of scrolling" which is, for the first time, non-mechanical;
- Blendie by K. Dobson (http://web.media.mit.edu/˜monster/blendie/). A blender that can be continuously controlled by motor-resemblant voice sounds. It engages the user in an emotional intercourse;
- Ballancer by M. Rath [25]. A controller for balancing tasks that relies on auditory feedback of continuous rolling sounds;
- Augmented Molly by D. Rocchesso [26]. The augmentation of lift-the-flap books for children with continuous synthesised sounds;
- AcouMotion by T. Hermann [11].A system for acoustic motion control to implement novel auditory sports games like Blindminton, a audio-only Badminton for visually impaired users.

In a sense, these are all examples of enactive interfaces, as they are advocated by the European IST Enactive Network of Excellence, a forum where interaction is conceived as an embodied form of perception and action.

Designing the sonic appearance of products and artefacts is thus becoming a competitive issue as well as a lively playground. Three domains in which the design of sonic interaction is crucial can be listed: product sound design, sonification and interactive art.

Product sound design is already a challenging area of research in industry[28] but there is a lack of tools that can help designers to introduce the sonic aspects in the process of design.

Sonification is a challenging topic since the auditory channel is a promising alternative to visualise complex data, monitor complex system, or design complex displays [27, 29]. This field is already structuredby the International Community for Auditory Display (http://icad.org/) but is experiencing scarcity of finalised funding and coordinated research efforts. A crucial aspect that needs further research endeavours is the evaluation of the quality and relevance of sonic interaction. Cognitive science provides a background to address this issue.

The work of artists, especially in the area of interactive arts, is increasingly being recognised as a driving factor for technology and, sometimes, for science as well. New fields such as that of "aesthetic computing" are emerging from the joint efforts and mutual interests of scientists and artists [6]. Sonic Interaction Design is however not a solid discipline yet. Current spread out research activities are involved in defining sound design methodologies, sound creation tools and evaluation techniques. Researches in this area are by nature multidisciplinary, needing knowledge

in acoustics, physical modelling, interaction design, perception and cognitive sciences, and need to be federated.

As far as sound communication is concerned, in Europe previous COST Actions have set the ground by focusing on real–time sound synthesis and transformation, and on gestural interaction with audio systems in musical contexts, respectively. Among the recent European initiatives, the IST–FET Coordination Action S2S^2 (http://www.s2s2.org) is particularly important because it provides a multidisciplinary fertile research community and a general roadmap for future research in sound and music. More specific initiatives, such as the NEST Pathfinder project CLOSED (http://closed.ircam.fr) and the 5-th Framework FET "Disappearing Computer" Sounding Object project are keen to the theme of Sonic Interaction Design, and are providing example cases and new investigation and design methods. Previous music and gesture–centred projects, such as the 5th Framework FET–Open project ALMA (http://www-dsp.elet.polimi.it/ alma/) and the IST project MEGA (http://www.megaproject.org/), also highlighted the importance of interaction and gesture–driven sound production (e.g., the ALMA virtual air guitar – http://airguitar. tml.hut.fi). It is therefore apparent that a networking action in this area is urgent and it is likely to put Europe in a worldwide leading position, thus giving it a competitive advantage in the process of shaping the working and living environments of the future. COST – SID is complementary to other COST Actions (such as the ICT Actions on cross–modal and non–verbal communication): COST – SID intends to concentrate and expand on the specifics of sound–mediated non–speech interaction with objects of various kinds. Finally, COST – SID naturally expresses a multi–fold link between advanced information and communication technologies and the "Individuals, Society, Culture and Health" domain.

COST – SID provides a conceptual roof over four pillars defining profitable areas, each being addressed by a Working Group:

A) Perceptual, cognitive, and emotional study of sonic interactions -understanding of how humans interact with objects through sound has two benefits: it allows first to define sound design methodologies and to provide prediction tools for sound designers; second, it allows to evaluate the quality of a design.

B) Product sound design -interactions that optimally favour flow experience, stress reduction, and increased ergonomy; design and measurement methods stressing the aesthetic, emotional, and perceptual qualities of sounding objects;

C) Interactive art and music -the visionary character of some artistic products is likely to provide insight to scientists and technologists, as it was often the case in the past;

D) Sonification -expected to have impact in many fields such as information engineering, data mining, biomedicine, therapy, entertainment, etc.. As compared to visualisation, sonification inherently develops in time, it is critically dependent on interaction, and it exploits the fastest of human senses.

In a world where computing is ubiquitous and sensors and actuators are going to be disseminated everywhere, it is important to think about the concerns and the opportunities for everyday life. The experience of the world will be largely affected by these new technologies, and it is important to promote the growth of new design disciplines that will contribute to a better quality of life. These disciplines should not only be informed by new scientific or technical knowledge, but should also address the cultural, social, and even ethical questions (including privacy). In the long term, it would be desirable to achieve soundscapes that are informative, pleasant, and non obtrusive. Artists and designers have been engaged for sometime in questioning the ways that sound is used in everyday life and in creatively exploring future possibilities for interactive products and systems,

including those with embedded sound. Psychology too has sought to account for various sources of interpersonal and inter–cultural differences in sound quality perception [4]. COST is the ideal framework for nurturing and guiding emerging scientific, technological, and cultural intercourses.

Nowadays loudspeakers are relatively inexpensive actuators, microphones are cheap sensors, and even the lightest microprocessor has enough power to process and synthesise sounds in real time. On the other hand, the form and sizefactor of many devices put serious constraints on the size of visual displays. So, it is clear that the auditory channel has a privileged role in exploiting this emerging convergence of computing, communication, and sensing, both with speech and non-speech communication. As technology makes it possible to exploit this auditory channel, the issue is also now to define what would be relevant sonic interactions. Studying human interaction with sounding objects, human cognition and behaviours provides the keys to build future sonic interactions that will be smarter than the sonic jungle of today. COST – SID intends to coalesce scattered research efforts in sound science, design, art and cognition into a coherent movement capable to affect the acoustic appearance of future environments.

C. OBJECTIVES AND BENEFITS

The main objective of this Action is to foster research on the multifaceted sonic aspect of interactive artefacts.

This objective can be achieved by building a strong European network in the field which can give rise to future EU funded projects. The effort requires the establishment of a community where psychologists, cognitive scientists, acousticians, computer scientists, designers, and artists can talk and understand each other, under the common objective of understanding sonic interactions and designing future artefacts that exploit the auditory communication channel at the functional, informational, and aesthetic levels. Prior COST Actions dealing with sound synthesis and audio systems proved to be effective instruments to boost emerging disciplines and to create communities. The topic of this Action is broader as it has the potential of affecting everyday life, beyond artistic manifestation. Considering how large were the effects of the Bauhaus school (in a sense, a European action on design) on twentieth–century life, one may expect that a European design–centred initiative focusing on the sonic aspect of interactive artefacts can produce global effects in research, education, industry, and society.

Product designers of the future will be busier conceiving and prototyping the interactive character of their creations rather than their static appearance. Richer and more intuitive modes of interaction are increasingly a focus of research in interaction design, and products can be improved in these areas by the provision of appropriate, task and context-based acoustic feedback. The acoustic behaviour of objects in response to interactions is often the most straightforward aspect that can be cheaply manipulated, especially when sensors, loudspeakers, and processors can be embedded into products (such as smart textiles or clothes, enabling these to perceive gesture with different levels of detail). However, at the moment designers feel lost when they have to choose appropriate sounds, especially if these sounds have to be made continuously variable in response to continuous interactions. Nevertheless, as indicated in section B., several application examples are already appearing on the market or in research laboratories that are indicators of a design trend.

A different yet related objective is that of empowering the designers of sonifications. The role of interactivity is crucial in applications exploiting the auditory channel in the exploration of multidimensional information manifolds [12]. Through research in Sonic Interaction Design it will be possible to devise and test new sonic exploration devices that improve the effectiveness of information foraging, browsing, and surveying.

Several major objectives mentioned in the preliminary documentation of the Seventh Framework Programme of the European Commission will need to take sonic design into serious consideration: anything ranging from *Personal and Home Environments* to *Robotic Systems*, from *Intelligent Infrastructures* to *Health Systems*, from *Personal Content Development* to *Embedded Systems*, will have to include sound as an information conveyor – therefore creating the urgent need of development of a solid discipline and community.

A leap forward in (sonic) interaction design depends on the availability of suitable sound models on the one hand, and of tools for prediction and evaluation on the other hand. Sound designers are faced with two more issues for which they lack formalised tools. They first have to predict how sound may be used by the listener to interact with the object. Once the sound is designed they then have to validate whether the sound creation fulfils what it was intended for, in its functional, aesthetic and emotional aspects. Both issues are already under the scope of studies in cognitive sciences, but not immediately available in the form of off–the–shelf tools.

Indeed, knowledge and understanding of sound perception and production will be increased by both rigorous scientific experimentation and occasional observations driven by creativity and intuition. In this sense, a wide campaign of design exercises conducted in academic contexts may provide a catalog of design patterns that will inform product designers of the future, while at the same time being case studies for psychologists and sound modellers.

The COST – SID Action will create the conditions for this kind of cross–fertilisation between art and science, so to repeat in the auditory realm what happened, for example, with colours in the visual realm, where the valuable educational work of designers Itten and Albers can be compared with the knowledge in physiology and colour perception acquired in the last century.

With the improving inclusion of media technologies in our everyday life, it is also important to consider the possible negative impacts on health (physically or psychologically) and social relationship. In public spaces, use of objects including Sonic Interaction Design should not disturb non–user people around. In some case, the presence of a sound component in an object should not isolate the user from his context in a dangerous way (e.g., when driving a car). In some other case, it should not socially isolate the user, when she/he is not supposed to be. Ethical “golden rules” could be established to prevent such impacts. This needs to collect and develop perceptual, cognitive, and sociological knowledge in an interactive configuration when sound is involved. Moreover, it can be also necessary to provide new adequate technologies to allow designers to respect these rules.

Interactive technologies are still the bottleneck of interactive systems, and the choice of sensing devices may affect the capability of acquiring information from all actors without incurring in informational masking, nor in communication, storage, or power shortage. Many great applications can be dreamt of, but the available technologies are either in a too early stage of development, confined to some research lab, too expensive, too bulky or too basic. Investigation in the core technologies that can be useful (and necessary) in the context of Sonic Interaction Design, such as tangible interfaces technologies, multimodal toolkits, embedded components and systems, sensors, etc. will be a useful addition stemming from the COST – SID Action.

The creation and consolidation of a new research community, new design theories, tools, and practices exploiting sound in interactive contexts will be achieved by means of the following objectives:

1) To establish links between the diverse disciplines involved in COST – SID, namely psychology, computer science, acoustics, design, art and music, etc., and to forge a

dialogue with indirectly related research in fields such as communication, sociology, and cultural studies;

2) To raise shared appreciation of the challenges and possibilities related to the use of non–speech sound in interactive systems and artefacts;

3) To collect, explore, and test technologies, tools, and designs, thus identifying the most promising solutions and focusing the future research;

4) To coordinate the most prominent efforts at European level in this field or in related areas, in particular facilitating the creation of new research projects in the 7th Framework Programme of the European Commission.

The objectives will be achieved by preparing the following deliverables:

A) COST – SID Workshops in established conferences in the fields of computing, data exploration, design, psychology, art and music. Objectives1and2are better achieved via penetration of Sonic Interaction Design in neighbouring fields;

B) Short–Term Scientific Missions of researchers and PhD students to visit laboratories across European countries. Visits are based on exchanges: the visitor shows his/her specialities and problems, the hosting laboratory proposes possible plans based on its skills. Visits allows for a mutual exchange of knowledge, integration of tools, validation of theories between different fields, comparative studies, and joint publications of the achieved results;

C) An open–content high–quality Book to be released by the end of the Action, with the goal of being the reference in Sonic Interaction Design;

D) A web repository of sound models, sound interaction tools, experimental data and procedures, guidelines, etc., built incrementally on top of previous European efforts such as COSTG6 –DAFx, COST 287 – ConGAS, S2S2, etc.;

E) Training Schools (at least one per year) to be organised by one of the Action delegates at his/her own institution, where a class of PhD students is involved in basic sound design exercises, under the guidance of COST – SID delegates and of an invited expert. To maximise results, training schools may be organised in correspondence with the Sound and Music Computing Summer School (http://www.soundandmusiccomputing.org/ summerschool). This Summer School, one of the major results of the S2S2 Coordination Action, is quickly establishing itself as the main researcher/doctoral/post doctoral high–level gathering for the Sound and Music Computing community and as such it is the ideal setting to enhance the visibility of the COST – SID Action itself.

The main expected impact is the creation of a community of researchers who are neither isolated nor self–referential, rather being respected, recognised, and understood in a variety of scientific and artistic contexts. A growing interest in the acoustical interactive properties of artefacts is expected among designers, educators, system evaluators, and even marketing persons. This interest will be measured in terms of conference sessions, publications in journals, university classes, and products appearing on the market. A related impact could result from the identification of new application areas and market niches that will benefit from the results of COST – SID. In this sense, COST – SID will foster technology transfers in cooperation with the fore–coming FP7 consortia and along with EUREKA projects, umbrellas and clusters (such as the ITEA–2, etc.).

D. SCIENTIFIC PROGRAMME

To achieve the objectives, several research tasks need to be carried out and made manifest through the deliverables. The innovative peculiarity of the Action is in the interdisciplinary character of these tasks. A schema of the structure of the Action along with the rationale that is behind the strategic decisions is outlined in Fig.1 on the following page.

The Action will encourage research that involves at least two of the four listed areas (cf. section B.):

(A) Perception and cognition; (B) Product design; (C) Interactive art and music; (D) Sonification. The research tasks are:

T1) Aesthetic and sonic quality assessment in product and interaction design
(A+B) Research will proceed along the three lines:

- Functional evaluation according to design criteria, with the aim of developing new methods for the assessment of the usability and design suitability of sound qualities in relation to the function or task addressed by a design, as well as its context. The latter may be taken to encompass the demands of the task, associated functions or services, and the sensory environment it occupies. New assessment methods that take into account the unique role played by sound in the designed appearance, as well as the sonic feedback provided in interaction and product design, are needed. The task aims at both generating this knowledge and promoting its integration into existing practices from human–computer interaction and interaction design, including usability methodologies, as well as more recently developed user-centred and participatory design practices [30].

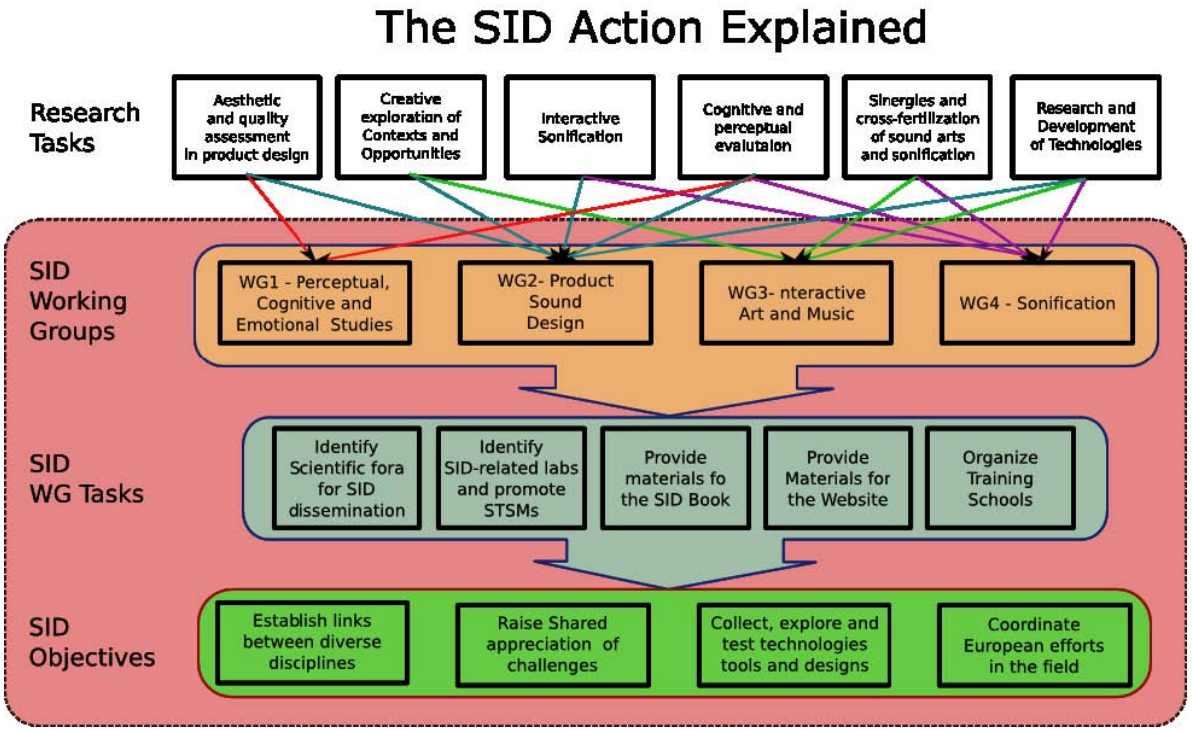

Figure 1: The COST – SID structure

- Investigation of the role of continuous sonic feedback, for improving user experience in the context of continuous manual control of – or of gestural input to – products or artifacts that furnish such feedback. The task will promote both conventional objective usability measures, such as task-performance, that have been under-applied to cases in which multisensory feedback is present in an interactive product, and in addition will propose more holistic indicators that may be acquired through user-centred design practices. A further goal of the research that the task advocates will be to informally identify promising sonic metaphors or other models for user reception that may contribute to the more concrete measurement aims of T4.
- Phenomenological experimentation via specific designs under tight constraints, with the aim of exploring relations between form, material, and interactive qualities in relation to sound. This is the method traditionally used by the post–Bauhaus schools(Ulm,Yale,etc.) to educate designers [1, 3]. The aforementioned qualities will be further evaluated, using analyses based on the extraction of primitive sonic interaction qualities, or gestalts [30], as well as the user-centred assessment methodologies mentioned above.

Through these activities, the COST – SID Action will stimulate simultaneously aesthetic and functional views of sound product quality assessment. The subject is addressed from a standpoint that (by contrast with T4, below) is centred on the qualitative assessment in design, on user experience, and on the extension of existing practice in product and interaction design to the unique demands of designing the sonic appearance of a product or service.

T2) Creative Exploration of Context and Opportunities for Interactive Sound Artifacts (B+C) This task will critically explore the present use of sound in artifacts and reveal related future opportunities and trends for interactive sound artifacts through artistic and design practice. Two sub–tasks are involved:

- Creative analysis and future application scenario development Interactive art and interaction design methods will be used to explore the cultural and artistic significance of sound in the everyday use of artefacts, or in more unusual scenarios involving them. Artists and designers will generate a number of future scenarios and inspirational examples, perhaps commenting on established interaction behaviours. Goals will be to inspire scientific research, reveal interactive product opportunities, and expose social and ethical problematics.
- Artistic production with sonic interactive objects The Action will promote artistic productions exploiting sound–augmented interactive objects. Just as Le Corbusier's Pavilion at the 1958 Brussels World's Fair (with musical works by Varèse and Xenakis reproduced through 400 loudspeakers in synchronisation with projected images and colourlights) is considered by Philips to be the first multimedia show, this task promotes new forms of artistic expression that are likely to anticipate future trends and point to new research directions. Artists from sound and performing arts will be asked to create new works utilising sonic interactive objects – for example, to orchestrate ensembles of objects that respond to manipulations via multisensory feedback, sound being the privileged communication channel.

T3) Interactive Sonification (B+D);

Different from T1 and T2, sonification is specifically concerned with the systematic communication of information. It is about how sound can be used to support the discovery of structures and the monitoring of changes in the data by listening. Interaction has become a particular focus in sonification research, and the discipline of interactive sonification can be defined as the focus on how a sonification systems can profit from a tight closure of the interaction loop between the user/listener and the sonification system [12]. The perspective here is not only the tight integration of physical interactions into sonification systems, but beyond that the creation of multi-modal interactive systems [14].

To advance the interactivity of sonification systems, the following approaches are possible and of high interest within the Action:

- Affecting Sonification via Gesture Controllers

  Gestural interaction with sonification is aimed at enhancing the way data is handled, allowing the users to transform and manipulate their acoustic representation. The technique of parameter mapping sonification can here develop in conceptually interesting lines by connecting it with “tangible” representations of the sonification mapping, which enables the use of movements and gestures to control acoustic variables. The generation of innovative sonification scenarios will be promoted by the Action, in particular aiming at exploring scientific data visualisation and manipulation, enhanced sociospatial information generation and fruition (e.g., data on surrounding people and objects, environment and climate, traffic level, etc.), interaction with extended reality and immersive computing applications. Such sonification systems may even be exploited in artistic contexts yielding data-inspired sonic art.

- Model-based sonification

  This research path is devoted to the design of effective interactive sounding objects based on the model-based sonification framework [13]. This modelling approach relies on the exploitation of physical knowledge to represent the acoustic outcome due to the interaction with virtual “data-driven” objects through a sonification rendering process that can for instance be inspired by the laws of acoustics. It proved to be an effective technique for sonification, and typically allows plausible acoustic responses on any excitations of the data-driven virtual objects.

  A challenging task here is to understand how users perceive and use the sound resulting from real-world physical interactions, and how sonification models can be posed to make specific structures of interest accessible. Building a better understanding of how acoustical cues are used for the refinement of activity in the real world will help to create design guidelines for the modelling phase of sonification models according to the model-based sonification framework.

- Multi-modal interaction devices

  The task will draw on the potential offered by the large variety of available capture devices (sensors), used to sense the information, and interaction devices (gesture controllers) used to provide our feedback into the system. Where possible, it will take advantage of the achievements of COST 287 Action (ConGAS), and the knowledge base on the field. The Action will moreover encourage experiences on the integration of sonification, visualisation

and haptic rendering techniques in the design of interactive objects. Advances in this field will increase the possible interaction strategies to be used in interactive sonification systems.

T4) Cognitive and perceptual evaluation in Sonic Interaction Design (A+B+D)

Since design is an iterative process based on refinement, some measurement of error is definitely needed. Measurement tools that guide or complement human expertise and intuition will be a key component for advancing the field. Namely, tools are needed that combine perceptual measures with emotional and contextual factors. The COST – SID Action will encourage the production and evaluation of such tools.

- Sonification parameters

  The effectiveness of sonifications may largely depend on the choice of technique, and specifically in parameter mapping sonification, on the mapping strategies and the used acoustic variables. Besides low level psycho-acoustic features (such as pitch, loudness, brightness, roughness), more complex attributes motivated by accurate auditory models, are often successfully adopted in a variety of fields, from speech recognition, to music compression, analysis and retrieval. This task will look at the implementation and assessment of auditory displays based on acoustic cues and on psychoacoustical models, and on the influence of different acoustic attributes on the effectiveness of sonification for completing specific tasks.

  The objective measurement of the functional qualities of sound in sonification contexts will make the sonification design process more reliable.

- Investigation of perceptual, cognitive, and emotional aspects of functional sounds, i.e. sounds associated with an object function, with special attention to the context. Certain classes of functional sounds may be of particular interest for our everyday life. A significant example is that of alerting or signalling sounds which, if featured with the right cues for acoustic recognition, auditory localisation and emotional arousal evaluation, may provide useful indications about the danger level, position, and closeness of a possible threat. More generally, developments in fields including machine learning and auditory psychology have led some to assert that new software tools for the measurement of heretofore unaccessible aspects of sound quality may be within reach. The task will address the promotion of such cross-disciplinary research. The goal will be to generate new knowledge, such as algorithms capable of mapping or relating low-level acoustic features to subjective quality descriptors that may be highly correlated with human reception of sound in a particular interaction and task context.

Thus, the COST – SID Action will stimulate the mutual fertilisation between design and cognition in the field of interaction, and make progress in both areas, through schools and scientific investigation.

T5) Synergies and cross fertilisation of sound arts and sonification (C+D).

Sonification, as a scientific approach to gain insight into data, often leads to designs that are tightly tuned to achieve maximal discrimination of sounds on changing data. However, the sounds obtained according to this objective may not be most aesthetically compelling. Bringing together sonification researchers with interest in compelling data display, and sound artists and sound designers with their interest in engaging and aesthetically convincing sound responses, is likely to yield the creative potential to obtain novel designs and sonification

systems that find wide public acceptance, perhaps even in such a degree that the long expected "killer application" may be realized, thus establishing sonification as an indispensable information channel and analysis technique.

T6) Research and development of COST – SID technologies (B+C+D)

This task will advance the state of the art in technologies with the aim of supporting the design of user interfaces, novel and extended musical instruments, toys, sonification, and product design. Focus will be placed on the connection between the input of the user and the corresponding sonic output. Two interconnected sub–tasks are involved:

- Design of algorithms for interactive sound generation The task will design a set of sound synthesis algorithms based on physically meaningful parameters. Such algorithms will be designed with the aim of being applied to the design areas noted above. A toolkit for constructing such musical instruments and sounding objects from elementary functional blocks will be provided to both composers and interaction designers.
- Development of input and control technologies for embodied interactive sound design

  The task will design a set of input and control technologies, integrating both hardware sensing/actuation and software control (including mapping algorithms) in ways that are adapted to the salient synthesis algorithms. These technologies will be developed toward facilitating the kinds of input sensory–motor tasks involved in the design areas noted above. A set of guidelines for developing input devices and control building blocks will be made available to both composers and interaction designers.
- System Integration

  The task will outline the integration of a full system, indicating the proper choice of a communication network which will depend on the technologies and/or sensing devices being used and suggesting system partitioning strategies to adopt (i.e. centralised vs. distributed strategies, on a case–by–case basis).

E. ORGANISATION

COST – SID implements the following project coordination staff line up:

Action Chairperson:	General coordination of the project
Action Vice–Chairperson:	Chairperson's assistance and substitution when needed
Scientific Secretariat:	Administration and coordination
Management Committee:	Action steering organism (up to 2 national delegates per member country)
Working Groups:	Scientific activities (cf. below)

The novel field of COST – SID can benefit from technologies and tools emerging from prior COST Actions, from a general research roadmap provided by the S2S^2 IST–FET Coordination Action, and

from specialised results achieved in IST or NEST projects. In order to avoid dispersion of such a knowledge capital and boost interdisciplinary developments, future activities must be concerted among the various actors. COST is the appropriate framework for such concertation, because it affects the research activities only by steering them towards shared objectives, and by encouraging knowledge transmission and sharing across the boundaries set by laboratories or projects.
The organisation of the COST – SID Action reflects its objectives in and across the profitable areas. Four Working Groups(WG) will be established, each dealing with one of the primary areas of COST – SID. Each of the scientists joining the network will choose the working group that best fits his or her field of expertise.

The Working Groups are:

WG1 Perceptual, cognitive, and emotional study of sonic interactions.

The activity focuses on extending information and valuable resources (including bibliography, guidelines, methods, and workbenches) on experimental scientific findings about human sound reception in interactive contexts. Research on new experimental paradigms such as neurosciences, ergonomical and psycholinguistic studies will be a stimulating challenge. Basic research will be included as well in these activities, promoting paper publication and dissemination.

WG2 Product sound design.

The activity focuses on collecting resources useful to establish a grounded design method for designing interactive products having a salient sonic behaviour. Initiatives will be promoted, in the form of schools, studies, design exercises, etc., to improve the design culture and sensibility in this area. Relevant design patterns will be collected and documented.

WG3 Interactive art and music

The activity aims at promoting new productions in the interactive and performing arts, exploiting the role of enactive engagement with sound–augmented interactive objects. Artists will be actively involved in COST – SID activities so to increase their awareness of the emerging possibilities in sound–mediated communication and interaction.

WG4 Sonification

The activity will collect prominent cases of data and information sonification, thus growing a body of sonification patterns, especially those emphasising the important role of interaction. Possibilities for killer applications will be highlighted and brought to the attention of scientific, educational, and industrial forums.

A Leader will be appointed for each WG, taking responsibility for the following tasks, to be performed by each WG in its own scope:

W–1 Identifying important scientific forums (conferences, journals, etc.) for discussing and disseminating research in Sonic Interaction Design; organising special COST – SID sessions in related 3rd–party conferences to enhance the visibility and the outcome of the Action (deliverable a);

W–2 Identifying laboratories as possible targets for Short–Term Scientific Missions and stimulating PhD students to propose and organise such activities (deliverable b);

W–3 Providing material for the open–content Book on Sonic Interaction Design (deliverable c);

W–4 Contributing content to the common web site (deliverable d);

W–5 Organising one training school at the institution of one of the delegates (deliverable e).

A Steering Committee (SC), composed by the project Chairperson, the Vice–Chairperson, the Scientific Secretariat and the Working Group leaders, will be responsible for coordinating the activities across the four task areas (e.g., providing a common web framework), encouraging information cross– fertilisation, integrating the contributed Book chapters into a self–standing publication, updating and sharing the technologies available to working groups. These activities will be proposed for approval by the assembly of all Action delegates (Management Committee, MC). The SC will support those delegates who are in charge of organising the semestral MC meeting of the COST – SID Action. Every other meeting will be organised every year in combination with an important conference linked to one of the Working Group areas (four areas, four years). The SC will also support those delegates who are in charge of organising the Training Schools (at least one per year), with the purpose of spreading the COST – SID ideas, theories, and methods, as well as to foster their scientific and industrial exploitation.

Toward the end of the Action, a general Conference on the themes of COST –SID will be organised and sponsored under SC support, with the purpose of portraying the state of the art and how it has been affected by the Action itself.

F. TIMETABLE

This Action will last 4 years. Every year, one COST – SID Workshop will be organised as a satellite event of an international conference. Hosting institutions have already expressed their interest in organising a workshop in 2007 in Copenhagen as satellite of the International Computer Music Conference (ICMC 2007), and in 2008 in Helsinki as satellite of the Digital Audio Effects (DAFX) conference. By the end of the Action, one COST – SID International Conference will be organised. Up to two Management Committee meetings a year are planned. Working Groups may meet several times a year according to their necessity and to budget. Management Committee meetings will be combined during Workshops, Conferences and Working Group meetings in order to optimise the use of available resources. The Workshops and Conference will become a centralised research exchange point: they will collect works on the subject from all over the world and will provide a basic framework for research in the field.

Two Milestones have been provided:

After the first two years (M1). Milestone **M1** will lead the COST – SID Action to provide a survey on recent findings in cognition, perception, and emotions as well as on emerging design practices, technologies, exercises and patterns in the area of Sonic Interaction Design.

At the end of the Action (M2). Milestone **M2** will provide: (i) a catalog of exemplary pieces of interactive art and music, (ii) examples of sonification that are representative of the possibilities offered by Sonic Interaction Design, and (iii) a report on new application fields that could benefit from a technology transfer process carried out following the Action's guidelines.

The timeline is described in the diagram in Fig. 2.

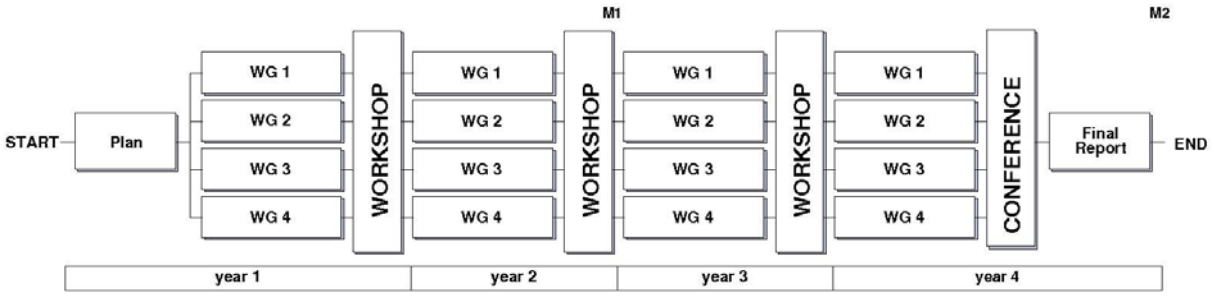

Figure 2: COST – SID timeline

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: Austria, Belgium, Croatia, Denmark, Finland, France, Germany, Ireland, Israel, Italy, Spain, Sweden, Switzerland, UK.

On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 18 million EUR for the total duration of the Action.

This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

H. DISSEMINATION PLAN

The COST – SID Action will ensure the dissemination of results and liaison with appropriate organisations and groups outside the Action.

Dissemination will be implemented by the following means:

- Implementation of a regularly updated web site for the Action, where all the Action initiatives (meetings, short–term scientific missions, workshops, software, tutorials, conferences etc.) are listed, and where progress reports, agenda and minuted meetings are published;
- The diffusion of the research results through publication in international journals and proceedings of relevant conferences where the cooperation and the Action support is acknowledged, as well as special issues in international journals;
- Distribution of publicly available COST Action reports;
- Organisation of yearly COST – SID workshops and one final international conference open to external participation;
- Collaboration with industries dealing with interaction design and interactive sound such as telecom industries, games and multimedia industries, electronic toys, interactive design industries, music industry, etc.. A primary opportunity for collaboration will be obtained by inviting experts from industries to join the COST – SID special sessions at conferences or the COST – SID Training Schools;

- Research and design training schools within university classes, with the purpose of enriching existing curricula;
- A final open–content high–quality book;
- Final report on the Website for public distribution.

In addition, the COST – SID Action will provide to the distribution of freely downloadable interactive sound software tools, as well as specifications and schemata of sensing and display technologies, which will be contributed by different members of the Action. Wherever possible, the dissemination process and efforts will be a shared responsibility among all participants to the COST – SID Action both at a national and at an international level. The dissemination plan, including efforts and methods, will be updated during the course of the Action in accordance with the results of the evaluation of the Action.