

**SIXTH FRAMEWORK PROGRAMME
PRIORITY IST-2002-2.3.1.6
Multimodal Interfaces**



Contract for:

NETWORK OF EXCELLENCE

Annex I - "Description of Work"

Project acronym: **HUMAINE**

Project full title: **Human-Machine Interaction Network on Emotion**

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Table of Contents

1	Project summary	3
2	Project objectives	4
3	Participant list	7
4	Relevance to the objectives of the specific programme	9
5	Potential Impact	14
5.1	Contributions to standards	18
6	Outline joint programme of activities (JPA) - for the full duration of the project	19
6.A	Activities	22
6.1	Integrating activities	22
6.2	Programme for jointly executed research activities	26
6.3	Spreading of excellence activities	36
6.4	Management activities	38
6.B	Plans	41
6.5	Plan for using and disseminating knowledge	41
6.6	Gender Action Plan	42
6.7	Raising public participation and awareness	43
6.C	Milestones	44
6.8	Major Milestones over full duration of the action	44
7	Quality of integration and performance indicators	45
8	Project organisation, management and governance structure	47
9	Detailed joint programme of activities (JPA) – first 18 months	51
9.1	Introduction - general description and milestones	51
9.2	Planning and timetable	53
9.3	Graphical presentation of work packages	61
9.4	Work package list /overview	62
9.5	Deliverables list	63
9.6	Work package descriptions	66
10	Project resources and estimation of incurred eligible costs	80
10.1	Indicative Efforts for full duration of project	80
10.2	Indicative Efforts first 18 months: Partner 1-14	81
10.3	Indicative Efforts first 18 months: Partner 15-27	82
10.4	EC contribution full duration	83
10.5	Project management level description of resources and grant	84
11	Ethical Issues	86
12	Sub-contracting	86
13	Competitive calls	87
14	Bibliographic References	88
Appendix A - Consortium description		91
A.1	Participants and Consortium	91
A.2	Full list of the names of the researchers and doctoral students	100
A.3	Short Curriculum Vitae	127

1 Project summary

HUMAINE aims to lay the foundations for European development of systems that can register, model and/or influence human emotional and emotion-related states and processes – ‘emotion-oriented systems’. Such systems may be central to future interfaces, but their conceptual underpinnings are not sufficiently advanced to be sure of their real potential or the best way to develop them. One of the reasons is that relevant knowledge is dispersed across many disciplines. HUMAINE brings together leading experts from the key disciplines in a programme designed to achieve intellectual integration. It identifies six thematic areas that cut across traditional groupings and offer a framework for an appropriate division of labour – theory of emotion; signal/sign interfaces; the structure of emotionally coloured interactions; emotion in cognition and action; emotion in communication and persuasion; and usability of emotion-oriented systems. Teams linked to each area will run a workshop in it and carry out joint research to define an exemplar embodying guiding principles for future work in their area. Cutting across these are plenary sessions where teams from all areas report; activities to create necessary infrastructure (databases recognising cultural and gender diversity, an ethical framework, an electronic portal); and output to the wider community in the form of a handbook and recommendations of good practice (as precursors to formal standards).

2 Project objectives

The general aim of the network is to equip European teams to take a leading role in the development of systems that can register, model and/or influence human emotional and emotion-related states and processes. We call these emotion-oriented systems. We consider emotion in an inclusive sense rather than in the narrow sense of episodes where a strong rush of feeling briefly dominates a person's awareness – we have called those 'fullblown emotions' (Scherer, 1999; Cowie & Cornelius, 2003).

There is widespread interest in emotion-oriented systems (Picard 1997, Cowie et al. 2001, Campbell 2003, Douglas-Cowie et al. 2003a, Trappi et al. 2003), but the theory that should underpin their development is fragmented, incomplete, and often unfamiliar to the relevant technological communities. This theory is extensive because emotion in the broad sense pervades human communication and cognition. Human beings have positive or negative feelings about most things, people, events and symbols. These feelings strongly influence the way they attend, behave, plan, learn and select. The feelings are conveyed e.g. in faces, voices, gestures, and postures; and people judge others by the way they respond to such signals. They seek out situations that are emotionally rich (not necessarily pleasant), and are persuaded as much by emotional appeal as by factual content.

Humaine aims to bolster sound long-term development by clarifying the scientific, cultural and ethical underpinnings of emotion-oriented computing; developing accessible literature and standards based on that understanding; and establishing enduring relationships among research groups in the key areas of information technology and the science of emotion.

Our specific objectives are chosen in the light of that general aim. Some are concrete enough to expect success. Others are deeper, and there our goal can be defined in terms of making progress.

Objective 1 Assembling interdisciplinary expertise

The network achieves this objective by its membership. It includes excellent teams with backgrounds in diverse disciplines and approaches. Network researchers work or are trained in a broad range of pertinent disciplines including artificial life, classical and embodied AI, experimental psychology, mathematics, music, neural nets, neuroscience, philosophy, psychiatry, signal processing, social psychology, speech science, telecommunications and virtual reality. All of these contribute perspectives that we believe need to be represented if a satisfactory synthesis is to be achieved.

Objective 2 Defining viable thematic areas

The organisation of effort around certain themes shall allow effective division of labour. The thematic areas which we have provisionally identified are as follows:

- (a) theories of emotion;
- (b) from physical signals to emotionally significant features and vice versa;
- (c) patterns of signs that convey emotion in interactions;
- (d) functions of emotion-related elements in communication and persuasion;
- (e) emotion in cognition and action;
- (f) usability of emotion-oriented systems.

The effectiveness of this division is to be tested. The measure of success will be the ability to generate a piece of work in each of the areas which exemplifies how a key problem in the area can be solved in a principled way; and which also demonstrates how work focused on that area can integrate with work focused on the other areas. We call these pieces of work *exemplars*. The exact form of an exemplar is not prespecified: it may be a working system, but it might also be a well-developed design, or a representational system, or a method for user-centred design.

Objective 3 Creating dialogue across discipline and application boundaries

We aim to create dialogue through a series of workshops organised around the thematic areas. To ensure that presenters look beyond their own immediate concerns, we have specified a format that includes area overviews and peer commentary (for details, see section 6). Proceedings will be published, and will provide an indicator of success in meeting this objective. Effective interaction

among disciplines will be demonstrated by a pattern of co-authorship by researchers from different disciplines throughout the project's deliverables and publications.

Objective 4 Promoting shared insight through joint actions

Experience suggests that partners are more likely to understand each other's capacities and concerns if they work together rather than just talk to each other. The development of exemplars is calculated to achieve that. During the first 12 months of the project, the members associated with each thematic area will co-operate to define tasks that are of fundamental significance for the area. These will then be circulated to the whole network so that connections between thematic areas can be examined. That period will inform selection of one task in each area on which members associated with it will work together to produce an exemplar. These aspects of the network will produce concrete output (task analyses and exemplars) which can be evaluated directly.

Objective 5 Establishing essential infrastructure

We aim to promote integration by assembling resources that will be available to all partners and will together define a shared intellectual and practical framework. Four main elements fall under this heading.

- (a) *Shared electronic portal* We will establish a single HUMAINE site through which resources related to emotion-oriented research can be accessed. These will range from lists of relevant individuals and organisations to tools, systems, and databases.
- (b) *Databases* A major obstacle to emotion-related research is the lack of suitable databases. There is a pressing need for material that is naturalistic, multimodal and multicultural. We will assemble pre-existing material through the portal, and develop a prototype of the kind of database that future research needs. Ethical issues are pressing in this area: HUMAINE will produce recommendations on ethical issues (see (d) below) which will be applied within the consortium, over and above the standard existing practices
- (c) *Convergence towards standards* Groups are currently disparate at fundamental levels – such as use of key terms, descriptive systems, basic tools, and measures of performance. We cannot establish formal standards within the scope of this project, but we will draw up extensive recommendations for good practice which shall offer coherence at least within the European research community.
- (d) *Ethical framework* Interactions involving emotion are intensely personal, and therefore ethically sensitive. Failure to deal with this sensitivity carries a real risk that the public will regard emotion-sensitive systems as 'Frankenstein technology'. We will carry out a thorough ethical analysis, leading to recommendations for ethical development and use of emotion-oriented systems.

In all these areas, the network will produce public reports, and, in (a) and (b), electronic resources which can be accessed by network members and (with suitable restrictions) non-members.

Objective 6 Train new and established researchers in relevant combinations of skills

Training is a clear requirement for establishing a European presence in the area. There is a training element in the workshops, already presented in Objective 3. We also aim to carry out further activities which are specifically oriented to training.

- (a) *Summer schools* We will conduct summer schools to give network members grounding in areas where verbal description is not an ideal medium – e.g. because they depend on experience with equipment or techniques.
- (b) *Postgraduates* Where it is appropriate, we will appoint research students to take part in the development of exemplars. They will learn by carrying out research.

Objective 7 Dissemination of excellence

Much of the product outlined above will be available to the wider community. In addition, we expect that partners will disseminate insights and developments by submitting papers to conferences and journals in the normal way. We would also intend to make a proportion of the places in the summer schools and workshops available to researchers from outside the network.

We also envisage one activity specifically concerned with dissemination of excellence. Our intention is that the workshop contributions should form the basis for a handbook on the fundamentals of emotion-oriented systems.

Objective 8 Establish a framework that recognises differences between individuals and cultures
Human beings may share common emotional inheritance (Darwin, 1872, Ekman, 1999), but it interacts richly with cultural and situational factors (Harré, 1986). It would be pernicious if emotion-oriented systems became a vehicle for imposing a single emotional style (which would presumably reflect the predominant style among their developers). We aim to ensure that emotional diversity is systematically recognised, primarily by ensuring that the databases collected (see Objective 5) fully represent both genders and a range of European cultures. The geographic spread of the network is important for allowing that objective to be achieved.

Objective 9 Establish a framework that recognises the human dimension of emotion-sensitive systems
We aim to ensure that realistic assessment of the human dimension is embedded in the European approach. That is critical because it is not self-evident that emotion-oriented interfaces will benefit users in the short term. Some potential costs are obvious (complexity, erratic behaviour), others less so (adverse ethical and cultural impacts). Systems may need to reach quite a high level of sophistication before their advantages outweigh these costs, and they should not be offered to the public until that point has been reached. To achieve this objective, we will produce an authoritative report on the ethical aspects of emotion-sensitive systems (see Objective 5d), and on user response and its evaluation.

3 Participant list

List of Participants

Partic ip. Role*	Partic. Number	Participant name	Participant short name	Country	Date enter project**	Date exit project* *
CO	1	The Queen's University of Belfast	QUB	United Kingdom	Month 1	Month 48
CR	2	Deutsches Forschungszentrum für Künstliche Intelligenz GmbH	DFKI	Germany	Month 1	Month 48
CR	3	Institute of Communication and Computer Systems of the National Technical University of Athens	ICCS	Greece	Month 1	Month 48
CR	4	Universite de Geneve	UNIGE	Switzerland	Month 1	Month 48
CR	5	University of Hertfordshire	UH	United Kingdom	Month 1	Month 48
CR	6	Istituto Trentino Di Cultura	ITC-irst	Italy	Month 1	Month 48
CR	7	Universite de ParisVIII	Paris 8	France	Month 1	Month 48
CR	8	Österreichische Studiengesellschaft für Kybernetik	OFAI	Austria	Month 1	Month 48
CR	9	Kungl Tekniska Högskolan	KTH	Sweden	Month 1	Month 48
CR	10	Universität Augsburg	UA	Germany	Month 1	Month 48
CR	11	Università Degli Studi di Bari	DI-BARI	Italy	Month 1	Month 48
CR	12	Ecole Polytechnique Federale de Lausanne	EPFL	Switzerland	Month 1	Month 48
CR	13	Friedrich-Alexander-Universität Erlangen-Nürnberg	FAU Erlangen	Germany	Month 1	Month 48
CR	14	Università Degli Studi di Genova	DIST	Italy	Month 1	Month 48
CR	15	University of Haifa	HU	Israel	Month 1	Month 48
CR	16	Imperial College of Science, Technology and Medicine, London	Imperial	United Kingdom	Month 1	Month 48
CR	17	INESC ID - Instituto de Engenharia de Sistemas e Computadores: Investigação e Desenvolvimento em Lisboa	INESC ID	Portugal	Month 1	Month 48
CR	18	Kings College London	KCL	United	Month 1	Month

				Kingdom		48
CR	19	Centre National De La Recherche Scientifique	CNRS	France	Month 1	Month 48
CR	20	The Chancellor, Masters and Scholars of the University of Oxford	UOXF.CQ	United Kingdom	Month 1	Month 48
CR	21	The University of Salford	USAL	United Kingdom	Month 1	Month 48
CR	22	Tel Aviv University	TAU	Israel	Month 1	Month 48
CR	23	The Provost Fellows and Scholars of the College of the Holy and Undivided Trinity of Queen Elizabeth Near Dublin	TCD	Ireland	Month 1	Month 48
CR	24	La Cantoche Production	Cantoche	France	Month 1	Month 48
CR	25	France Telecom SA	FTRD	France	Month 1	Month 48
CR	26	T-Systems Nova GmbH	TSN	Germany	Month 1	Month 48
CR	27	Instituto Superior Técnico	IST	Portugal	Month 1	Month 48

*CO = Coordinator

CR = Contractor

4 Relevance to the objectives of the specific programme

HUMAINE within the overall vision of IST in FP6

The HUMAINE Network of Excellence contributes to FP6 Priority Thematic Area *Information Society Technologies* (1.1.2), research priority *Knowledge and interface technologies* (1.1.2.iv). Following the **general objective of IST in FP6** stated in the 2003-2004 Workprogramme – “to ensure European leadership in the generic and applied technologies at the heart of the knowledge economy” – the general aim of the Network (this Annex, section 2) is to equip European teams to take a leading role in the development of *emotion-oriented systems*: systems that can register, model and/or influence human emotion and emotional-related states and processes.

The focus of the Network on emotion-oriented systems falls within the **focus of IST** in FP6 on the future generation of technologies that integrate computers into the everyday environment through easy-to-use human interfaces, and follows the IST vision on ‘*ambient intelligence*’ that places the user “*at the centre of future developments for an inclusive knowledge-based society for all.*” Emotion pervades and colours human life and therefore user-centred interactive technologies must be attuned to this fact. Emotion-oriented systems are a basic requirement for the realisation of ambient intelligence at the micro-level of the individual, as well as highly pertinent to achieve an inclusive knowledge-based society for all at the macro-level of the society, by rendering accessible a multitude of services and applications through very easy-to-use human-adapted interfaces.

To achieve real European leadership in this area, coordinated efforts must go beyond the more engineering- and application-oriented developments undertaken in leading countries outside the EU, in particular in USA and Japan. Addressing this objective necessitates a proper underpinning of research in the area that lays the ground for long-term sound and integrated development. For this reason, a Network of Excellence is necessary in this area, as this objective would not be achieved only through particular Integrated Projects and other types of instruments. A specific aim of Networks of Excellence is to lower barriers between hitherto split communities and disciplines. HUMAINE deals with communities and disciplines that are actually split in several respects, and achieving a satisfying interdisciplinary dialogue depends on bringing experts together across the main divisions (this Annex, section 2, Objectives 1, 2 and 3). These divisions are at several levels, notably:

- a) The applications in view, particularly
 - comprehension/production of natural speech, including recognising and producing appropriate emotional colouring
 - designing artificial agents which are sensitive to users’ emotions and exhibit emotion-related behaviour
 - achieving emotion-directed search in large databases
 - achieving emotionally-directed cognition and action capabilities, and simulation of human behaviour
 - mobile applications, in particular enriching the affective bandwidth between users
- b) The contexts in which these applications are to occur, notably
 - entertainment (games, films, etc)
 - virtual reality (for communications, recreation, etc)
 - person-sensitive speech-based interfaces as an alternative to keyboard and screen
 - situations involving influence and persuasion (tutoring, sales, etc)
 - computer-mediated communication
 - monitoring of humans in emotion-sensitive situations (clinical, driving, service provision, etc).
- c) The underlying intellectual traditions, including Philosophy, Linguistics, Sociology, Anthropology, Psychology, Biology, Neuroscience, Classical and Embodied Artificial

Intelligence, Artificial Life, Neural computing, Signal processing, Human-Computer Interaction.

The network will address these divisions in a way that satisfies several natural requirements:

- a) The treatment of emotion across these domains should be coherent rather than piecemeal, to prevent individual, ad hoc and probably incompatible solutions coming to predominate in different contexts;
- b) It should be grounded in sound theory – biological, psychological and sociological – rather than ad hoc heuristics or common sense;
- c) It should be informed by sound ethical principles rather than unconstrained commercial or serendipitous research motives
- d) It should respect cultural and gender diversity in emotional matters rather than tacitly reinforcing the emotional norms of a single dominant culture or group.

The concrete ways in which the proposed Network's programme and integration goals specifically address the particular scientific, technical, socio-economic and policy objectives of the IST priority as described in the 2003-2004 Workprogramme are detailed below.

Scientific objectives: HUMAINE and the Workprogramme content

HUMAINE is relevant to several strategic objectives described in the 2003-2004 Workprogramme.

a) Multimodal Interfaces

The area to which HUMAINE belongs most directly is *Multimodal Interfaces* (2.3.1.6). The network specifically addresses the objective of this area to develop natural and adaptive multimodal interfaces and its focus on interaction between and among humans and the virtual and physical environment, with particular emphasis on recognizing and responding to emotive user reaction. The development of emotion-oriented systems relates to the stated objectives on a broad front, particularly:

- To develop interfaces that are:
 - Natural and intuitive: emotion-oriented systems designed to appear as 'life-like,' 'believable' entities and social partners to humans so that they are meaningful, easy to use and accepted by the human side of the interaction loop;
 - Autonomous: capable of responsive and pro-active emotion-oriented behaviour without explicit human-initiated action, however leaving the ultimate control of the interaction to the human user;
 - Capable of learning and adapting to the user environment (in particular emotion-related aspects) through continued interaction;
 - Multimodal: covering a broad range of human sensory and interaction modalities particularly relevant to emotion-oriented interaction.
- To respond intelligently (and in ways that are emotionally appropriate) to speech, language, vision, gesture, haptics and other senses (e.g. through the use of bio-sensors), in particular regarding emotion-related qualities.
- To achieve robust dialogue capability and facilitate translation especially for spontaneous or ill-formed speech inputs, which abound in emotion-related dialogues.

As detailed in the Joint Programme of Activities, work will span: critical analysis of existing models and systems; identification of needs regarding research, applications, good practice and usability; basic cross-disciplinary research; and specific joint activities (exemplars) aimed to investigate system level integration.

b) Other activities in the First Call

The project is also relevant to several other headings in the First Call, notably:

- *Mobile and Wireless Systems Beyond 3G* (2.3.1.4): Emotion-oriented systems are particularly suited to be partly developed using mobile and wireless technology, such as wireless devices or

smart clothes that for example recognise or monitor the affective state of the user. Conversely, an emerging challenge for these technologies is the development of mobile and wireless devices specifically designed to meet the requirements of emotion-oriented systems.

- *e-Safety for Road and Air* (2.3.1.10): There is some evidence that emotional states (e.g. anger or boredom) can substantially reduce the performance of a driver or a pilot. That suggests road and air safety systems would benefit from the inclusion of devices and interfaces to monitor the emotional state of the driver/pilot, and to provide support for the self-awareness and control of extreme emotional states.
- *eHealth* (2.3.1.11): Emotion-oriented systems should also be integral part of intelligent environments that enable ubiquitous management of citizens' health status and to assist health professionals in coping with some major challenges. On the one hand, an important number of health problems arise from emotion-related disorders, and these need specific support tools for their treatment. On the other hand, some emotional states (e.g. anxiety) can be used as indicators of other health problems, and eHealth systems should include devices for their detection and monitoring.
- *Technology-Enhanced Learning* (2.3.1.12): Emotions strongly influence the learning process in various respects. An appropriate emotional tone and emotionally positive feedback ('reward') can motivate learners and facilitate their memory and problem-solving skills, whereas extreme and negative emotional states will have the converse effects. It is thus very important to develop learning-oriented technology that encourages the appropriate emotional interaction and response from the user. In addition, more tools are needed to address pedagogical aspects particularly related to emotional states, following the example of the EU FP5-IST project VICTEC to develop empathic characters that support coping and remedy bullying behaviour in schools.

c) *Relevant activities and strategic objectives in the Second Call:*

- *Cognitive systems* (2.3.2.4): HUMAINE is extremely relevant to this strategic objective, which focuses on methodologies and construction of physically instantiated or embodied robust and adaptive cognitive systems integrating a wide range of perceptual, cognitive, interaction and communication capabilities. Due to the pervasive involvement of emotions in all these aspects, as well as to their integrative role as a glue that brings together and coordinates the functioning of other subsystems, a sound understanding of emotion-related mechanisms and their relevant computational realisations can shed much light towards the development of integrated cognitive systems.
- *Applications and Services for the Mobile User and Worker* (2.3.2.6): In this area, emotion-oriented systems are relevant to intelligent, adaptive and self-configuring applications and services that deploy wearable interfaces and enable automatic context-sensitivity, user profiling and personalisation, and multiple modes of interaction.
- *Cross-Media Content for Leisure and Entertainment* (2.3.2.7): Emotion-oriented systems are relevant to achieve device adaptivity and contextualisation, personalisation and emotive feedback, and ability to capture real-time, multimodal and multisensorial input. Phenomena such as mood-congruent recall and emotional memory can also be used to retrieve content from different sources, types and locations, and to store and categorise it.
- *Inclusion* (2.3.2.10): Emotion-oriented systems should be part of the intelligent systems and assistive technologies to empower and improve the quality of life of persons with (physical and cognitive) disabilities and ageing citizens advocated in this objective. These users are more prone to experience negative feelings such as loneliness, anxiety, frustration, and (mild or severe) affective disorders, given the increased difficulty they have to carry out daily activities, and the physical and social isolation they often suffer. It is possible to imagine assistive technology that effectively *cares* for these users by recognising and monitoring their affective states, responding appropriately to them, and trying to elicit positive reactions and feelings from the users. Additionally, emotions can be used as cognitive aids: assistive technology should take into account not only the fact that some of the cognitive disorders suffered by these users carry affective impairments, but also that some aspects of emotions can be used to

influence and facilitate cognitive tasks that pose particular problems for them, such as recall, problem-solving, or decision-making. Such ideas have ethical dimensions, and HUMAINE addresses those as well as the technical issues.

d) Future and Emergent Technologies (FET)

Finally, HUMAINE is also relevant to some of the pro-active initiatives of this objective, namely:

- *Beyond Robotics*: in particular the development of cognitive (and emotion-oriented) robots that serve humans as assistants or companions, being able to learn in an active open-ended way and to grow in constant interaction and co-operation with humans.
- *The Disappearing Computer*: emotion-oriented systems can play a vital role in the development of future ambient systems – IT systems intimately integrated with everyday environments and supporting people in their activities – in particular when combined with wireless and mobile systems.
- *Life-like Perception and Cognition Systems*: subsystems and complete autonomous artefacts that are inspired by architectures and mechanisms found in living systems. In addition to the issues highlighted under ‘Cognitive systems,’ emotions and their expressive and behavioural manifestations are one of the key elements to achieve ‘life-like’ qualities and the impression of life.

Technical objectives

HUMAINE addresses specifically the following technical objectives of IST (summarised in pages 6 and 7 of the 2003-2004 Workprogramme):

- Developing “*communication infrastructures as well as software and computing technologies* that are reliable, pervasive, interoperable and can be adapted to accommodate new applications and services” with the aim to “contribute to the next generation of products and services.” To achieve interoperability of solutions and further innovation, this objective encourages “the development of open standards and open source software”. HUMAINE addresses all these issues. Reliability and adaptation are sought by aiming to underpin sound long-term development of emotion-oriented systems (this Annex, section 2), by the joint development of exemplars that exemplify how a key problem in the area can be solved in a principled way (this Annex, section 2, Objective 2) and by ensuring a realistic assessment of the human dimension and the potential costs and benefits of these systems (this Annex, section 2, Objective 9). Pervasiveness is considered in the aim to address emotion in an inclusive sense that pervades human communication and cognition (this Annex, section 2). Achieving interoperability is also linked to the Network’s objectives of promoting convergence towards standards and developing means of sharing existing material and resources (this Annex, section 2, Objective 5).
- “Developing *user friendly interfaces* which are intuitive, can interpret all our senses such as speech, vision and touch and that understand our gestures and various languages [...] coupled with more powerful and flexible knowledge technologies that are semantic-based and context-aware.” The Network’s objectives 1 (assembling interdisciplinary expertise) and 2 (defining viable thematic areas) described in section 2 aim to gather the necessary expertise to achieve this goal regarding user-friendly emotion-oriented systems.

Socio-economic objectives

HUMAINE contributes to the following IST socio-economic objectives of IST in FP6, summarised on page 6 of the 2003-2004 Workprogramme:

- “Solving ‘trust and confidence’ problems so as to improve dependability of technologies, infrastructures and applications.” HUMAINE addresses ‘trust and confidence’ problems at two main levels. On the one hand, it aims to provide the technological community with a thorough ethical analysis, which gives users in general rational grounds to trust the systems (see Objective 4, section 2). On the other hand, it aims to provide a realistic assessment of the human dimension (the benefits and costs of emotion-oriented systems, cultural and gender diversity, etc.) which encourages a subjective sense of trust in the systems.

- “Strengthening social cohesion by providing efficient, intelligent and easy to use systems for health, transport, inclusion, risk management, environment, learning and cultural heritage.” The relevance of HUMAINE to various strategic objectives of IST in FP6, such as *eHealth*, *eInclusion*, *eSafety for road and air*, *Technology-enhanced learning*, etc. has been extensively developed under the heading ‘scientific objectives’ in this section.
- “Enabling sustainable growth and improving competitiveness of large and small business.” Emotion pervades human life, and it is our belief that technologies that are attuned to it will have enormous advantages over technologies that are not, and that therefore they will become commercially dominant. To take account of this vision in a realistic way, the network involves in its activities not only academic researchers but also companies from relevant sectors. The technology-oriented dissemination activities will start to shape new interfaces and applications. In a first step, the improved accessibility of emotion modelling for the design of interactive systems will engender joint research and development projects with industry. In a second step, this work will find its way into products. In particular for SMEs, who cannot afford long-term basic research, the existence of reusable kernel tools and model exemplars will reduce product creation times and time-to-market considerably.
- “Supporting complex problem solving in science, society, industry and businesses” with the aim “to harness the computing and knowledge management resources across Europe and bring them into the desktop of any researcher, engineer or other end user.” Emotion-oriented systems can support complex problem-solving in many areas of science, society, industry and business, as exemplified by their relevance to a number of the scientific objectives of IST in FP6. The pervasiveness of emotion in human life makes of these systems a basic requirement for the realisation of ambient intelligence, as well as highly pertinent to achieve an inclusive knowledge-based society for all by rendering accessible a multitude of services and applications through very natural, easy-to-use and human-centred interfaces.

Policy objectives

HUMAINE addresses the limited set of strategic policy objectives stated in the 2003-2004 Workprogramme:

- “To overcome weaknesses in areas which are critical for European competitiveness and for addressing societal challenges.” The importance of achieving European leadership in the development of emotion-oriented systems and how these systems contribute to address socio-economic challenges has already been discussed. Europe has world leadership in some issues related to emotion-sensitive technology, but lags in others. The general aim of the network is to address the main weakness regarding emotion-oriented systems: the lack of integration at different levels (applications, contexts, databases and resources, intellectual traditions, systems, etc.). The structure and joint programme of activities of the network are designed to achieve deep and durable structuring and integration of European research in emotion-oriented systems.
- “To reinforce European strengths in areas where it has established industrial and technology leadership.” As mentioned before, emotion-oriented systems can contribute to enhance some of these areas explicitly mentioned in the Workprogramme, such as mobile and wireless technologies or applied IST for health, transport and business support tools.
- “To exploit new opportunities and respond to emerging needs.” One of the network’s packages (WP2, ‘Plenary sessions’) will specifically attend to these issues through activities such as a ‘Visions’ session at the beginning of the network, concerned primarily with foreseeing potential applications, and a Plenary session (month 16) that specifically aims to identify the key tasks for research.
- “To ensure the co-evolution of technology and applications so that technology advances are exploitable in innovative products and services.” The integrated approach of Humaine to underpin research in emotion-oriented systems aims to ensure this co-evolution. Particular attention is paid to take account of users’ needs and usability and accessibility of technologies and applications, with one of the network’s workpackages (WP9) specifically devoted to this.

HUMAINE also attends to other objectives of the European Research Area (ERA) in IST, notably:

- Networking of existing centres of excellence in Europe and the creation of virtual centres through the use of new interactive communication tools. This latter point is one of the activities of Workpackage 1.
- Better use of instruments and resources to encourage investment in research and innovation. A major obstacle to developing accurate (computational) models of human emotion is the absence of rich, realistic databases. That leaves researchers dependent on small, ad hoc datasets, or worse still, their own intuitions. Workpackage 5 (Data and Databases) aims to overcome this problem.
- More abundant and more mobile human resources. The ‘Training and Outreach’ workpackage (WP1) will work towards stimulating young people to pursue research and careers in this area. Emotion research traditionally has a good gender balance, and the outreach activities will consciously aim to reach potential researchers of both genders.
- It is also expected that the activities of the network towards achieving European leadership in this area will improve the attraction of Europe for emotion researchers from the rest of the world. Activities related to the dissemination of excellence (Objective 7 of section 2) carried to a big extent through workpackages 11 (Handbook), 2 (Plenary sessions) and 1 (Training and Outreach), in addition to journal and conference publications, will play a key role in this. Links to relevant groups and organisations, such as the International Society for Research on Emotion, will also be valuable means towards this goal.
- Promotion of common social and ethical values in scientific and technological matters. The consideration of Cultural and Ethical Issues is one of the network’s activities with explicit integrative goals. This is reflected in two of the main objectives of the network presented in section 2. One of them (Objective 8) is the establishment of a framework that recognises differences between individuals, cultures and groups in emotion-related issues. The other objective (item (d) of Objective 5) is to carry out a thorough ethical analysis of sensitive issues, leading to recommendations for ethical development and use of emotion-oriented systems.

5 Potential Impact

In the global race for more intuitive interfaces that must allow non-expert users to operate increasingly complex technology, Europe has a strategic need to strengthen excellence on the scientific foundations of the role of emotions in the design and use of such interfaces. Failure to account for emotions as a natural, unavoidable part of all interaction can lead to rejection by users. With the emergence of complex, (apparently) intelligent multimodal interfaces, any lack of appropriate emotional interaction will be much more disturbing than for traditional, machine-like interfaces which were perceived as tools rather than interaction partners. In the best case, the intelligence behind the new generation of interfaces will be perceived as simply dull if it fails to account for emotions; in the worst case, it will be perceived as hostile. It is therefore essential to understand the emotional mechanisms at play in human-machine interaction. Without foundations being properly laid down, however, any research and development work in the domain will stay piecemeal, leading to ad hoc decisions and inappropriate approaches to this delicate field.

There are already a considerable number of individual groups in Europe performing world-class research in different aspects of emotion research, with a wide variety of orientations, from theoretical and basic research to applied system design and usability studies. Although these groups can compete with research carried out in the US (e.g., MIT, Picard 1997, ICT, Hill et al., 2003) and in Japan (e.g., JST-CREST, Campbell, 2003), the current situation is far from satisfactory. Due to the inherent multi-disciplinarity of the domain of emotion research, there is no shared or generally agreed understanding of how to approach emotions, how to describe, model, measure or elicit them, how to utilise them in order to achieve a dialogue goal, or how to assess their role in the usability of interfaces. Furthermore, there is currently insufficient consideration given to the ethical issues arising from systems becoming able to influence a user’s emotional state.

A large, potent network linking the existing excellent groups together over a period of several years provides a unique opportunity for researchers to come to a common understanding of essential

aspects of the field. By encouraging and rewarding interdisciplinary exchange of know-how at different levels, this network will work as a catalyst for the required information exchange and the emergence of a more complete view of the field. By developing common visions and agreed approaches to the essential thematic areas, the network will produce the initial sparks for future research projects. By agreeing on the desirable properties of systems and building exemplars, the network will provide the building blocks for future research and development projects.

Linking together recognised experts in key sub-areas of emotion research, the network has the authority to issue recommendations of good practice and, ultimately, standards. Such recommendations and standards provide guidance for those aiming to apply the research results in their products, enabling them to design and produce emotion-oriented technology on the basis of an agreed pool of concepts, data, tools, and kernel components. At the same time, the authority of such a network must extend to the ethical domain and issue recommendations for acceptable use of such technology.

The network sets itself an ambitious goal – to make the specialists in the many sub-areas of emotion research talk to each other, learn from each other, and distil a common view on the complex field in such a way that results in concrete recommendations, tools and exemplars for technological use. That kind of interaction has not been achieved in the past, and is not being attempted on the same scale in other parts of the world.

An obvious question arising from this ambitious goal is *why* this has not been tried before. Indeed, several partners in this network have seen the necessity of such an undertaking for many years. However, up to now, three factors have been missing for such a project to become realistic:

1. The research in sub-disciplines has made serious advances in the understanding of their respective aspect of emotion, which was a necessary specialisation phase before an integration could be attempted.
2. An incentive for specialists to interact has been missing – there is no immediate reward for a specialist in one field to talk to a specialist in another field, if they cannot publish within their respective communities. Consequently, the limited resources were put to use to achieve advances within each field rather than in interdisciplinary cooperation. For the first time, now, a Network of Excellence provides such an incentive, thus providing the initial spark required for mobilising and structuring the resources of participants.
3. The upcoming technological use provides a point of focus. Only in a running system can the effects of theoretical decisions become totally apparent, which forces emotion models to become more explicit. The constraints and limitations of a given technological application, on the other hand, will make it easier for specialists of various sub-disciplines to give up some specialized aspects dear to their hearts in exchange for a working system.

In the context of this unique opportunity, the network's goals appear highly but suitably ambitious. The long-term goal of a single, unified model of emotions is broken down into feasible, promising subtasks, which we have named thematic areas (see section 2, objective 2). Each of these is designed to cut across traditional boundaries between research communities by identifying questions relevant in different communities. This will necessarily lead to representatives of different communities exchanging and discussing their respective views, and thus allow for a larger picture on the respective question to emerge.

The first challenge is for participants to realise that their own view on and approach to emotions is only one facet of a bigger picture. Consequently, the first task at hand in each thematic area is to create a common view of the bigger picture, and to identify missing or unfitting puzzle pieces. This is achieved by means of a workshop in each thematic area, in which peer comment will play a major role.

The second challenge is for participants to come together and cooperate. To that end, each thematic group will work out a proposal for common action, embodied in one or more exemplars to be built during the second half of the funding period.

These key actions will be complemented by the necessary infrastructure facilitating communication and collaboration, dissemination and training activities such as the yearly summer schools and the handbook, and the build-up of lasting and reusable resources of data and tools.

The added value of carrying out this work on a European, multilateral scale is clear: Only by bringing together the experts in all relevant sub-areas of emotion research can a sufficiently broad consensus be achieved. Little would be gained by an attempt to carry out the same task in a small team or a small cluster of teams. Such an approach would only reproduce the current practice of domain-specific, tailor-made solutions, lacking the necessary grounding in a thorough understanding of the theoretical underpinnings. Because of this limited view, the work would risk being too specific to be reusable and even to serve as the basis for future work, and thus would not bring about the wider, integrating effect of a truly multi-disciplinary effort.

The large-scale task that we envisage will draw on the competences of partners from eleven European and associated countries. No single country possesses a richness of experts in such a wide range of disciplines. Consequently, the network will have a visibility and reach many times larger than that of the constituent groups, which will be mediated by the communication infrastructure to be built up during the initial phases of community funding. The breadth and depth of know-how in the HUMAINE consortium is the best possible precondition for an integrative, structuring effect of the network's actions on research and technical development within Europe.

While the network's activities are different from previous activities in both magnitude and scope, the network builds upon numerous research projects carried out by the partners. These include:

- national-funded projects such as Smartkom and Virtual Human in Germany, Commedia in Italy, several agent-based projects in Austria, AURORA and the North West Virtual Prototyping Centre in the UK, and CABÓG in Ireland;
- European-funded projects such as ERMIS, NECA, SAFIRA, MagiCster, DIVERCITY, ISLE NIMM, NICE;
- internal research projects of industrial partners.

None of these is comparable in scope with the HUMAINE network, but all are relevant building blocks and contribute to the richness of the overall picture.

The unique contribution of the network is the initial build-up of a structure designed to cut across disciplines, and to maintain this structure for a number of years, thus allowing it to establish itself in the research landscape, and then to establish a durable voluntary association. It urges specialists to exchange their know-how and to enrich each other's view. It enforces to take the necessary step back required for establishing a research roadmap going far beyond the typical lifetime of a research project. In addition to these structure-building top-down activities, it rewards individual bottom-up integration activities such as staff exchanges between labs or the collaborative establishment of new, interdisciplinary curricula.

The resulting integrated research landscape will provide a unique framework for carrying out research on emotions and human-machine interaction. This will provide an exciting perspective for young European researchers and attract researchers from outside Europe, thus strengthening Europe in the competition for the brightest heads.

An essential goal in the network, apart from gathering a new integrated view on emotion, is to spread the combined excellence to those who can naturally benefit from it. This will be done on a number of levels.

Most immediately, an electronic portal will be set up and held up to date, in order to always reflect the latest state of the combined research of the partners and, if possible, of other groups in the world. This portal will be made widely known through the many communication channels of partners in all participating disciplines, and must be sufficiently attractive for first-time visitors to have a reason for coming back. It will become the most up-to-date and most complete resource of emotion research for human-machine interaction, and will encourage website visitors to participate in the creation of web site content, e.g. by providing a Wiki space which allows all visitors to add content. This portal has the potential to become a crystallising point for a new, interdisciplinary research community, spreading across the whole network and even beyond the limits of the network. Access is discussed in section 6.5.

Training is an important aspect of the work. A summer school will be organised every year, providing researchers both inside and outside the network with an opportunity to get an understanding of the latest work in the various thematic areas in the network. Funds are available to support exchanges between partners, and the establishment of interdisciplinary curricula at partner sites is recognised as a legitimate use of them.

The work will also become increasingly relevant for industrial application. Kernel tools, reusable application components and exemplar systems will be created and made available. SMEs and larger industries will be given the opportunity to learn how to benefit from these newly available technology components in targeted tutorials, which will be held during the summer schools in the second half of the network.

Via the end of the funding period, a considerable pool of gathered know-how will have been established. The plan for its wider distribution includes the compilation of a high-profile handbook, as well as the formulation of pre-standard recommendations of good use in emotion research and technical applications. These publications will be designed to serve as scientific and technical references giving direction to research and development for many years to come, and will be of importance for scientific as well as industrial users. Steps will also be taken to ensure that the portal, which is the electronic counterpart of the handbook, will have a long term future – see section 7 below.

European research can be expected to experience a durable structuring impact of this network's activities. At the end of the network's funding period, it will have established a new understanding of the way to conduct emotion research aimed at of technological applications, and will have begun to make that understanding widely known.

A major shaping effect on the way research is carried out will be achieved through the members of the network itself, whose work as experts in their areas will benefit from the newly gained perspective. The work packages cutting across discipline boundaries should create new communities perpendicular to and complementing the previously existing ones, thus leading to a flourishing exchange between disciplines which in the past did not communicate with each others.

The regular, high profile summer schools on emotion and HMI research have the potential of establishing a new tradition, which participants will want to continue if they perceive them as sufficiently valuable.

The jointly executed research is designed to generate new resources and tools, which will become widely available and known. Their integrated character, resulting from a careful design during the first 18 months of the network, should allow them to be widely reused in many different contexts.

The technology-oriented dissemination activities will start to shape new interfaces and applications. In a first step, the improved accessibility of emotion modelling for the design of interactive systems will engender joint research and development projects with industry. In a second step, this work will find its way into products. In particular for SMEs, who cannot afford long-term basic research,

the existence of reusable kernel tools and model exemplars will reduce product creation times and time-to-market considerably.

Taken together, these activities will provide the ignition spark required to overcome the obstacles for a coherent and mutually enriching research on emotions in the multitude of relevant disciplines. Once a thorough basis of vocabulary, concepts and methods will have been established, the compatibility of research and development in different sub-disciplines will be facilitated, the cumulativeness of research will improve, and application developers will have a considerably easier starting point for incorporating emotion-oriented aspects into their products. While it would be naive to pretend that all problems will be solved, it appears fully realistic to assume that the change brought about by the network's actions will be groundbreaking in the sense of an unprecedented common understanding of emotions in the context of human-machine interaction.

5.1 Contributions to standards

In the long term, it will be desirable to attain an agreement on standards regarding the various aspects of emotion modelling relevant for HMI. However, recent experience in similar attempts has shown that in the limited time frame of this network, a fragmented research area as that of emotion research is unlikely to develop as tight a coherence as would be required to formulate definite standards.

At this stage, a more realistic aim is to draw up recommendations of good practice. Such recommendations are to be formulated in areas including the following:

- Descriptions of emotions
- Descriptions of emotion-relevant signals
- Descriptions of emotion-related cognitive structures
- Mark-up languages (based on the previous three items)
- Emotion-related ethical issues

Depending on the degree of coherence that can be achieved during the four years, it may be possible to start a standardisation effort as a follow-up to the network. Partner sites have connections to standardisation bodies such as MPEG and FIPA, which may become relevant at that stage.

It is also possible that agreement in individual domains can be achieved comparatively quickly, and that such agreement can have a local impact on other standards in which emotion modelling plays only a secondary role. A clear picture of whether any such case is present can be expected to emerge by the end of the initial clarification phase, particularly through discussions at the second plenary meeting, which will inform the second annual review.

6 Outline joint programme of activities (JPA) - for the full duration of the project

Overview

This section explains the general structure of the JPA, summarising our general understanding of the development that is needed, and its relationship to the broad shape of the network.

The integration that the JPA will achieve is primarily intellectual. It sets out to establish shared understanding of the problems involved in developing emotion-oriented systems, and of the ways different disciplines should contribute to solving them. The task is challenging because the intellectual issues involved are both diverse and deep. At present, the research community lacks a shared overview of these issues and their inter-relationships. As a result, it lacks well-established ways of locating particular efforts within a broader framework, and it is difficult to address sub-problems in a principled way. For instance, it is not obvious when research on an attractive topic can safely adopt partial, ad hoc solutions to various associated problems for the sake of rapid progress, and when they risk undermining the treatment of the core issue. Recent reviews show some of the reasons for concern about ad hoc solutions in two areas where they are often adopted – choosing ways to describe emotions and emotion-related states (Cowie & Cornelius, 2003), and collecting databases of emotional behaviour (Douglas-Cowie et al., 2003b).

Our approach to integration hinges on establishing a division of labour that can be understood and accepted by the community as a whole. The division that underpins HUMAINE was introduced in section 2 (see under objective 2). It is fundamental to the structure of the JPA, and so the meanings of the titles set out in objective 2 are explained here. The research issues associated with them are introduced in section 6.2 below.

We distinguish six areas of expertise involved in the task of developing satisfactory emotion-oriented systems. We call them thematic areas (see section 2, objective 2). Four of them relate to different levels of component in a system, and the remaining two relate to perspectives on emotion in humans (and animals). We consider the system-related divisions first. They follow a fairly standard progression from low-level (sensory) to high-level (conceptual).

(a) Signal/sign interfaces (from raw signals to emotionally significant signs and vice versa)

Emotion-related interactions are mediated by physical signals in various modalities – i.e. distributions of energy that fluctuate in time and/or space. The function of these signals is to carry signs – information structures that human or artificial systems use to signify particular types of object or event.

The signal/sign interface in emotion poses major technical challenges in both directions (signal to sign and sign to signal) and in several modalities. These include finding emotionally significant features in an image of a face, synthesising sound patterns that convey emotionally significant voice qualities, detecting patterns in physiological data that are systematically associated with emotion, and much more. The challenge in the signal/sign interface thematic area is to ensure that work on these low-level but difficult issues receives the attention it needs, and is both understood and informed by other parts of the community.

(b) Signs and emotional content in interactions (from signs to emotion descriptors and vice versa)

Emotion-sensitive systems need to embody knowledge about the relationships between emotional states and the signs, in many modalities, by which they are conveyed. Standard analyses of those relationships concentrate on the simplest and clearest types of emotionality. The challenge in this thematic area is to develop analyses that extend at least to simple interactive situations. The task has multiple levels. It requires good ways of describing the types of sign that appear in those situations, and the variations in them that are important; it involves finding suitable ways of describing the emotional and emotion-related states that occur in interactions; and it involves finding ways to relate the two. Good solutions to these problems would serve both synthesis (allowing appropriate combinations and sequences of signs to be generated) and analysis (allowing appropriate interpretation of combinations and sequences of signs).

(c) Emotion in cognition and action

Modern research in various disciplines has emphasised that emotion has pervasive effects on the mind: it entails distinctive ways of perceiving and assessing situations, processing information, and prioritising and modulating actions.

In effect (though not necessarily explicitly), an emotion-sensitive system needs to embed models of these phenomena. Otherwise, for instance, it cannot “understand” a user’s emotional state well enough to anticipate how s/he is likely to act, with or without particular interventions by the system; nor can it synthesise actions which are consistent with the emotion it sets out to portray. The challenge in this thematic area is to develop ways of embedding appropriate models of emotionality in systems that use emotion-sensitive interfaces.

(d) Functions of emotion-related elements in communication and persuasion

There are many potential applications of emotion-oriented systems where the goal is not to manipulate or match emotion as such, but to use emotion-related means as a way of achieving pragmatic ends (Stock, 2002) – for instance, ensuring that a person is receptive to information, or motivated to carry out a task. There is a long-established literature on these issues in social psychology (e.g., Lazarus, 1991), and recently the technological community has become increasingly interested in the ways that these effects may be used. For instance, several researches have suggested that the user’s productivity and performance is enhanced by the use of emotionally coloured embodied agents. Users spend more time interacting with an agent with a stern face than one with a neutral expression (Walker, Sproull, & Subramani 1994).

The challenge in this thematic area is to understand the way emotion-related means can be used to enhance systems’ ability to communicate and persuade.

(e) Theories of emotion

There is a well-established psychobiological tradition that aims to discover the essential nature of emotion in humans and (particularly since Darwin) in animals (e.g., Plutchik 1980, Scherer & Ekman, 1984). It is backed by a large body of empirical research. It is clearly important that the insights developed by that tradition should be available to technologies concerned with emotion. The converse may also be true – it is quite likely that attempts to develop emotion-oriented systems may cast useful light on pure theory.

The challenge in this thematic area is to develop a body of understanding that effectively links theoretical work on emotion to technological issues entailed in developing emotion-oriented systems.

(f) Usability of emotion-related systems

Any attempt to develop novel systems for human use needs to be supported by work on humans’ reactions to the systems (Höök et al., 2003). Usability traditionally focuses on goals such as effectiveness, efficiency, safety, utility, learnability, and memorability. These objective usability goals contrast with user experience goals, which cover subjective qualities such as being fun, rewarding, motivating, satisfying, enjoyable, and helpful. Usability goals and user experience goals often stand in complex relationships, involving tradeoffs such as safety vs. fun or efficiency vs. enjoyability (Preece et al., 2002). Introducing emotion thus raises many new dimensions for research on usability to address.

The challenge in this area is to ensure that research on emotion-sensitive systems can be effectively informed by understanding of users’ responses to them. This does not mean simply passive evaluation: it has profound implications for the design process.

The joint program of activity aims to promote a shared understanding that this general kind of organisation needs to emerge, so that people with conceptually related interests converge on satisfying ways of handling their core tasks – and also recognise that there are other tasks to be considered, in which other groups have special expertise. We do not stand on the particular dividing lines described here. Within limits, spontaneous re-organisation is expected, and it is useful if it produces a macrostructure with which key research groups are at ease.

The approach is embedded at an organisational level through work packages that focus on one of the thematic areas. To ensure that the workpackages do not perpetuate old divisions, the teams working on any one workpackage have varied home disciplines and application goals, and each

partner contributes to more than one workpackage. Each workpackage has a designated leader, and the workpackage leaders make up the steering committee.

In most thematic areas, the work will follow a common pattern. There will be a workshop exploring the thematic area. It will be designed to ensure both that the key issues in it are understood throughout the network, and that the way work proceeds reflects issues affecting other areas. Workshops are held as early as practical limitations allow. There will also be a sustained process leading to the development of an exemplar designed to embody good practice in the area, by showing how a key problem in the area can be solved in a principled way; and also how work focused on that area can integrate with work focused on the other areas.

The process will begin with production by each thematic group of a review of key concepts achievements and problems in its thematic area; and drawn from the review, an assessment of the key development goals in the area. This review and assessment will be circulated to the whole network for discussion and comment, aimed both at building understanding of basic issues across areas, and at identifying the choices of goal that would be most likely let the different groups achieve complementary developments. That consultation phase will provide the basis for deliverables in month 11, which describe in some detail a few alternatives that might realistically be chosen as exemplars in each area, and their linkages to issues in other thematic areas. A decision and planning period will follow, involving consultation within and between thematic areas, leading to presentations at the second plenary conference, which will describe a single exemplar that has been chosen for development in each area, and the way work on the exemplar will be divided across institutions. The remainder of the project will be absorbed in developing the chosen exemplar.

The program involves two broad types of interaction, information exchange and shared activity.

Information exchange is achieved mainly through workshops. In most of them, the primary contributors will be associated with one of the thematic areas. Hence they are designed to promote consolidation within thematic groups. However, they will also include peer commentary elements, specifically drawn from researchers in related thematic groups, with a view to avoiding introversion or excessive encroachment. The information exchange in workshops will be supplemented in several ways. Proceedings will be published. We will also develop from the proceedings a handbook which will consolidate the material and make it available to a wider audience. We will hold summer schools to transmit expertise that is difficult to absorb without hands-on experience. We will also establish an electronic information portal which will make available to network members the widest possible range of key resources, not only text, but also tools, systems, data, etc..

All of the elements described above involve research – mainly because they require each participant to work out how ideas that are standard in his or her own field can be adapted so that they make sense to people rooted in other fields, and can be integrated with the ideas that are standard there.

The main shared activity takes place in the research activity linked to the thematic areas. Two other shared activities stand outside the division into thematic areas. There is a pressing need for adequate databases. Adequacy involves both scale and structure. Assembling a database on the necessary scale is not an undertaking for this kind of instrument, but part of our joint program of research is to develop a database that can serve as an exemplar in terms of form. It will provide a shared point of reference for the thematic groups. There is also a pressing need to establish ethical guidelines, and our joint program of research will also include work aimed at providing the area with a sound ethical base.

The outline given here is meant to convey the spirit of the network. There are particular reasons to supplement and adapt the basic pattern in certain areas. The remainder of this section details the specific activities that we propose, including variations on the core pattern.

6.A Activities

6.1 Integrating activities

Integration is a key goal in most of the network's activities. Referring to the list of objectives in section 2, it can be seen that least six of them have integration as a central element. These are:

Objective 1 Assembling interdisciplinary expertise

Objective 2 Defining viable thematic areas

Objective 3 Creating dialogue across discipline and application boundaries

Objective 4 Promoting shared insight through joint actions

Objective 5 Establishing essential infrastructure

Objective 6 Train new and established researchers in relevant combinations of skills

This section concentrates mainly on elements where integration is the explicit goal. But for completeness, it concludes with a brief review of other elements designed to contribute to integration indirectly, as a by-product of achieving some other, more immediate goal.

Explicitly integrative functions include meetings directed strategically towards the kind of intellectual integration that is our main goal. These are of two types, plenary meetings and workshops. The plenary meetings are designed to reflect the perspectives of researchers from the whole network, whereas the workshops are designed to focus on a particular theme – usually (but not always) tied to one of the thematic areas described in the previous section – with the aim of achieving consensus among those who are most directly concerned with that issue. The other main element whose explicit goal is integration involves visits and exchanges between laboratories (see under section 7, “Competitive calls”).

ACTIVITIES WITH EXPLICIT INTEGRATIVE GOALS

a) Plenary sessions (see objective 3 in section 2)

We have scheduled three plenary meetings, which are as follows.

Prospects for emotion-oriented systems: initial appraisal

Time	month 3	Organiser	DFKI
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This is the ‘kick-off meeting’ for the network. Its main function is to create a foundation of mutual awareness within the network, covering the full range of concerns and perspectives that are represented within it. To achieve that, the meeting will combine a review of current and recent projects with explicit discussion of long-term visions and aspirations. An additional attraction of the second element is that there have been relatively few sustained attempts to define application possibilities. Experience suggests that finding applications that are genuinely within reach is both important for focusing research and more difficult than one might initially assume.

Key tasks for the development of emotion-oriented systems

Time	month 16	Organiser	QUB
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This meeting is designed to achieve closure on the first phase of the network's activity and to establish shared awareness of the tasks identified for the second phase. Representatives of each thematic area will explain to the network as a whole what they have identified as key tasks in their thematic area, and describe the kind of exemplar that they aim to develop in the jointly executed research activity associated with their group.

Prospects for emotion-oriented systems: final appraisal

Time	month 43	Organiser	QUB
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This plenary session is designed to achieve closure on the EU funded phase of the network's activity; to identify what has been learned from that activity by drawing contrasts with the ideas set out in the opening plenary session; and to point forward by articulating the tasks that are now in front of the network members. It will also constitute a voluntary association which will continue the network beyond the period of EC funding.

b) Workshops (see objective 3 in section 2)

For the workshop elements, we are proposing a basic model that is designed specifically to promote interaction across disciplines. It is based on experience with workshops on comparable objectives, such as the ISCA workshop on speech and emotion (held in 2000) in which several network members participated. Workshop proceedings will be published, and will be made publicly available in electronic form via the electronic portal.

Most workshops will be linked to a thematic area, and organised by the steering group member responsible for that area. The organisers will aim to ensure a core of keynote papers which between them cover most or all of the following topics:

- Key aims and conceptual issues
- Key exemplar systems
- Key application / research scenarios
- Key assumptions and dependencies
- Evaluation methods
- Tools required & available
- Critiques of existing systems/approaches
- Proposals for developments

There will also be peer commentary, based on previews of the keynote papers, and published in the proceedings. These core elements will always be present, but they may be supplemented by papers describing relevant research efforts at individual laboratories.

It is at the discretion of the WP leader how this is done. However, we assume that the postdoctoral researcher attached to each designated area will take on a large part of the organisation for the workshop in his/her own area, and will act as a commentator for some of the other workshops.

The workshops are sequenced to begin with material that is fundamental, but (in our experience) can be relatively difficult to assimilate. That maximises the opportunity for these issues to be revisited, and also maintains the promise of material with immediate appeal later in the sequence.

Descriptions of workshop topics are given below. Where they are related to thematic areas, the descriptions refer to the main descriptions of the relevant area rather than duplicating.

Theories of emotion

Time	month 7	Organiser	UNIGE
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Popular wisdom has absorbed a few ideas about emotion from psychology and biology. It is very easy for individuals with a technological background to assume that those ideas represent scientific understanding of the subject. In reality, contemporary treatments of emotion (Scherer & Ekman, 1984; Frijda, 1986, Parkinson 1995; Cornelius, 1996; Scherer, 1999) are both diverse and complex, partly because they draw on a great diversity of empirically established phenomena. The aim of this workshop is to develop connections between that research community and the research community concerned with emotion-oriented systems. Its function is partly didactic, in that researchers with a mainly technological background need to know about the theory and evidence assembled by other disciplines. However, it also aims to establish communication in the other direction. Attempts to simulate biological systems have had profound effects in other areas (e.g. Marr 1982), and questions arising from technological work on emotion have the potential to contribute to the theory of emotion, particularly by showing how abstract ideas translate (or fail to translate) into working systems.

The network includes key figures in the theory of emotion from across Europe, representing different perspectives and disciplines, led by Prof K. Scherer, who may be Europe's most distinguished emotion scientist. One of the functions of the workshop is to set up effective channels of communication between that group and the other teams, so that their input can shape all other aspects of the project.

Signal/sign interfaces

Time	month 10	Organiser	ICCS
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Sign/signal interfaces are a major limiting factor in the development of emotion-oriented systems, whether the modality is visual, auditory, somatic, or other. They affect both reception and synthesis.

There is a pressing need to raise the profile of these issues, for several reasons. In our experience, people who work with relatively intuitive descriptions of emotional effects are often unprepared for the limitations enforced by the difficulty of seemingly simple tasks (such as detecting a pause or the pose of a head). Tasks that are important in the context of emotion may be made difficult because standard tools have been developed for other purposes (eg extracting linguistically significant features from speech or medically significant features from somatic signals). Other tools have become established without close analysis of their effectiveness.

The workshop aims include exploring the prospects for a cohesive response to those issues, and raising awareness of them among members of the wider network.

Data and databases

Time	month 12	Organiser	QUB
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A major obstacle to developing accurate models of human emotion is the absence of rich, realistic databases (Douglas-Cowie et al., 2003b). That leaves researchers dependent on small, ad hoc datasets, or worse still, on their own intuitions. It also has social aspects – most people believe that emotion and emotion-related effects are sensitive to gender (which the call expressly recognises as an issue) and to nationality (we are uneasy about the prospect of Europe depending on technology that tacitly imposes US-American styles of emotional behaviour). These variables cannot be taken into account without databases that give at least some recognition to differences associated with them.

The workshop has a two main functions. On one hand, it aims to inform the wider network about the databases available – not least about the concerns associated with the databases that are currently available. On the other, it aims to prepare for the joint research activity concerned with preparation of a database that can serve as an exemplar (see research activity under 6.2): the activity needs to register the concerns of the potential users as well as the empirical and theoretical perspectives of the teams that will be leading it. An additional function is to inform network members about the ethical and data protection issues surrounding databases.

Signs and emotional content in interactions

Time	month 14	Organiser	Paris8
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This workshop has a pivotal role. Its aim is to consolidate an area of expertise that has been submerged in attempts to handle the whole scope of emotion-related issues in a single step. It may be possible to achieve single-step solutions in radically simplified instances of emotion, but that seems unlikely in even relatively simple instances of interaction between intelligent agents (Pelachaud & Poggi, 2001).

The area of expertise addressed involves two descriptive systems, and the connections between them. These descriptive systems are essentially formalisations of schemes that human beings adopt spontaneously, and that appear to provide highly efficient ways of summarising extremely complex fields of behaviour. They describe signs of emotion on one side, and emotional or emotion-related states on the other. They provide the basis for impressionistic coding of databases, and for coding of commands in synthesis and targets structures in recognition.

The workshop needs to involve researchers from both the areas that are more concerned with physical realisation (see workshop on **Signal/sign interfaces**) and the areas that are more concerned with central processes (see workshops on **Emotion in cognition and action** and **Functions of emotion-related elements**). However, it also has to establish a robust position for an intermediate sub-discipline.

Emotion in cognition and action

Time	month 19	Organiser	UH
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Emotions entail distinctive integrated ways of perceiving and assessing situations, processing information, and modulating and prioritising actions. Elaborating computational models that embed the effects of emotions in cognition and action is a complex, multi-faceted problem that poses multiple integration challenges.

The function of this workshop is to explore the semantics of suitable emotion descriptors for such computational models, taking into account the need for integration at various levels. It is inherent in the semantics of emotion descriptors that they will entail characteristic predictions of dispositions to act, appraisals of the situation, attentional priorities, processing styles, and other attributes. These may be embodied in explicit declarative discrete modules and the control relationships among them, as symbolic ('classical') artificial intelligence assumes, or in quantitative balances, which are more natural models from the perspective of embodied artificial intelligence, neural nets, or artificial life.

The workshop aims include exploring the prospects for coherent and integrated responses to these issues, and raising awareness of them among members of the wider network community.

Usability of emotion-related systems

Time	month 22	Organiser	KTH
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One obvious challenge for affective interfaces and their evaluation is to find ways to verify whether the goal of communicating an intended emotion is achieved - i.e. whether affect expressed by an artefact is understood and perceived in a timely fashion – and whether the system can interpret user emotions correctly – again, both with respect to recognition and utilisation of this information. Even more challenging is whether usage scenarios are overall achieving their purpose in terms of user experience, of being e.g. fun, believable, or creating a relationship with the user, and how much of this is really due to the artefact's emotional capabilities.

This workshop aims to further diffuse and reinforce awareness of the central practical target of affective computing research among its multidisciplinary community, and to improve understanding of the ways individual facets of affective interaction research and engineering are related to this goal.

Functions of emotion-related elements in communication and persuasion

Time	month 24	Organiser	ITC-IRST
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The function of this workshop is to locate emotion-related factors within a wider perspective that considers how human beings are brought to change the way they evaluate and understand things and circumstances.

Issues of that kind arise in many potential applications – teaching, automatic query, artificial companions, and so on. They are linked to forms of communication that involve emotion, but that are not generally understood as purely emotional – such as humour (Stock, 2002), or mood music.

This workshop aims to explore issues surrounding the integration of emotion-oriented systems into larger processes of these kinds. As in other areas, there are several directions of influence to consider. On one hand, the design of systems that are concerned primarily with emotion should reflect awareness of the larger contexts in which they are likely to be used. On the other, information about the kinds of emotion-oriented system that can realistically be envisaged should feed into plans for larger systems. At a different level, both ethical and cultural issues are salient in the context of applications like persuasion.

Cultural and ethical issues

Time	month 31	Organiser	QUB/KCL
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This workshop draws together work from two strands concerned with social acceptability. On the ethical side, emotion-oriented systems raise difficult questions because they potentially touch on intensely sensitive aspects of personal life. There is a real prospect of public outcry at a machine capable of manipulating a person's emotions in ways that might humiliate, or degrade, or manipulate for commercial purposes, without the constraints of conscience and sympathy that a

human would be expected to have. On the cultural side, users might reasonably expect to be assured that they could find systems attuned to the emotional norms of their own gender and culture.

Extensive groundwork is needed in both areas. By month 31, it will have been done through the research projects on databases (for the cultural issues) and on ethics. The workshop aims to ensure that these issues are thoroughly discussed with practitioners.

Recommendations of good practice for emotion-oriented systems

Time	month 35	Organiser	OFAI
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The workshop provides the basis for a subsequent systemic integration of recommendations of good practices. Such recommendations shall facilitate and contribute to not only the rigour of specific activities or the validity of single research outcomes, but shall also reflect a broader view considering relationships and dependencies between different areas of emotion-oriented research. The recommendations will therefore also provide incentives and directions for reaching out across disciplinary boundaries and explain the community value of adhering to certain procedures.

To this purpose, the workshop cuts across all areas of emotion-oriented research and development, including a screening of results obtained in previous workshops. This effort will be facilitated by the fact that the workshop organiser is the steering group member coordinating the handbook activities. These recommendations for good practice and standards for emotion-oriented systems document the added value brought about by the interdisciplinary and integrating characteristics of the Network of Excellence, and ensuring its enduring impact beyond its own lifetime.

c) Visits and exchanges

The network has set aside a sum of money that can be made available to network members so that they can spend time at other laboratories in the network in order to carry out work that is relevant to the objectives of the network. Bids for this kind of funding will be invited, and decisions made by the Steering Group (see section 7 below for details of the steering group and the mechanism for competitive calls).

ACTIVITIES WITH IMPLICIT INTEGRATIVE GOALS

Most elements of the network's activities have at least implicit integrative effects. They are described more fully elsewhere, but we point out key integrative functions here.

d) Electronic portal

The electronic portal (see Objective 5 (a), section 2) will encourage integration by providing both a means of communication among research teams concerned with emotion, and access to a common set of emotion-related resources.

e) Establishing shared resources

Several actions are designed to exert a unifying effect by providing resources that will be shared by all the partners, and (to varying degrees) by research groups outside the network. These resources include databases, descriptive languages, an ethical code, recommendations for good practice, and literature.

f) Jointly executed research activities which are designed to integrate

The program for developing exemplars is designed to ensure that workpackage teams address their different tasks in ways that are complementary, or at least informed by awareness of the issues being addressed by other teams.

6.2 Programme for jointly executed research activities

Having described the overarching themes, the specific activities aimed explicitly and implicitly at integration, we are now ready to consider the core research work of the network.

(a) Data and Databases

The development of emotion-oriented systems is thoroughly dependent on access to data on human emotional behaviour and experience. In some contexts, the need is for live data, for instance in studies of interactions involving humans and a proposed system. A large part of development, though, will depend on pre-recorded databases. This is an area where team members have extensive experience (eg Tolkmitt & Scherer 1986, Amir Ron & Laor 2000, Douglas-Cowie et al. 2003b). The Geneva team is beginning a major project to record actors both simulating emotion and undergoing emotion induction, and we anticipate that the results will be made available to the network.

There are databases that are widely used in emotion research, such as the databases of static faces from Yale (<http://cvc.yale.edu/projects/yalefaces/yalefaces.html>) or of Ekman and Friesen (1975a), and the Berlin database of emotional speech (Kienast & Sendlmeier, 2000). These have played a key role in developments to date. However, they are not designed to support the new generation of work on emotion-oriented systems. There are three fundamental reasons. First, very few of the earlier databases are naturalistic (though there are naturalistic sources for emotion-related states such as stress). They consist of archetypal, isolated examples, often acted. Very little is known about the relationship between these and emotionally coloured features of everyday interaction. However, it is known that systems designed to recognise archetypal instances transfer poorly to real interactions (Batliner et al 2003). Second, very few databases are multimodal, and so it is impossible to work on intrinsically multimodal techniques, or to compare techniques based on different modalities. Third, some modalities are poorly represented, for instance somatic signs of emotion.

Meeting the need for databases raises difficult challenges, notably the following:

1 Access In many respects, the ideal way to obtain raw material for a database is to record people going about their daily business (or at least some business other than generating data). Network members have been in the forefront of obtaining that kind of data (Scherer & Ceschi 2000, Douglas-Cowie et al 2003b), but there are difficult issues associated with it, including rights to privacy, copyright in the case of broadcast material, ratio of useful to redundant material, and quality of recording and of information about participants.

2 Elicitation An important complement to pure naturalistic collection is to develop methods of eliciting behaviour with strong emotional components. These have to strike a difficult balance between tractability and artificiality. Again, team members have been active in this area, and bring considerable expertise in it. Techniques that they have used include computer games designed to induce emotional stress (Scherer, Johnstone & Bänziger 1998) or ego-involvement (Kaiser & Wehrle 1996), simulated conversations designed to induce emotion (Cowie and Douglas-Cowie 2003), vigilance tasks and driving (Cowie et al 2003).

3 Capture Good quality capture is almost always intrusive, even more so when it involves biosignals. Unfortunately, intrusion is likely to inhibit or modify emotional behaviour. Here again, difficult balances have to be struck.

4 Scale and Design Many technical applications need both large quantities of data and balanced sampling of all relevant combinations. Given the variety of forms and shades of emotion and emotional expression that occur in everyday life, and the likelihood that a high proportion of material initially recorded will be of little use, the scale of data collection needed for an ideal database is immense.

5 Basic annotation In a multimodal database, there are many basic types of description that should accompany raw material so that they do not need to be derived separately by every investigator using the data – from speech a verbal transcript, traces of voice pitch and perhaps voices spectrum; from the face bounding contour and positions of key facial points; from bio-signals derived measures such as heart rate, rate of breathing, and perhaps others. With a large database, these are very large undertakings.

6 Encoding of relevant signs The signs that intuitively seem to be indicative of emotionality lie at a level beyond the kind of general annotation that has just been described. Signs that people mention spontaneously might be a choke or a tremor in the voice, a tear or a lowering of the head, ‘racing’ of the heart or breaking out in sweat. A whole range of other indicators that are numerical rather than categorical come to mind naturally from an engineering perspective (Banse and Scherer 1996, Picard and Scheirer 2001, Raouzaïou et al 2002). It is a major undertaking to select from that

potential range a set of descriptors that should be routinely incorporated in a database. The selection itself needs to be empirical, and driven by analysis of databases.

7 Encoding of emotion-related content As with signs, there are many ways of conceptualizing the information about a person's emotional state that should be incorporated into a database. Emotion labels from everyday language are one possibility, but they pose many problems (Cowie & Cornelius 2003). Alternatives include dimensional descriptions (Osgood, Suci & Tannenbaum 1957), and descriptions based on hypothetical elements of emotion-related cognitions (Ortony, Clore & Collins 1988, Greasley et al 1995). Establishing a principled basis for selection is another major task.

Cutting across these challenges is the need to recognise individual differences in emotional expression. Intuitively, two main dimensions of difference seem essential to consider. One is gender: the other is national culture. The relevance of age will also be explored.

The joint research in this area will consist of two phases. The first, during the first eleven months of the project, will aim to achieve a comprehensive review of the various issues that arise in this area, and to arrange access to as many of the key existing databases as possible via the electronic portal. During that phase, we will seek to define the structure and contents of a database or a set of linked databases that would serve as an exemplar for the next generation of research. Proposals will be set out at the workshop, and will be brought to the network as a whole at the 16 month plenary session.

During the second phase, joint work will be carried out to produce an exemplar of the kind of work that we believe is needed. This will involve balanced judgements on the various issues listed above, informed by both theoretical analyses of emotion and its expression and the requirements of potential users in information technology. The database will systematically consider both gender and national culture. Our initial intention is to collect material in at least three countries, one northern, one central, and one Mediterranean.

Interim findings relating to gender and culture will be brought to the workshop at 31 months that examines cultural and ethical issues associated with emotion-oriented systems.

(b) Ethics

HUMAINE cannot avoid ethical issues, because the systems that it is concerned with involve interactions with human beings that may be intensely personal. However, the issues involved have not been explored in great depth, and solutions do not flow easily from existing ethical and legal frameworks (e.g Chadwick 1994, Lloyd 2000). Hence we will include the first in-depth study of them as one of the joint research activities.

To illustrate the complexity of the field, not all emotion-oriented systems raise deep ethical issues, but some do. As an example of applications that are straightforward, there seem to be very few problems, if any, with the idea of enhancing a spreadsheet application with an emotion-oriented interface that allows it to recognize when the user shows signs of frustration, and to offer emotionally toned help and/or reassurance. In contrast, ethical issues do quite clearly arise in examples such as emotion-sensitive interfaces to medical or emergency services, aircraft cabin crew, and so on; emotion-sensitive interfaces in the workplace that have the potential to provide monitoring of employees; and emotion-sensitive interfaces that take on a key role with vulnerable individuals, e.g. children or people with disabilities that make them dependent on communication devices (see, e.g. Iida and Campbell, 2003).

Examining the reasons why emotion-oriented systems have an ethical dimension offers some clarification. One obvious reason is that responding to another person's emotions is ethically sensitive – as witness the fact that in the extreme, inappropriate response to another person's emotions may be classed as mental cruelty. Artificial systems have a disturbing potential to carry through inappropriate responses without the inhibitions that humans usually have. A second reason why emotion-oriented systems have an ethical dimension is less obvious, but raises deeper issues. They may be involved in forming, storing, and possibly transmitting potentially sensitive judgments about people. In the extreme, they could in effect be treated as experts free of human fallibility and allowed to make pronouncements with far reaching consequences – in the tradition of the polygraph. It is also worth noting a third issue, memorably expressed by President Nixon in one of the infamous White House tapes:

“I don’t know anything about polygraphs and I don’t know how accurate they are but I know they’ll scare the hell out of people”

It is clearly true that machines with poorly understood abilities to probe inner states are frightening, and using them to create fear is an ethical issue.

The most reasonable response to these issues is probably to seek to reflect the multiple perspectives that may become significant rather than attempting to achieve a single, compact formulation, which could too easily be overtaken by unpredictable shifts in public perception of the issues. HUMAINE aims to carry out research in that spirit, which identifies the main problem areas that need to be considered, reviews the ethical principles that might guide responses to those problems, and outlines prescriptions for addressing the problems that appear to be defensible.

The network is well placed to address these issues. It includes individuals who have addressed related issues in other projects (Taylor, 2001), and one of the few philosophers who is a recognized expert in both emotion and ethics (Goldie 2000, 2003). The research will be under Dr Goldie’s auspices, but it will have the rare advantage of being able to access leading experts in the relevant fields of psychology and technology as well.

(c) Theory

There is now an increasingly cohesive field of Affective Science, as reflected in the recent Oxford Handbook of Affective Sciences (Davidson, Scherer, & Goldsmith 2003). A large part of the task in this thematic area is to make the conceptual and theoretical foundations of affective science, as well as the most recent research evidence available to the members of the network.

That is not a simple dissemination activity. It requires a positive research effort to conceptualise work in affective science in a way that relates to the needs and capacities of technology. We identify four specific areas where new work is needed.

- i. Operational definitions need to be developed for the various emotion-related categories – affect, emotion, attitudes, moods, affective personality, and affective stances. They will provide the basis for recommendations as to the specific attention to be given to each class within the network and the most appropriate contexts to study the forms of affective phenomena that are most relevant to HUMAINE’s concerns.
- ii. A working model that is suited to the development aims of the network needs to be elaborated and operationalised with respect to basic assumptions about different types of affective state, their induction conditions, and the processing required for differential response patterning. A major aim is the specification of response profiles in different modalities as well as their synchronization for both measurement and animation purposes.
- iii. Implementation proposals will be developed involving one or several exemplars. Specifically, it will be necessary to integrate fundamental knowledge about emotion processes into a communicative context by modelling production and perception/inference of emotional messages in a coherent interface. A central feature of this activity will be the modelling of the dynamic process of recursive production-perception loops in humans and automata.
- iv. A toolbox of measurement instruments needs to be developed based on the fundamental working models that are specifically adapted to the aims of the network.

The theoretical group will pursue these objectives throughout the project, reporting progress at the plenary sessions.

(d) Signal/sign interfaces

Information about people’s emotions is ultimately transmitted by physical signals – optical, acoustic, and in some circumstances bio-signals. These signals encode the signs by which people express their emotions in modalities such as speech, facial and bodily gestures, and somatic responses such as sweating or blushing. A system that attempts to interact with humans, taking into account their emotional state or attitude, needs the ability to extract these emotionally significant signs from the physical signals that carry them. Conversely, to convey emotional messages to a user, it needs the ability to generate appropriate physical signals.

The expected focus of the research activity is achieving coherent treatment of these issues. While a lot of effort has been invested in examining individually these aspects of human expression, recent results make a strong case for a multimodal approach to the recovery of emotion-related signs,

and ultimately, of the user's emotions. That involves addressing a range of problems that have traditionally been handled by separate disciplines.

At least two types of analysis have been involved in the processing of information about emotion from speech. The first consists of linguistic analysis, which derives information from a word string, extracted as text from the signal. A postprocessor stage then provides an interpretation of the emotion associated with the speaker. This procedure can be viewed to include speech to text. In emotional speech this task presents particular problems, because it is in the nature of emotion that speech tends to be difficult to process in various ways – rapid, imperfectly articulated, and tending to violate turn-taking norms. Very little is known about the next logical step, from text to emotion, though work is under way on techniques that use emotional lexicons. The other component is paralinguistic. It uses different components of the raw acoustic signal to infer underlying emotion states of the speaker. It needs first to carry out basic signal processing operations, next to use its output to describe the main prosodic structures present in a general way, and then to use those descriptions to recover parameters that may be relevant to emotion. Synchronising and combining the two streams of data and cues is a difficult and necessary research task.

It might be expected that the tasks of detecting and synthesizing emotional speech would use the same conceptual framework but operate in different directions. There have been some attempts to harmonise the two directions, but rather disparate solutions have tended to predominate in the two areas. It is not clear whether the separation is well founded.

Similarly, analysis of the emotional expression of a human face requires a number of pre-processing steps which attempt to detect or track the face, to locate characteristic facial regions such as eyes, mouth and nose on it, to extract and follow the movement of facial features, such as characteristic points in these regions, or model facial gestures using anatomic information about the face. Hand gestures and body posture provide another emotionally rich input source. A research goal, therefore, is to treat gestural interaction as a higher-level feature, complementing speech and facial analysis. Among the important problems involved in the analysis are those of hand localization, hand tracking, and selection of suitable image features. Highly articulate human hand motion consists of the global hand motion and local finger motion. Hand motion capturing is finding the global and local motion of hand movements. Two types of cues are often used in the localization process: colour cues, and motion cues. The computation of model parameters can then be followed by gesture recognition. Meaningful gestures could be represented by both temporal hand movements and static hand postures. Hand postures express certain concepts through hand configurations, while temporal hand gestures represent certain actions by hand movements. In general, one can classify hand movements with respect to their function as semiotic, i.e., gestures that are used to communicate meaningful information or indications, ergotic, i.e.: manipulative gestures that are usually associated with a particular instrument or job and epistemic, again related to specific objects, but also to the reception of tactile feedback.

Recent results, especially related to the ISO MPEG-4 synthetic natural hybrid coding model, provide a promising framework for extracting emotion information-carrying signs of various kinds from the visual signal. In particular, MPEG-4 specified parameters for Face (FAP) and Body (BAP) Animation (FBA). The FAP parameter set contains two high-level parameters, visemes and expressions. Most of the techniques are based on a well-known anatomically oriented system for describing “all visually distinguishable facial movements” called the Facial Action Coding System (FACS). The Facial Definition Parameter (FDP) and the FAP sets in FBA allow the definition of a facial shape and texture, eliminating the need for specifying the topology of the underlying geometry, through FDPs, and the animation of faces reproducing expressions, emotions and speech pronunciation, through FAPs. Viseme definition has been included in the standard for synchronizing movements of the mouth related to phonemes with facial animation. Research on monitoring facial gestures corresponding to FDP and/or FAP movements over time is needed to examine derivation of cues about user's emotional state. An MPEG body is a collection of nodes. The Body Definition Parameter (BDP) set provides information about body surface, body dimensions and texture, while Body Animation Parameters (BAPs) transform the posture of the body. BAPs describe the topology of the human skeleton, taking into consideration joints limitations and independent degrees of freedom in the skeleton model of the different body parts. BDPs and BAPs can be used to model gestures, considered to consist of specific hand-shapes and motions. MPEG-4 adopted in its latest

amendment a generic deformation model, which is called BBA (Bone-based Animation). As specified in the Part 16 of the MPEG-4 standard this generic model is implemented through bones and muscles and this concept has as result the Skeleton, Muscle and Skin (SMS) framework.

Individual tools within this range still need to be examined with emphasis on automatic extraction and synthesis of emotionally expressive cues. Potential approaches to combining them then need to be explored. It is not clear as yet whether separation between streams is an efficient strategy, because emotionally significant events are often multimodal (e.g., sudden sound accompanied by raised eyebrows and abrupt movement of the whole body). Techniques may well be required for efficient synchronized analysis of all different types of multimodal inputs, including physiological signals, obtained from the user and providing other possible emotional signs.

The joint research in this area will consist of two phases. The first will achieve a comprehensive review of the various techniques that are available in this area, with particular emphasis on the processing issues that they raise and interdependences among them. During that phase, the sign-signal interface team will seek to identify tasks that embody key steps towards a coherent treatment of low-level issues. Proposed tasks will be brought to the network as a whole.

During the second phase, joint work will be carried out to produce an exemplar of the kind of system that needs to be developed. It would be premature to specify what we will conclude is the best focus of effort, but the following are illustrative possibilities:

- (a) specifying systems for detecting and synthesising multimodal events that are emotionally significant (eg non-speech sounds intruding into a speech stream, with accompanying facial and body movements);
- (b) developing attentional mechanisms which use evidence of emotionality in one modality (which might, eg, be a physiological signal such as GSR) to allocate the resources needed for close analysis of signals in other modalities.

(e) Signs and emotional content in interactions

People convey their thoughts not only through the propositional content of their speech, but also through their (conscious or unconscious) choice of words, the way they speak them, their facial expressions, their gaze, their body postures and body movements, their hand gestures, and their actions. It may be possible to ignore the non-propositional elements when the only goal is to exchange factual information, but they become critical when emotion is involved. The focus of this thematic area is to understand how signs of these various kinds jointly convey emotion-related content in the context of interactions. We do not attempt to go beyond simple, one-on-one interactions: they are complex enough (de Rosis, De Carolis, Carofiglio, Pelachaud, & Poggi, 2002).

The case of facial expression provides a good illustration of the need to consider signs in context. Facial expressions do not occur randomly, but rather are synchronized to one's own speech, or to the speech of others. They are used to control the flow of conversation; that is they help in regulating the exchange of speaking turns, keeping the floor or asking for it. Actions such as smiling, raising the eyebrows, and wrinkling the nose often co-occur with a verbal message. Some facial expressions accompany the flow of speech and are synchronized at the verbal level, punctuating accented phonemic segments and pauses. Other facial expressions may substitute for a word or string of words, or emphasize what is being said. They can also express attitude toward one own speech (such as irony) or toward the interlocutor (like showing submission). These attitudinal functions shade into the expression of emotion-related states: it is not clear whether a useful line can be drawn between them (Cowie & Cornelius 2003).

The fact that multiple channels are active can give rise to redundancy, which can be exploited. For example, a question can be marked by any one of the following signals: the voice pitch, a raised eyebrow or a head direction, or by a combination of these signals. But also, the interpretation of a signal from one modality can be modulated by other co-occurring signals. A raised eyebrow coinciding with a high end of tone is interpreted as a question mark signal rather than as the emotional signal of surprise in American-English (Ekman, 1979).

The core challenge in this thematic area is that our understanding of emotional signs needs to be integrated into that kind of context. In concrete terms, if an agent is to be credible, it will not do to superimpose emotion-related signs in arbitrary channels on its behaviour whenever its emotional state shifts.

Synthesis has a strong attraction as a medium for research in the area (Cappella & Pelachaud, 2001). Practically, it is directly linked to one of the main application tasks, which is to construct embodied conversational agents (ECAs). Formally, focusing on synthesis allows ideas to be cast in a form that is reminiscent of a generative grammar, proceeding from abstract specifications of what is to be conveyed to explicit, appropriately ordered lists of the signs needed to convey it.

Various languages of representation have been developed to drive and control the animation of ECAs (RRL, MURML, VHML, APML, CML, AML, HumanML, etc). These languages encode information on the communicative functions an ECA should convey (performative, emotion), on the signs to display (a smile, a head nod), on the semantic relation between items (rhyme / theme), etc.. In general, they serve as interface between the different modules of the architecture of an agent system. Specifically, languages used both as a synchronization scheme between modalities, and to ensure that information at a lower level (e.g. sign level such as a gesture or a particular speech pattern) is linked to higher level information – e.g. with a given linguistic constituent (for example, questions, statement), or with a given emotion.

This approach is most highly developed in the context of reproducing affective and conversational facial expressions on synthetic faces (Ball & Breese 2000, Bates 1994, Cassell et al. 1999, Poggi & Pelachaud 2000). There is well-known work on the way human emotions like fear, anger, happiness, sadness, surprise are expressed through specific facial muscular actions (Ekman & Friesen 1975b) and these expressions can be simulated in synthetic animated faces (Pandzic & Forchheimer 2002). These are significant achievements, because facial expression is undoubtedly an important part of emotion-related communication. However, there are many other pressing issues.

There are many channels for emotional expression other than the face. Some involve language itself – pausing, obeying or violating turn-taking rules, repetition and emphasis, choice of sentence structure and vocabulary, use of direct and indirect speech acts, etc. Key non-verbal signs include gaze, posture and gross movement, gesture, and expressive actions (walking away, dancing, or throwing a teacup at the wall). Emotional impact appears to depend on the way these are coordinated and develop over time. An interesting perspective on these channels is that they must be responsible for communicating emotional states in animals, which a strong research tradition has insisted are continuous with human emotions.

The signs corresponding to an emotion need to be defined beyond the level of gross categories to address the characteristic expression of the signal (manner of a gesture defined by amplitude and speed of movement, movement quality, etc.). Temporal issues are crucial, as well, to the simulation and rendering of affective behavior. Often ECAs systems compute the signals to display but without any information on how it should be conveyed. Emote is one of the first attempt to simulate the expressiveness of gesture (Chi et al 2000). It is based on the domain of movement observation science, specifically Laban Movement Analysis (LMA) and its Effort and Shape components.

It is not only at the level of signs that descriptions need to be refined. The emotional states that occur in natural interaction tend to be graded and complex, and follow their own trajectories in time (Cowie and Cornelius, 2003). Languages that deal satisfactorily with interaction need the ability to capture that kind of emotional subtlety. There also needs to be a satisfying interface with issues of the kind considered in the communication and persuasion thematic area. For instance, the emotion representations should allow suitable activation to follow when an agent engaged in persuasion sets out to signal friendliness.

Although synthesis provides a particularly attractive context, there are two inverse problems that cannot be ignored. One is understanding the effects that synthesized displays have on users. That should go beyond checking whether users assign synthetic displays to the intended emotion category (eg ‘friendly’), and consider whether the syntheses are perceived as convincing or flawed in ways that induce adverse or unintended reactions (eg ‘insincere’). The other inverse problem is automatic recognition of emotional displays produced by humans. Ideally, the structures that govern synthesis should also support parsing once low-level processes (considered in WP 4) have recovered evidence of relevant signs from the signal stream – and very probably they should also be capable of contributing to top-down control of the low-level processes. Evaluation of a system needs to include assessment of its potential for use in recognition as well as synthesis.

The research will examine key exemplar systems in each domain looking at what they aim to do and how they achieve it, and also at their limitations and drawbacks. This will be done in the light of

information arising from the other workpackages, particularly information about sign-signal interfaces and about the functions of emotion-related elements in an interaction (for instance, to engage the users more; to enhance their capacity to learn; to achieve persuasion; etc).

Again, the first phase of the research will provide a review of existing material. The reviews will encompass a large field of research. ECAs system will receive a particular attention. Concepts and tasks will be identified.

During the second phase, we aim at

- specifying a representation of emotionally significant signs (facial expression, gesture) and qualitative characteristics (gesture manner, intensity).
- developing a representation language that embeds characteristics of emotion at different levels.

(f) Emotion in Cognition and Action

Recent research in psychology and neuroscience has provided evidence that emotions pervade human intelligence at many levels (see e.g. Damásio 1994 & 1999, Frijda 1986, LeDoux 1996, Panksepp 1998, Rolls 1999, Scherer *et al.* 2001), being inseparable from cognition and action. Such findings have led to a paradigm shift, departing from the rationalistic tradition that equated intelligence with pure reasoning, and that considered emotions as undesirable consequences of our embodiment that hampered reasoning. On the contrary, emotions are nowadays regarded as a necessary component of cognition and intelligent behaviour, and therefore they offer a rich potential for the design of artificial intelligent and interactive systems (Picard 1997, Cañamero 2001a&c, Cañamero 2003), and for enhancing our interactions with them (Paiva 2000, Dautenhahn *et al.* 2002).

Research on interfaces cannot dismiss interactions between emotion, cognition and action as a subject for disciplines concerned with higher level functions, because convincing emotional interaction cannot be achieved by modelling (and responding to) only the externally observable features of emotional expression and behaviour. On the contrary, it requires grounding these externally observable features in models of the (internal) mechanisms that govern observable emotional manifestations. This task presents considerable integration challenges at various levels. Theories and models of human emotions are diverse and often address only subsets of the relevant issues. Similarly, there are diverse approaches to computational emotion modelling, such as symbolic artificial intelligence, embodied artificial intelligence and robotics, artificial life, neural networks, and machine learning: these suggest different conceptual frameworks, representations and techniques (for representative papers from the main traditions see Cañamero 1998 & 2001b, Cañamero and Petta 2001, Trapp *et al.* 2003).

The strategy of this package is to explore how our developing understanding of emotional cognition illuminates the design of artificial emotional systems for artefacts that must interact with humans. Such a strategy should have a dual benefit, both (a) enhancing the behaviour of emotion-oriented systems and our interactions with them, and (b) providing feedback to emotion theorists to gain further insight in their understanding of human emotions. Implementing it necessitates an integrated effort spanning different disciplines, rather than the development of isolated engineering projects, and critical reflection on problems at many levels.

Joint research in this area will involve two main phases:

The first phase will consist of a cross-disciplinary review and critical analysis of existing computational models, systems and techniques, and their theoretical underpinnings, with a view to identifying needs and directions for sound future research. This analysis will be performed along several cross-thematic threads, and integration of results will be assured by (a) a workshop in month 19 and (b) proposals for exemplars that will be developed during the second phase of the project.

Phase two will span the rest of the project. During this phase, joint work will be carried out to develop exemplars of the kinds of systems that would need to be developed to achieve sound progress in this area, as identified in the critical analysis of needs and future directions carried in the previous phase. The particular exemplars to be developed cannot be decided at this stage, as they will be the result of the shared critical analysis performed during phase 1, but tentative illustrations could be:

- a) specifying (computational) mechanisms for modelling the role that emotions play in integrating other bodily, (lower- and higher-level) cognitive and behavioural subsystems in a particular type of activity such as decision making.

- b) developing an autonomous artefact capable of learning the emotional significance of events based on its interactions with humans (and /or possibly other artefacts) and of developing appropriate (adapted) responses to them.

(g) Functions of emotion-related elements in communication and persuasion

The thematic area is related to a tradition of literature on 'social influence', which looks (among other things) at ways of using or adapting to emotion. That kind of issue underlies many of the obvious applications – teaching, informing, selling, supporting, entertaining, pre-empting problems. Systems in these areas need to know not only how to express and recognise various emotions and emotion-related states (such as boredom or irritation or humour), but also how to use them or avoid them so that desired goals can be achieved (Pelachaud, Carofiglio, De Carolis, & de Rosis, 2002). From an applied point of view we can say that future intelligent interfaces will have contextual goals to pursue. They may aim at inducing the user – or in general the audience – to have some beliefs and perform some actions in the real world. They will have to take into account the “social environment”, exploit the situational context, and give due weight to emotional aspects in communication.

Some foreseeable scenarios of this kind are: dynamic advertisement, preventive health care, social action, and edutainment. In all these scenarios rational exchange of information is not enough. For people to adopt the desired stance, often what really matters is not only the content but also the overall impact of the communication. Hence there is a strong motivation to provide interfaces with the capability of reasoning on the effectiveness of the message, and not only on the high-level goals and content.

Persuasion is a computationally interesting example. It is clearly concerned with elements that transcend argumentation. Inducing emotions is a means for obtaining a given result, either directly or indirectly by devices like the use of specific languages, such threatening or promising, which have emotional overtones. They all can be regarded as resources for inducing the receiver to act in a desired way. Elements that are relevant in the computational study are:

- The cognitive state of the participants (beliefs and goals of both the user and the interface)
- Their social relations (social power, shared goals etc.)
- Their emotional state (both the emotional state of the user and the one expressed by the system)
- The context in which the interaction takes place.

Persuasive technology is a theme becoming very popular in the Computer Human Interaction milieu.

Another theme is the general attitude of the participants to communication and specifically with aspects of pleasurable communication. Relevant studies include, among others, the case of humour. Specific workshops concerned with Computational Humour have taken place in recent years; the latest one at the big CHI convention in 2003.

Recently, there has been growing acceptance that humour is inseparable from an emotional element (e.g., Ekman 1999). Ruch (1997) postulates a specific emotion underlying humour called exhilaration. Humour also has the typical emotional effect of facilitating change in a person's global appraisal of the priorities in a situation (Oatley 1992).

The joint research in this area will consist of two phases. The first will aim to achieve as broad as possible an overview of the various issues that arise in this area. It will result in recommendations to the plenary meeting after 16 months, and will underpin the workshop at month 24. The second phase will consist of joint work towards specifying a system or systems that would constitute an exemplar for the area, showing how these issues can be addressed in a principled way that links to principled treatments of emotion per se. As suggested above, areas under consideration include persuasion and humour.

(h) Usability of emotion-related systems

Affective interfaces include those that express emotions, those that attempt to understand user emotions, and those that use affect as part of the system's “mind”. User evaluations in this new field are still infrequent, and lacking an established theory providing similarly well defined targets to assess as in traditional human computer interaction. At the same time, most researchers have

been focussing on the natural phenomenon of affect and its expression, communication, perception, and hypothesised processing, without being overly concerned with whether qualities such as believability or naturalness of synthetic characters do in fact contribute to the overall success of a system. Neglecting the relationship between natural source of inspiration and actual engineered systems, designers and researchers are all too easily misled into not questioning whether inter-human communication really forms the best model for interaction between human and machine. Results from natural language interfaces, adaptive interfaces, or intelligent user interfaces indicate that there exist principles and idiosyncrasies that are specific to the design of human machine interaction (Dahlbäck et al., 1993, Höök, 2000). Among what little results exist today, there already are a number of findings underlining the importance of empirical verification and questioning of intuitions and working hypotheses of the appropriateness of the deployment of affective functionalities for specific purposes, e.g. (Issroff and del Soldato, 1996).

On the other hand, the well-established goals of usability research, including effectiveness, efficiency, or safety either are probably not adequate for scenarios centred on subjective user experiences of being satisfied, rewarded, pleased or motivated; at least there is no clear understanding of what should be measured in which way so as to assess the standard usability qualities with respect to these new targets. Many other difficulties ensue from the social and biological grounding of the phenomenon to be investigated. Affective interfaces address directly inherently adaptive faculties of humans; the methods for user studies therefore have to take into account that not only test users, but also “emotionally enabled” artefacts will alter their behaviour within and across evaluation runs. As also mentioned in many other parts of this document, in different contexts, the manifestations of greater or actual interest are not those of extreme states, but rather the subtle emotions; the challenges posed by these difficult to detect and highly susceptible targets are complemented by those of rarely occurring emotional states and of those that take significant time to develop. The latter are only two examples making it rather evident that usability assessments concerning affective interfaces hardly can be sped up at will or carried out in a conclusive fashion within a limited timeframe using standard approaches. To mention just one last example, the simple circumstance that users are *always* emotional immediately points to the difficulties in clearly identifying affect that is due to and related to the application at hand, excluding reliably exogenous causes; conversely, the scope of usability assessments is difficult to contain when consequences outside the intended reach of the application are hard to rule out or prevent.

The situation is further complicated by the fact that studies of affective interfaces are being carried out against a background of theory and technology that is still embryonic. Appropriate utilisation of reported usability results therefore needs to be carefully considered among the alternatives of performing tuning or adaptation of the currently employed system components, altering the architectural design introducing different components that replace or complement the current ones, or initiating a new research thread defined by the intersection of open issues and indications from the usability study.

Taken jointly, these three views on usability of emotion-related systems document vividly how usability research forms a particularly well suited hub that not only invites but downrightly requires collaboration and exchange of information across all of the multifarious research community. The circumstance that every discipline can both contribute as well as gain from the interactions is an important facilitating aspect.

The joint research in this area will consist of three phases. The first will aim to elaborate the mutual contributions of usability assessment and the individual areas of research in affective interfaces. The results are to be consolidated in a green paper document - covering methods to analyse scenarios, usability assessment techniques, and strategies for exploitation of usability results - to be presented at the plenary meeting after 16 months. The second phase tentatively covers the time span up to the topical workshop to take place 6 months later and is aimed at putting the content of the green paper into practice in a number of small project activities. The workshop at month 22 will mark the release of a first working draft of a paper documenting standardised and/or exemplary methods, that is then to be revised over the remaining lifetime of the network according to further empirical results and finally included in the project handbook.

This conception lends itself to two types of division of labour;

- *Parallel*: different teams work on complementary scenarios specifications and related evaluation techniques;
- *Serial*: some associated teams develop systems that invite evaluation, others develop and execute evaluations.

6.3 Spreading of excellence activities

A number of activities will ensure that the know-how built up by the network will become available to the wider research and development community in Europe and beyond, thus strengthening the reputation of Europe as a place where excellent research is conducted.

The activities start early by creating an intellectually compelling, high-profile portal website, which should attract and keep the attention of the interested research community. The authority of the network as a key player will be built up through workshops in all thematic domains. Each workshop represents a first culmination point of the integration activities in a thematic domain, and will produce condensed results in the form of workshop proceedings, which will be made widely available. The network's reputation as a source of excellent training will be built up through the organisation of yearly summer schools, which, in the second half of the network, will include tutorials on the creation of emotion-oriented systems, targeted towards industry. Finally, the converging "big picture" on emotion research for HCI will be laid down in an ambitious handbook, and will prompt the formulation of "recommendations of good practice" as the starting point for future standards.

In the following, these activities will be described in more detail.

Electronic portal

In the past, websites representing European projects were minimalist and low-profile. Often they were not held up-to-date after their initial setup, and presented only partial information about the state and results of the project. In most cases, their scope did not reach beyond the project that launched them, so that they attracted only a small audience.

The electronic portal to be produced by HUMAINE is of a totally different kind. It is meant to become *the* source of information for interested researchers in emotions and human-machine interaction research worldwide.

The principle underlying the portal will be maximum access. Some areas must necessarily be restricted (because of issues involving privacy or IPR). However, restriction will systematically be minimised, and the area open to the general public maximised.

From an early stage, it will present the current state of the art in the various thematic domains, thus providing a centralised source of information even before the integration activities of the network will have produced any results by themselves. It will be properly advertised on the numerous communication channels to which the partners have access. By providing this information service, the portal will attract a relevant audience, and will thus be well placed for spreading the know-how developed through the integration and research activities of the network.

DFKI will be in charge of setting up the electronic portal. Its ability to do so is illustrated by the high-profile language technology portal LT-World (www.lt-world.org).

The portal will consist of sections addressing different information needs. It will

- inform about current events and relevant news;
- list existing teams and players in the field, link to their website, and optionally present a short profile;
- collect existing and newly created resources and tools;
- advertise the activities of the network;
- encourage readers to take an active role in the creation of certain parts of the website.

This last point will draw in a qualified way on the so-called "wiki" principle. It allows visitors to edit specific web pages and thus contribute their know-how. Content produced in the "wiki" area of the web page would be selected before insertion into the "reviewed" area of the portal. That allows it to contribute to the richness in content. Additionally, though, the method appears to be extremely powerful in building a virtual community, as it gives visitors the feeling that this is "their" web page rather than a one-way information channel.

Summer Schools

The network will organise a summer school on emotions in human-machine interaction every year. This will provide both network participants and interested individuals outside the network with the possibility to obtain hands-on experience in the various thematic domains of the research area. It is intended that the summer schools organised during the funding period of the network will lay down the basis of a new tradition, which participants will want to continue beyond the end of the HUMAINE network.

The summer schools envisaged are inter-disciplinary by nature and will offer courses in a number of thematic domains every year, with the core focus shifting from one year to another. Overall organisation of summer schools will be done by DFKI. The current planning predicts the following core themes and local organisers.

In addition to the courses, practical tutorials will be gradually added to the summer schools as resources, kernel tools and exemplars take shape. These practical aspects will make the summer schools increasingly attractive also for industrial participants. Course material will also be made available via the web.

Year	Core theme	Local organiser
1	Inducing and describing emotion	QUB
2	Expressed emotion in virtual reality and autonomous agents	UNIGE
3	Physiological measurement of emotion	To be decided
4	Automatic detection of emotion	ICCS

Workshop proceedings

At the core of the network's integration activities are the workshops held in each of the thematic domains. Each of these workshops will produce proceedings, including on the one hand the contributions of experts in the field, and on the other hand peer comments furthering the dialogue and integration of different domains.

These proceedings will be made widely available, and will thus form a growing knowledge pool of an interdisciplinary view on emotion research for HMI.

Recommendations of good practice

In addition to the scientific and practical results described above, the network will also use its authority to formulate recommendations of good practice in the design and use of emotion-oriented systems. These will include descriptions of emotions, of emotion-relevant signals, and of emotion-related cognitive structures, thus enabling both researchers and system developers to draw upon the collective experience of the HUMAINE network when making their design choices.

As any system influencing user emotions potentially bears the risk of abuse, it will also be necessary to debate and draft recommendations of good practice in the field of ethical issues in emotion-oriented systems.

It is hoped that as convergence between research strands increases, the HUMAINE recommendations will form the basis of future standards.

Handbook

Selected material from the workshops will be developed and consolidated into a handbook that will provide a foundation for people aiming to develop emotion-oriented systems. The handbook is to present the distilled results of the integration and joint research work. Work on the handbook will therefore be carried out in close collaboration with the workshop organisers. All partners will participate in the creation of the handbook.

Partners in the consortium have contacts and practical experiences with major publishers, ensuring an adequate placement.

Resources, tools, and exemplars

The joint research in the network will develop resources, kernel tools and exemplars for emotion-oriented systems. As they will be complemented by scientific foundations laid down in the workshop proceedings and the handbook, by practical documentation accompanying the packages, and by tutorials held at summer schools, these resources will be extremely valuable starting points for researchers and system developers. All of this material will be made publicly available via the network's electronic portal website unless there is a compelling reason not to (mainly involving privacy or contractual IPR issues).

6.4 Management activities

Section 8 describes the management structure of the project, but it is summarised here for convenience. HUMAINE has two management bodies plus a supporting coordination unit:

- the project Board of Management, representative of all project partners, is responsible for overall strategy and ratifying, as appropriate, decisions of the Project Steering Board. It also is the last resort in resolution of conflicts.
- the Project Steering Board (PSB), is representative but does not involve all of the partners. It is responsible for shaping the direction for the network activities, for reporting and dealing with most issues between partners (scheduling, payments, reporting, etc.)
- the Project Coordination Board (PCB) includes a subset of the PSB membership plus a full time administrator and provides executive management in support of the PSB, in particular carrying out day-to-day monitoring of the network.

We divide the management activities undertaken by these bodies into

Operational project management issues: these include preparing and distributing reports (Management Reports, Progress Reports), maintaining accurate consolidated records of costs, resources, and time-scales, preparing and submitting to the Commission the cost statements of all participants, communicating with other projects, and co-ordinating presentations.

Scientific, communication and strategic management issues: These include reviewing project progress, ensuring that the project maintains its objectives and relevance within IST programme, remaining in close contact with the Commission and the Project Officer, and resolving any technical, administrative or contractual issues.

6.4.1 Operational Management

The role of operational management is to oversee the whole network at a practical level so that activities are seamlessly integrated. Its tasks are as follows.

Task 1: Communication with the EC and co-ordination of reporting.

This task is the responsibility of the co-ordinator. It will consist of:

- reporting to the European Commission services and contacting them for administrative purposes
- coordinating the yearly activity report which will contain:
 - activity report and advancement;
 - identification of problems encountered and the corrective action taken by the PSB;
 - update of the Joint Programme of Activities for the next 18 months based on the decisions of the PSB;
 - report on the social issues related to Humaine activities;
 - certified statement of the costs incurred by the participants in implementing the JPA during the period;
- coordinating the final report which will contain:

- analysis of the extent, depth and potential durability of the integration realised;
- assessment by the consortium of the impact of the network on strengthening and spreading excellence on the topic in Europe;
- analysis of the impact of the network on the way that research is carried out in Europe on the topic considered, compared to the situation described at the time of the submission of the proposal;
- description of the network's activities relating to dissemination, transfer and exploitation of knowledge and of their potential impact;
- assessment of the technological impact of the activities of the network;
- assessment of the network's actions to promote gender equality;
- plan for sustainable actions after the end of the network;
- recommendation of further action by the European Commission.

These reports will be made public on the Humaine portal.

Task 2: Auditing

The Coordinator will be responsible for organizing, commissioning and monitoring the audit regime, following the decisions of the PSB . This concerns technical audits (including annual reviews): financial audits are organized, commissioned and monitored by the EC.

Timeline

After 12 months	<ul style="list-style-type: none"> • First annual report • Update of JPA • Report on audit regime • Ethical audit • Financial and accounting reporting • Report on Gender issues
After 24 months	<ul style="list-style-type: none"> • Second annual report • Update of JPA • Technical audits
After 36 months	<ul style="list-style-type: none"> • Third annual report • Update of JPA • Technical audits
After 48 months	<ul style="list-style-type: none"> • Final Reporting • Technical audits

Task 3: Resolution of Conflicts

The Consortium will follow a “collaborative” approach for avoiding conflicts. In the unlikely case there would be a conflict it will be addressed by the Project Steering Board (PSB). If necessary, input from the EC Project Officer will be sought. As a last resort, if conflict cannot be resolved by these means, it will be brought to the Board of Management.

6.4.2 Financial Management

The coordinator will be in charge of implementing the PSB decision in terms of project financial management, and will use a well identified account receive and transfer all payments by the European Commission to the parties .

Task 1: Accounting (consolidation and getting certificates from contractors)

The financial accounting of the network includes:

- Preparation of the provisional budget (according to the Joint Programme of Activities update): estimate of the costs to be incurred by each participant during the period, broken down by type of activity;
- Reporting costs to the European Commission in due time (consolidating cost reports from participants): summary of cost statement, cost certificate, mm-level justification, summary financial report by the co-ordinator;
- Reporting to the Project Steering Group.

It is the responsibility of each contractor to submit their audit certificates on time.

Task 2: Monitoring income and expense plan execution

- Following the execution of provisional budget and obtaining the relevant deliverables in the Joint Programme of Activities;
- Recovery of due sums and reports.

Timeline

After 12 months	<ul style="list-style-type: none"> • First annual cost statement • First budget revision
After 24 months	<ul style="list-style-type: none"> • Second annual cost statement • Second budget revision
After 36 months	<ul style="list-style-type: none"> • Third annual cost statement • Third budget revision
After 48 months	<ul style="list-style-type: none"> • Financial and accounting reporting

6.4.3 Technical Management

The function of technical management will be to monitor the Joint Programme of Activities in all the areas of the network. Monitoring and controlling the technical and scientific progress of the project will be achieved by means of biannual meetings, and intermediate teleconferences. All web-related activities will be coordinated and implemented in a professional manner by a web office, in charge of an external portal (ensuring input-outputs with the external world), an internal portal for communication and knowledge exchange between partners, and an administrative portal aimed to help the administrative management of the network (forms, reports, etc.).

Task 1: Activity report

Technical management will produce the yearly technical report of the network. This will be consolidated from the activity contributions. This activity report will be matched against the Joint Programme of Activities and will help measure the advancement of the Joint Programme of Activity. Proposals will be made by the PSB about shortening, or expanding tasks, allocating resources or changing partnership.

Task 2: Joint programme of activity revision and expansion

WP leaders will be responsible for suggesting changes in the Joint Programme of Activities and identifying members who will carry out the planned changes. This may include proposing candidates outside the network to join the network membership.

Timeline

After 12 months	<ul style="list-style-type: none"> • First Joint Programme of Activities revision
After 24 months	<ul style="list-style-type: none"> • Second Joint Programme of Activities revision
After 36 months	<ul style="list-style-type: none"> • Third Joint Programme of Activities revision

6.4.4 Legal and Knowledge Management

This activity concerns the legal aspects of the network activities. By stating clearly the legal principles governing Humaine, the network aims at avoiding any trouble in the course of its span. It also prepares a smooth transition for the instruments that must implement its sustainability after the term of the network.

Task 1: Monitoring of Consortium Agreement

All new members of Humaine will be required to sign the Consortium Agreement. The Project Steering Board will monitor the process.

Task 2: Intellectual property management

The PSB will, with the co-operation of the project partners, take appropriate action for protecting, sharing and developing patents, know how, and other intellectual property rights of the project. Plans for that activity are in section 6.5 below.

Task 3: Monitoring practical ethical and privacy issues

This area raises major issues at a practical level, as well as intellectually. The intellectual issues are addressed in WP 10. At a management level, the PSB will monitor the practical issues, particularly in regard to databases, and report on them as part of the ethical audit. Section 11 gives a fuller description of the network's ethical dimension.

6.B Plans

6.5 Plan for using and disseminating knowledge

The plan for disseminating knowledge is governed by the principle of openness of the work produced with the money of European taxpayers and fair return of investment to those who invest in the network.

Knowledge developed through the network's activities will be made available using a variety of media, mainly

- The portal (see section 6.3) will provide wide, rapid electronic access to a substantial proportion of the network's output and expertise.
- Workshop proceedings will be made available without restriction via the portal
- Other publicly available deliverables will also be made available without restriction via the portal
- Invitations will be issued to key individuals outside the network to attend workshops, and a proportion of summer school places will be open to outside applicants.
- The public profile of network activities will be maintained at a high level (see section 6.7)
- Scientific results will be published in peer reviewed journals. Wherever possible, these will be co-authored by scientists from more than one partner.
- Network members will produce a handbook for research on emotion-sensitive systems (see section 6.3)

Dissemination of information is necessarily subject to agreement on intellectual property issues which is incorporated in the Consortium Agreement. General provisions are:

- Research publication rights will be owned by those who produce them (either employers or employees depending on their country's regime)
- Output produced as part of the Joint Program of Activities will be diffused within the network at no cost

- Except that a decision not to disclose may be taken by the Project Steering Board with the agreement of the partners involved and the EC if there are compelling reasons to do so (e.g. protecting the rights of individuals recorded in a database)
- Software produced within the network will be the property of its producers with right of use for research and education purposes within the network at no cost.
- Databases developed within the network will be the property of its producers with right of use for research and education purposes within the network at no cost, subject to privacy restrictions agreed with participants during collection of the database.
- Material made available to teams within the network will be also be made available to research teams outside the network to use for research and education purposes (via a non-restricted area of the portal) unless the owners of the intellectual property rights request otherwise.

Because the network is not engaged in producing demonstrators or software ready for commercial use, protection relevant to that level of material is not appropriate.

Individual questions about the IPR regime will be resolved in accordance with the guidelines on knowledge and intellectual property right laid down for the 6th Framework Programme and with the Consortium agreement. Along these lines, the Project Coordination Board will monitor issues arising and report on a regular basis.

Timeline

After 12 months	• First report on IPR management and legal actions
After 24 months	• Second report on IPR management and legal actions
After 36 months	• Third report on IPR management and legal actions

There are connections between IPR issues and the ethical aspects of data protection. These are considered in section 11.

6.6 Gender Action Plan

We consider Gender Issues as part of a wider context with which Humaine is intrinsically concerned. WP10 deals at an intellectual level with socially sensitive issues linked to Humaine, covering ethical, gender, culture, privacy, and security issues. However, there is also a management task of recording issues in this area that arise in the day-to-day activity of network members, and taking appropriate action. Promoting gender equality within the network is part of the charter of all the Humaine activities and is not considered as an independent task here. If specific steps are seen to be necessary, appropriate measures could will be added to the Joint Programme of Activities by the Steering Group.

Task 1: Overseeing the science and society issues related to Humaine

This will take the form of internal awareness actions, and of reports to the EU on the issues that arise at a practical level, including:

- Observation of the issues that arise at a practical level in Humaine;
- Recommendations about the consideration of these issues; Report on the implementation of the recommendations and evolution of the issues.

Timeline

After 12 months	• First report on science and society issues related to Humaine
After 24 months	• Second report on science and society issues related to Humaine
After 36 months	• Third report on science and society issues related to Humaine

Task 2: Visibility of women

Women have a high profile in research on emotion in general and emotion related to computing in particular. The issues is to ensure that HUMAINE properly reflects that. In the course of the lifetime of the network, the following specific actions will be taken to ensure that women are seen to have an active role:

- Ensure that invitations to distinguished speakers include key women in the field
- Encourage presentations at workshops by all researchers, with special attention to ensuring balance between male and female researchers;
- Encourage presentations at workshops by all postgraduates, with special attention to ensuring balance between male and female postgraduates.

6.7 Raising public participation and awareness

Public awareness of the HUMAINE network can build upon an already-existing general interest in the research topics represented by HUMAINE, as evidenced by various appearances on TV and in press by several of the network partners. Promoting public awareness is therefore a matter of offering information to already-interested consumers (press and public) rather than having to raise interest in the research field; however, this also implies the responsibility to act appropriately in the face of exaggerated or otherwise wrong perceptions and expectations of the area.

One means of satisfying this interest is through regular and timely press releases on developments of relevance to the general public. In addition, a “popular interest” section will be set up on the portal website, which will be updated with relevant background information understandable for non-experts. Both will be announced via adequate information channels and maintained to reflect the progress made by the network.

More immediate contact with the general public will be made possible via open sessions at plenary meetings, where selected speakers (real or virtual!) give informative and entertaining introductions into various aspects of the research area.

The contact with schools will be sought by proposing open sessions for local pupils in connection with the HUMAINE summer schools. These will allow young people to make “first contact” with the exciting areas of research dealing with emotions in human-machine interaction, while at the same time providing an attractive frame for possible TV productions.

Contact will also be actively sought with important public and societal interest groups and associations, as well as policy makers, for whom the research area is seen to be of particular relevance. This includes both target groups who may benefit especially, but also addressees who are seen to be in need of being informed about the technology-related issues.

The resources made available by the Commission for media and information activities will be closely monitored and put to use to increase the impact of the HUMAINE publications on the general public.

6.C Milestones

6.8 Major Milestones over full duration of the action

The milestones that we have identified represent points at which the work that has been done enables key decisions to be made. The nature of the plan means that completion of work within a thematic area may have two types of effect. It may allow choices to be made about the way work proceeds within that thematic area; but it may also have implications for the direction of related work in other thematic areas. The milestones have been chosen with particular attention to the second type of effect: they are designed to ensure that the different thematic areas have the information necessary to recognise issues of the second type.

The milestones are as follows.

Milestone 1	Month 5 (ie following discussion at plenary 1)	Preliminary plans for the development of exemplars, including lists of key research targets in each research area and tentative levels of individual involvement in the research.
Milestone 2	Month 11	Developed descriptions of few potential exemplars for each workpackage.
Milestone 3	Month 18 (ie following discussion at plenary 2)	Decisions about an exemplar to be developed in each area and descriptions of roles to be played by partners.
Milestone 4	Month 18	Interim report on prospects for establishing standards evaluating opportunities for any contributions to standards in the light of workshops and the second plenary meeting.
Milestone 5	Month 24 (ie following the end of the main workshop cycle)	Preliminary outline of handbook contents and proposals for progressing the handbook.
Milestone 6	Month 36	Mid term reports on exemplar progress
Milestone 7	Month 36 (ie following completion of the workshop cycle)	Developed outline of handbook contents and plans for progressing the handbook.
Milestone 8	Month 44 (follows discussions at plenary 3)	Agreement on the establishment of the Humaine Association
Milestone 9	Month 44	Pre-completion reports on exemplars

7 Quality of integration and performance indicators

How the JPA is designed to achieve the expected degree of integration

The joint program of activities is designed to achieve a specific kind of integration. It aims to promote the emergence of communities of experts who share an understanding of the key issues in the thematic area which is their own specialism, and who are aware of their interconnections with experts in other thematic areas.

The task has similarities to a chemical reaction. There are major structural disincentives to the kind of reorganisation that we envisage, and they will not be overcome without a considerable input of resource and effort. However, once the initial disincentives are overcome, the changes that take place will not be easily reversed. The key disincentives are outlined in the next section.

The joint program of activities is designed to overcome these disincentives. It aims to ensure funding for the basic developments and the training that are essential for a new structure to emerge, but that would not be rewarded in other contexts.

The existing disincentives to integration

We identify four main types of disincentive. Each involves established structures that shape the way teams tend to operate, and that will continue to shape development unless a deliberate effort is made to achieve reorganisation. They are:

(a) Established conceptual frameworks

Groups from different backgrounds bring different conceptual frameworks, often highly developed in some of the relevant areas and tending to naivete in others. These involve not only knowledge, but also vocabulary, and what might be called intellectual horizons – assessments of the issues that deserve to be taken seriously.

(b) Established resource infrastructure

Certain resources – tools, databases, systems that serve as models to emulate or improve, etc. – are quite readily available to the research community; others may be potentially important, but they are not available in the same way. Research is inevitably drawn towards projects that have available resources support.

(c) Established training and career paths

Training tends to favour topics that are considered core within an established discipline, reinforcing established conceptual frameworks and directing trainees towards established resource infrastructure.

(d) Established reward structures

Established arrangements tend to favour projects that address goals that are well understood within a discipline, and often goals that seem attainable – at least to a first approximation – in the relatively short term. That militates against projects that are needed to address the previous three points.

EC funding of HUMAINE allows these disincentives to be targeted directly. If the network achieves its core goals, enduring integration at multiple levels will necessarily follow. These include:

- shared vocabulary
- shared knowledge
- shared appreciation of key problems
- shared tools and other infrastructure elements
- shared exemplars

Equally important, the program will leave a core of people who have been trained in the context of an integrated approach, and who are aware of the specialisms developed by the others in the core.

Two additional steps will be taken to consolidate these changes:

- The Belfast team will establish a *Humaine Centre* at the Queen's University of Belfast. This will be an interdisciplinary centre located administratively within the School of Psychology.
- A proposal to establish a *Humaine Association* will be prepared by the Steering Group and brought to the final plenary meeting. It will be a voluntary association supported by subscriptions from members, with an administrative base at the Humaine Centre.

One of the key tasks of the Humaine Association will be to ensure that the electronic portal continues to function in the long term.

Performance indicators of progress towards integration

Evidence of progress towards integration is inherent in most of the network's activities and deliverables. Key examples are:

- (a) Appointments of postdoctoral researchers committed to an agenda defined by the broader aims of the network rather than the individual aims of the host laboratories;
- (b) Establishment of an electronic portal (at DFKI);
- (c) Provision of relevant material by the partners;
- (d) Organisation of workshops on agendas defined by the broader aims of the network rather than the individual aims of the host laboratories;
- (e) Participation in workshops by researchers from laboratories whose emphasis does not coincide exactly with the subject of the workshops, particularly as peer reviewers;
- (f) Participation in summer schools, particularly by researchers from laboratories whose emphasis does not coincide exactly with the subject of the workshops;
- (g) Submission of agreed statements on priority tasks for thematic research areas;
- (h) Agreement on format requirements for a prototype multicultural database;
- (i) Sharing of work between researchers by joint supervision of postgraduate students or exchanges involving established researchers;
- (j) Creation of a prototype multicultural database that meets specifications jointly agreed by the partners;
- (k) Completion of exemplar specifications;
- (l) Completion of joint recommendations on good practice;
- (m) Completion of a joint statement on an ethical framework;
- (n) Completion of PhD's by research students sponsored under Humaine;
- (o) Submission of a jointly authored handbook on the science and technology of emotion-oriented systems.

If all of these are achieved, Humaine will have brought about enduring change in all the areas outlined at the beginning of this section:

- Established conceptual frameworks
- Established resource infrastructure
- Established reward structures
- Established training and career paths

Achieving that will mean that the profile of emotion research in Europe will have changed fundamentally and irreversibly.

8 Project organisation, management and governance structure

Management structures

The overall management of the Humaine NoE involves two main bodies: the Board of Management and the Project Steering Board.

Board of Management (BoM)

This body is made up of senior representatives of all the partners in Humaine. Each partner will be represented by a person authorised to make decisions on behalf of the partner (or a deputy to whom the same power has been delegated for the time being). The BoM will be responsible for all major decisions that have to be made regarding the NoE including:

- Review and formal release of project deliverables
- Considering and acting upon formal communications from the Commission
- Review and consideration of any significant change to the consortium or to the workplan (including changes in membership)
- Resolution of any issues arising between the partners
- Filling any vacancy on the Project Steering Board

The BoM will meet once per year unless an extraordinary meeting is required to resolve an important and urgent issue. Attendance by telephone will be an option to reduce travel commitments. The BoM will attempt at all times to manage by consensus between the parties but a voting system will be put in place should that fail. It is proposed that for an NoE of this nature one vote per partner is appropriate, with the Coordinator acting as chair of the BoM and holding a casting vote.

Project Steering Board (PSB)

The PSB will carry out all the main detailed and scientific management of HUMAINE. It is responsible for the overall orderly progress of the NoE. It will meet three times per year, reviewing and refining the NoE's strategic objectives, overseeing the practical planning in order to meet these objectives and resolving conflicts as far as that is possible. More regular telephone contacts, approximately every other week, will ensure that urgent issues are not allowed to remain unaddressed.

In particular, the PSB is responsible for the timely delivery of project deliverables to the Commission and for all routine communications with the Commission, the Coordinator being the principal contact.

Because of the extensive membership of HUMAINE and the need to establish an efficient and authoritative decision making process the permanent membership of the PSB is limited to a core group consisting of the ten members who have the following designated responsibilities. The relevant postholders, as at the start of the network, are named in asterisked brackets ()* after the title of the post.

- Network Coordinator (Roddy Cowie)*
- Management and Communication co-ordinator (Ellen-Douglas Cowie)*
- Signal/sign interfaces WP leader + Integration Area co-ordinator (Stefanos Kollias)*
- Theory/Research Area co-ordinator (Klaus Scherer)*
- Training & Outreach WP leader, Spread of Excellence Area co-ordinator (Marc Schröder)*
- Signs & emotional content in interactions WP Leader (Catherine Pelachaud)*
- Emotion in Cognition and Action WP Leader (Lola D. Cañamero)*
- Communication and persuasion WP Leader (Oliviero Stock)*
- Usability WP Leader (Kristina Höök)*
- Ethics and good practice WP Leader (Paolo Petta)*

This group contains the leaders of all ten WPs in HUMAINE. In addition, three of the members have additional responsibilities for three Areas of expertise and concern (Integration, Research and Dissemination) which cut across all WPs and activities of the NoE.

Attendance by telephone will be an option to reduce travel commitments. The PSB will attempt at all times to manage by consensus between the parties but a voting system will be put in place should that fail. For an NoE of this nature one vote per partner is appropriate, with the Coordinator acting as chair and holding a casting vote.

Other members of the project may be invited to sit on the PSB from time-to-time, for example whenever some key issue of which they have special knowledge is under discussion. This mechanism will, whenever possible, be used before escalating any issue between project members to the full BoM.

These broad structures are fleshed out by arrangements for dealing with specific issues, at an overall management level and within workpackages. In addition to the main management structure, a further body will be put in place to support the management in day-to-day issues which would otherwise be time-consuming; this is known as the Project Coordination Board. It is also recognised that individual workpackages need to be organised in ways that engage the researchers involved. The specific arrangements are described below.

Project Coordination Board (PCB)

The PCB has no fundamental decision making powers but serves to “off load” a number of administrative functions from the Coordinator and other members of the PSB. To this end Figure 1 shows that all WPs and Areas provide regular reports to the PCB which has the responsibility to collate and deliver as necessary the information which is required by the PSB and hence the BoM and the Commission.

The membership of the PCB will be as follows. Relevant postholders, as at the start of the network, are named in asterisked brackets ()* after the title of the post

- Project Coordinator (Roddy Cowie)*
- Management and Communication Coordinator (Ellen-Douglas Cowie)*
- Project Administrator: (to be appointed)

The majority of the administrative work will be undertaken by the full-time Project Administrator. The other two PCB members will be consulted whenever operating policies are to be set or modified or whenever decisions which fall within the scope of the PCB are to be taken. They provide the main link to the main decision making group, the PSB, to which the PCB will report.

Management within a workpackage

Workpackage leaders have responsibilities for management of activities within their areas. These include

- Establishing a working team in the area, including appropriate division of labour and mechanisms of consultation;
- Negotiating a suitable program for the development of an exemplar in his or her area;
- Bringing a summary of the proposed program to the PSB;
- Presenting progress reports to PSB meetings;
- Ensuring timely preparation of deliverables in their relevant workpackage.

The whole structure is summarised in Figure 1.

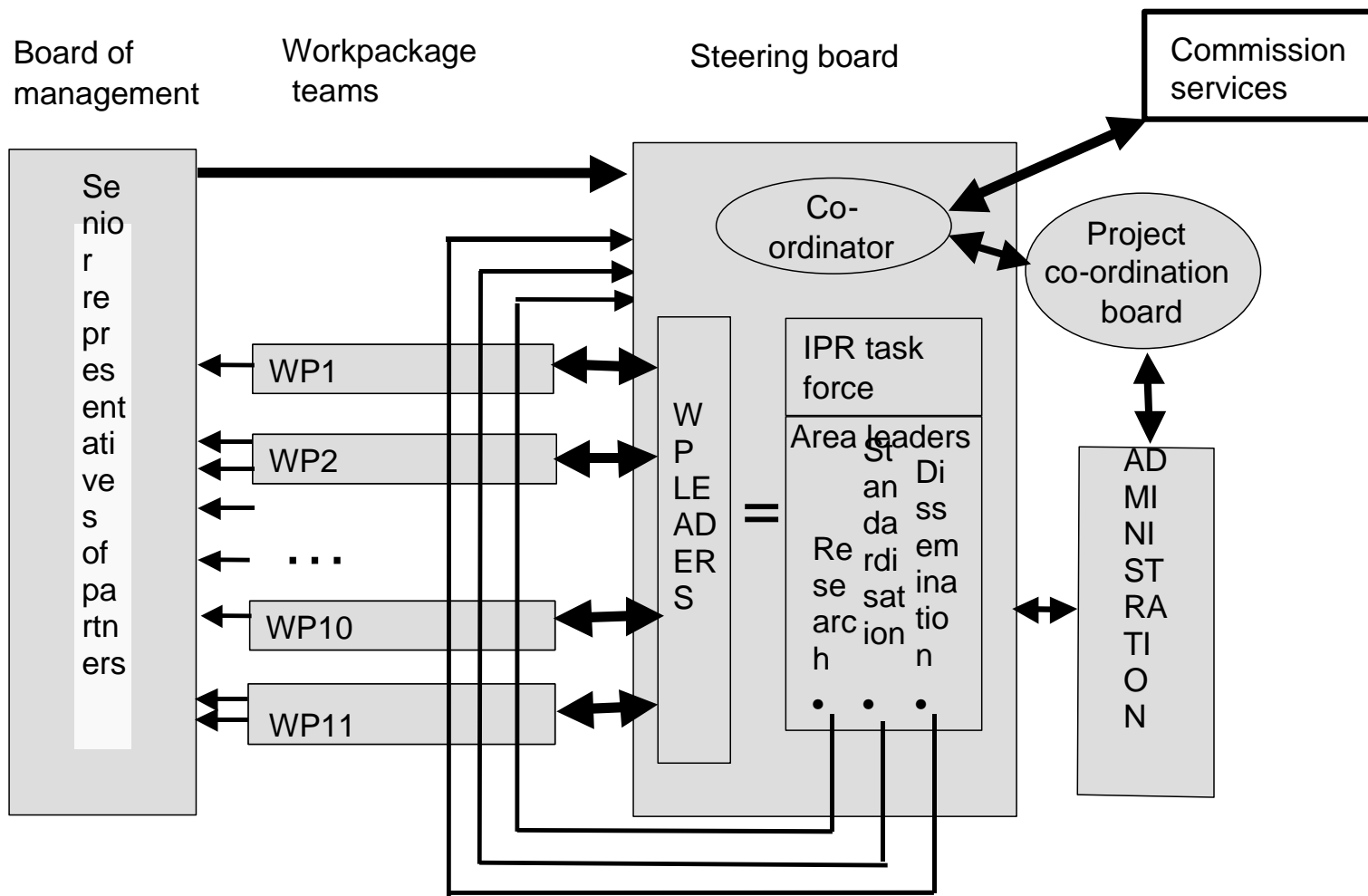


Figure 1: Humaine management structures

Specific structures are in place to deal with key management issues, as follows.

Ensuring openness

To facilitate attendance, meetings of the Board of Management will generally coincide with plenary meetings of the network; and the PSB will also hold one of its meetings at each plenary meeting.

The agenda of each PSB meeting will be distributed in advance to all network members, and the minutes will be distributed to them promptly afterwards.

All partners of HUMAINE have the right to raise issues for the consideration of the PSB, joining the discussion in person if the matter is of a serious or complex nature.

Revisions of the Joint Programme of Activities

The Project Steering Board will be in charge of the monitoring of the Joint Programme of Activities in all the areas of the network (Integration, Research, Spread of Excellence). Monitoring and controlling the technical and scientific progress of the project will be achieved by means of meetings three times per year with regular intermediate teleconferences.

Area co-ordinators, in collaboration with the WP Leaders, will be responsible for evaluating proposed changes in either the Joint Programme of Activities (shortening, or expanding tasks, allocating resources or changing partnership) or the personnel involved with particular activities. This includes proposing new candidates to join the network (see below). Some aspects of this activity are prospective since they depend on the evolution of technological and social context.

The Project Steering Board makes formal proposals concerning the evolution of the Joint Programme of Activities and new membership which are then considered by the Board of Management.

Audit of management

The EC will organise an audit of the network's management structures and procedures during the first six months of the project. The Project Steering Board will facilitate the audit in any way that is appropriate.

Competitive calls

Competitive calls will be made in four areas, subject to availability of funds.

1. Exchanges and visits In February and August of every year, a call will be issued to all members to bid for funds to support visits by members of one network partner to visit the laboratory of another partner and carry out research that contributes to the JPA.

2. Attendance at workshops If the organiser of a workshop considers it appropriate, a call will be placed inviting groups outside the network to apply for a specified number of places at the workshop.

3. Attendance at summer schools If the organiser of a summer school considers it appropriate, a call will be placed inviting individuals outside the network to apply for a specified number of places at the summer school.

4. Calls for new members will be made at strategic times linked to milestones – at month 6 (after milestone 1); at month 18 (linked to milestone 3); and at month 36 (linked to milestone 6).

All of these calls will be in accordance with the specifications laid down by the EC. They will be issued and evaluated by the Steering Board.

Extension of the network beyond the duration of EC funding

The heading is included here for completeness: the topic was covered in section 7.

Intellectual property rights

The heading is included here for completeness: the topic was covered in section 6.5.

9 Detailed joint programme of activities (JPA) – first 18 months

9.1 Introduction - general description and milestones

Workpackages and thematic areas

The core of the network's integration and joint research activities is organised around the work packages corresponding to the thematic areas first introduced in section 2, objective 2. These workpackages are:

- WP3 Theories and Models
- WP4 Signs of Emotion
- WP5 Data and Databases
- WP6 Interaction
- WP7 Emotion in Cognition & Action
- WP8 Emotion in Communication
- WP9 Usability

The thematic areas represented by these work packages are designed to cut across traditional boundaries between disciplines, so that each of them will bring experts from different fields together.

The thematic work packages share a very similar structure. In each area, a common understanding of the issues at stake must be gained, which will be made possible by a thematic workshop including peer comments to promote dialogue. In addition, each area should come to a common idea of challenging but attainable R&D goals, which will be condensed into a proposal for exemplar(s) at the end of the first 18 months.

There is a natural ordering between the thematic areas, from basic, low-level to complex, applied areas. This ordering is reflected in the order in which the workshops will take place: First a "theory" workshop, then a "signs" workshop, etc., and last a "communication" and a "usability" workshop. For practical reasons, the last two workshops cannot take place within the first 18 months, but are scheduled shortly after that.

Two content-oriented work packages have a slightly different role from the other thematic areas:

- WP3 Theories and Models
- WP10 Ethics and Good Practice

Both work packages have the general mission to support the thematic areas in WP4-9 by providing input to the deliverables in those work packages, e.g. through commentaries at workshops or through targeted comments on working drafts for the proposals for exemplars. The double role of WP3 as a thematic area and a supportive work package stems from the dual role of emotion theory. While being "work in progress" as the other thematic areas, therefore needing development in its own right, it must nevertheless be the basis upon which all the other work is based. As to WP10, it is anticipated that the activities in this work package will lead to recommendations of good practice in later stages of the network.

Each of these work packages is led by a partner who is a member of the Steering Group and supported by a Humaine-funded postdoctoral researcher whose primary duty is to support the partner in leading the workpackage activities.

Infrastructure

It is vital to the network that appropriate supportive structures are built up and maintained. These activities are grouped in the following work packages:

- WP0 Administration
- WP1 Training and Outreach
- WP2 Plenary Sessions

The function of these activities is to ensure that the content-based work in the thematic areas can take place.

Top-down and bottom-up activities

With a network of more than 25 participant groups, it is impossible (and undesirable) to plan all networking activities centrally. Instead, an incentive fund will be available to support grass-roots, “bottom-up” activities initiated by individual partners or by small groups. This fund will be dedicated to supporting any networking activities line with the Humaine goals, such as staff exchanges, or time off teaching. Funds are set aside so that partners who see an opportunity for such an activity can apply for financial support. The mechanism for competitive calls is described in section 8.

Risks and contingency plans

The main and central risk in the network is that the intended integration does not take place. This has two important sub-aspects:

- The risk that the proposed work is not carried out as promised. In the case that partners would be unable or unwilling to carry out the tasks they had agreed to do, the steering group would have to decide to reassign their tasks, either to a partner already in the network or to a new partner entering the network. The steering group must make sure that such cases are identified in a timely manner, so that the reassignment of tasks can be carried out quickly enough to avoid causing delays in the network’s activities.
- The risk of difficulties in interdisciplinary communication. The interdisciplinary thematic areas in Humaine are specifically designed to promote the exchange of ideas, approaches and viewpoints between disciplines. The proposed groupings may be unfamiliar to participants at the beginning, but it is anticipated that this will quickly be perceived by the partners as an enriching chance to learn and contribute. However, it cannot be excluded that individual participants in specific thematic areas may be very uncomfortable with their assignment and/or the scope of their thematic area. If such cases should arise, the steering group will decide whether it appears reasonable, as part of the larger context, to adapt the profile of the respective thematic area, or whether a reassignment of the respective partner to a different thematic area should be proposed.

A rather hypothetical risk is that of the network’s goals becoming obsolete, e.g. by a comparable networking effort carried out overseas. On the one hand, this appears highly unlikely, given the fact that no integration activity of this scale has ever been carried out in the past. On the other hand, a comparable networking effort overseas should be greeted with cheer rather than with contempt – there are certainly enough unsolved issues in this field for several such activities. Should the case arise, Humaine would actively seek co-operation with that initiative, thereby strengthening the outreach and impact of Humaine activities.

9.2 Planning and timetable

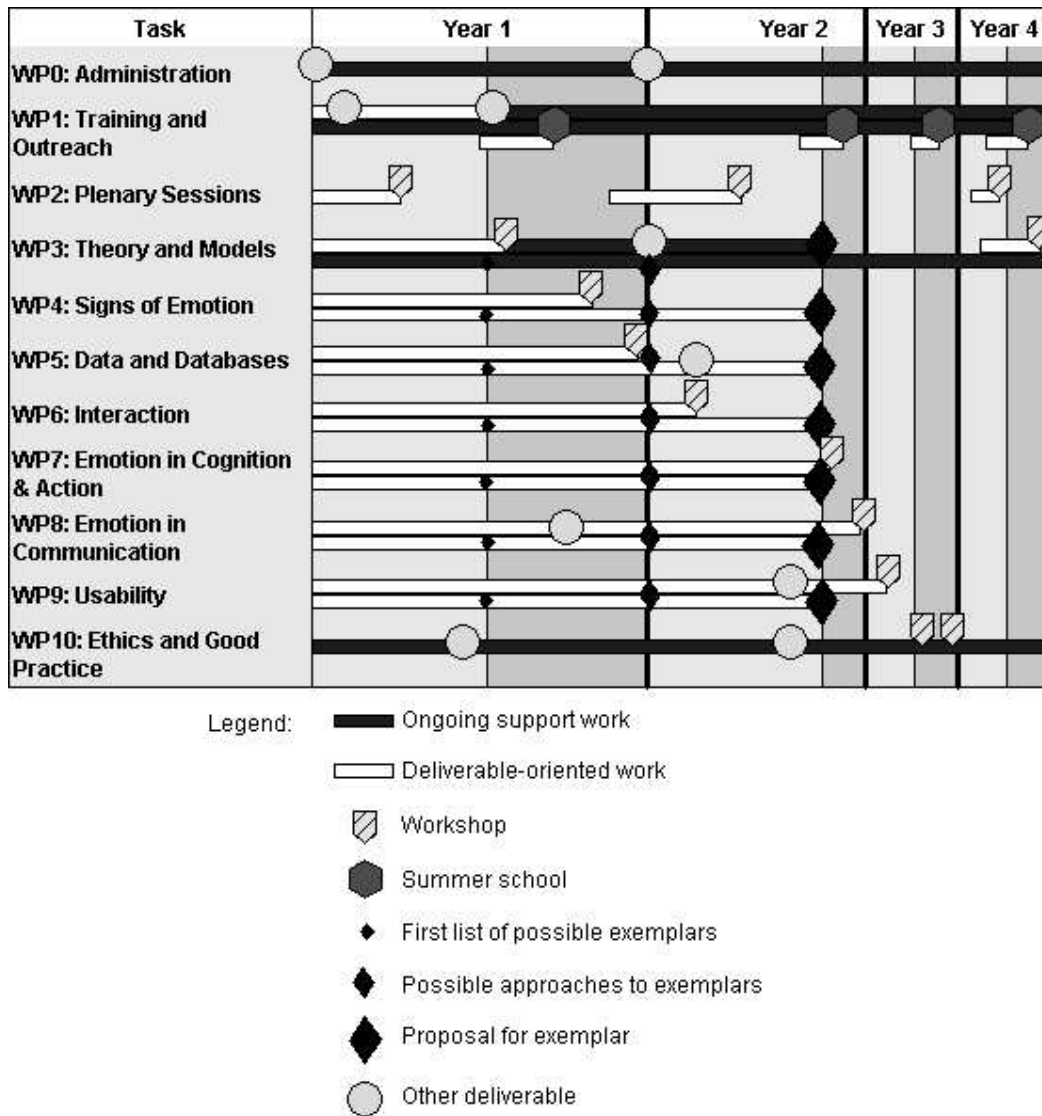


Figure 2 Humaine Gantt Chart

WP0 Administration

WP0 groups all administrative tasks, and has the role to ensure the smooth operation of all formal aspects of the HUMAINE network. The work package comprises six types of activity:

- operational management, such as the communication with the EC, the resolution of conflicts, and auditing;
- financial management, including accounting and the monitoring of income and expense plan execution;
- technical management, including activity reporting and the revision and expansion of the joint programme of activity;
- legal and knowledge management;
- and monitoring of the society and gender issues related to the network.

- monitoring of ethical and privacy issues directly related to the work done within the NoE, such as the database collection

QUB will be responsible for WP0: named WP leader as at the start of the network (Ellen Douglas-Cowie)*

WP1 Training and Outreach

WP1 is designed to group the activities primarily serving to spread the excellence created through the network's integration and joint research activities. The title is chosen to reflect the two main strands of this work:

- a) Outreach: Ensure that the network itself and the results it produces are perceived as relevant by a large audience;
- b) Training: Pass on the insight gained through the network's activities, both inside and outside the network.

The "outreach" aspect of the work during the first 18 months starts with the build-up of an efficient common communication infrastructure within the network, enabling the network as a whole to start its integration work. This will go hand in hand with an organisation of announcement distribution channels, including a collection of relevant mailing lists and forums in the different domains and countries. This basic work will create efficiency in all subsequent communication activities within and beyond the network.

A second, essential pillar for ensuring outreach is the high-profile electronic portal. Designed to attract the attention of virtually all relevant researchers worldwide, this portal will be an essential source of information. While this leads to a high build-up and maintenance effort, it is considered a most effective means of establishing the network and preparing a far-reaching platform for spreading the network's results.

The "training" aspect of this work will be supported in two ways. One is centrally organised, "top-down" in nature, namely the organisation of yearly summer schools. These will be efficient, concentrated opportunities for interested participants to gain an understanding of emotion and HMI research. Courses will address both breadth and depth: breadth in the sense that introductory courses will convey a feeling of the many aspects of the research field as examined in different disciplines; depth in the sense that advanced classes held by domain experts will provide a uniquely detailed understanding of a specific domain.

The second aspect of training is support for "bottom-up", grass-roots activities by the partners in the network. A "micro-project" funding structure will be built up, allowing all partners to apply for financial and/or logistic support for specific networking activities.

One aspect of the spreading of excellence that could potentially become important in the network is that of contribution to standards. As argued earlier, it appears highly unlikely that the network will come to a degree of cohesion sufficiently close to allow for the formulation of definite standards on emotion research. However, it is conceivable that specific aspects are sufficiently uncontroversial to allow them to be proposed as minor contributions to related standards. A milestone after 18 months is suggested as a date for re-investigating this question in the light of the first workshops, and come to a conclusion whether any such opportunities for contributions to standards are seen.

DFKI will be responsible for WP1: named WP leader as at the start of the network (Marc Schröder)*

WP2 Plenary Sessions

WP2 groups the activities bringing together all participants of the network. A separate work package was chosen for this task because of its distinct nature and the considerable organisation effort involved.

Plenary sessions will be rare but essential events marking milestones in the development of the network. Each plenary meeting will be a major, focalising event to which all working groups will contribute.

A first plenary meeting in month 3 will mark the start of the network and bring together the visions of the participants, thereby creating the momentum necessary to carry out the tasks set out in the work packages. A side effect which must not be underestimated is that persons working together in various tasks will meet in person, which, as experience suggests, is often a strong facilitator for remote cooperation.

A second plenary meeting in month 16 will serve as a target point for the joint research work carried out in the first 18 months. Each thematic area will present the results of their joint work on proposing exemplars. Feedback and discussion from the plenum will allow these proposals to be refined before delivery one month later.

The final plenary meeting is scheduled near the end of the funding period (month 43), to summarise the achievements of the network and to formulate directions for future integrated work.

DFKI will be responsible for WP2: named WP leader as at the start of the network (Marc Schröder)*

WP3 Theories and Models

WP3 represents one of the HUMAINE thematic areas, and as such features integration activities including a workshop (see section 6.1) and joint research activities (see section 6.2, which also reviews key aspects of the current state of the art). WP3 has the additional mission to inform the other work packages of relevant emotion theories and models.

There is indeed a need for all thematic areas to be well informed of the state of the art in emotion theory: Even though the integration of emotional phenomena into computer animation, robotics, and human-computer interfacing is undoubtedly one of the most rapidly growing areas in science and technology, many of the concepts used in this area are either based on lay psychology or on very selective reception of the state of the art in emotion research. Most importantly, there is a severe gap between applied researchers building emotions into computer applications and autonomous agents and basic researchers in the newly constituted interdisciplinary field of Affective Science (Davidson, Scherer & Goldsmith, 2003). Apart from the danger of reinventing the wheel or making avoidable errors, this gap deprives the S&T community of access to the dramatic progress of research on emotion made in the natural and neurosciences, as well as in the behavioural and social sciences.

Since much of the pioneering work on emotion is conducted in Europe, HUMAINE can draw on established competence in a number of leading edge European research groups. The purpose of WP3 is to summarise the conceptual and theoretical foundations as well as the most recent research evidence, and to make them available to the members of the network – in a form that allows immediate transfer to the joint activities undertaken by the members of the network. The following concrete aims will be pursued:

A major objective of WP3 consists in the clarification of fundamental conceptual issues to guide the activities of the network, including the development of operational differential definitions for affect,

emotion, attitudes, moods, affective personality, and affective stances. Recommendations as to the specific attention to be given to each class within the network and in developing exemplars for interfaces are to be elaborated and the most appropriate contexts for different forms of affective phenomena of interest to HUMAINE members identified.

In addition, the currently held models of emotion and other affective phenomena that can guide the activities of the network are to be critically reviewed with respect to their similarities and differences, as well as the currently available evidence. Based on the resulting synthesis a working model that is best suited for the development aims of the network will be elaborated and operationalised with respect to basic assumptions concerning the elicitation of specific affective states by different induction conditions and the processing required for differential response patterning. A major aim is the specification of response profiles in different modalities as well as their synchronisation for both measurement and animation purposes.

A central task for WP3 is the transfer of these fundamental assumptions to implementation proposals involving one or several exemplars that will be addressed by joint research and development activities of the network. Specifically, it will be necessary to integrate fundamental knowledge about emotion processes into a communicative context by modelling production and perception/inference of emotional messages in a coherent interface. A central feature of this activity will be the modelling of the dynamic process of recursive production-perception loops in humans and automata.

Last but not least, the WP will have the task of suggesting and developing a toolbox of measurement instruments based on the fundamental working models that are specifically adapted to the aims of the network. The availability of adapted methodological tools is a precondition for both development and evaluation.

UNIGE-GERG will be responsible for WP3: named WP leader as at the start of the network (Klaus Scherer)*

WP 4 Sign/ signal interfaces

WP4 represents one of the HUMAINE thematic areas, and as such features integration activities including a workshop (see section 6.1) and joint research activities (see section 6.2, which also reviews key aspects of the current state of the art).

Sign/signal interfaces are a major limiting factor in the development of emotion-oriented systems, whether the modality is visual, auditory, somatic, or other. They affect both reception and synthesis. WP 4 aims to lay the foundations for addressing these issues in a coherent way.

In everyday life people express their emotions through multiple modalities - their speech, their face and their body. This means that a system that attempts to interact with humans, taking into account their emotional state or attitude, needs to process, analyse and extract all these cues that are provided to them through their user's speech, facial expressions, hand and body pose. Conversely, all of the cues can be used to convey emotional messages to a user. Additional kinds of information not used in natural communication, but potentially relevant to interfaces, come from emotion-related somatic and cortical changes. The expected focus of the research activity is developing the basis for a coherent treatment of these issues.

The package will be carried out by members of the Sign/signal interface thematic group. They will take part in four main types of activity. Review and joint analysis of the field will lay the foundation of the work. It will be reflected in the workshop (in month 9), which will strengthen understanding within the group, but will also make its work known to members of other groups. Throughout the first 18 months, group members will work to define exemplar tasks that embody key steps towards a

coherent treatment of low-level issues. The outcomes will be presented to the plenary meeting in month 16.

The fourth kind of activity will extend beyond the 18 month period considered here. Joint work will be carried out to produce exemplars of the kinds of systems that we believe need to be developed.

ICCS will be responsible for WP4: named WP leader as at the start of the network (Stefanos Kollias)*

WP5 Data and Databases

WP5 represents one of the HUMAINE thematic areas, and as such features integration activities including a workshop (see section 6.1) and joint research activities (see section 6.2, which also reviews key aspects of the current state of the art).

Databases of emotional material are at the heart of empirical research on emotions. One straightforward goal of WP5 is therefore to arrange access to as many of the key existing databases as possible via the electronic portal.

Several network members are experienced in the collection of such databases and are well aware of a number of important problems. WP5 will carry out a comprehensive review of the relevant issues, and produce a proposal for the structure and contents of a database or a set of linked databases that would serve as an exemplar for the next generation of research.

The work package consists of four main types of activity. Review and joint analysis of the field will lay the foundation of the work. It will be reflected in a workshop (in month 11), which will strengthen understanding within the team, but will also make its work known to members of other groups. The outcomes will be presented to the plenary meeting in month 16.

The fourth kind of activity will extend beyond the 18 month period considered here. Joint work will be carried out to produce an exemplar of the kind of database that we believe needs to be developed.

QUB will be responsible for WP5: named WP leader as at the start of the network (Ellen Douglas-Cowie)*

WP6 Emotion in interaction

WP6 represents one of the HUMAINE thematic areas, and as such features integration activities including a workshop (see section 6.1) and joint research activities (see section 6.2, which also reviews key aspects of the current state of the art).

In WP6, we will look at the signs of emotions in interaction. The main context is the generation phase of the (visual and acoustic) communicative behaviors: we are interested in defining the underlying knowledge and set of parameters that a system requires to be able to compute the proper emotional signals. We will survey how ECA systems have characterized expressions of emotion for the face, gaze and gesture. We will also examine the basic functions that emotion may play in interaction, including its impact on users' experience in the interaction, and users' engagement. Symmetrically, we will consider how the emotions used in interaction are perceived by the users, and in particular whether the perceived emotions are really the intended emotions. WP6 will permit to understand better how emotion may be used in interaction and to determine the signs of emotion.

Paris8 will be responsible for WP6: named WP leader as at the start of the network (Catherine Pelachaud)*

WP 7 Emotion in Cognition & Action

WP7 represents one of the HUMAINE thematic areas, and as such features integration activities including a workshop (see section 6.1) and joint research activities (see section 6.2, which also reviews key aspects of the current state of the art).

In humans, emotions entail distinctive integrated ways of perceiving and assessing situations, processing information, and modulating and prioritising actions. Elaborating computational models that embed the effects of emotions in cognition and action is a complex, multi-faceted problem that poses multiple integration challenges (see section 6, overview). WP 7 aims to lay the foundations for addressing these issues in a sound, coherent and integrated way.

Different computational models and systems have been developed in recent years, such as algorithms for emotional learning, rule-based cognitive appraisal systems for problem-solving and user modelling, emotion-based architectures for decision-making in autonomous agents and robots, etc. These systems address particular aspects of the roles that emotion plays in cognition and action, often disregarding their possible integration with other relevant aspects and systems, and they often stem from very different modelling traditions. In addition, many of them are guided by rather engineering concerns, lacking an appropriate understanding of relevant theories and models of human emotions that could set their grounds.

Taking a step to overcome these problems, the work of this package during its initial 18-month phase will consist of a cross-disciplinary review and critical analysis of existing computational models, systems and techniques, and their theoretical underpinnings. The purpose of this critical analysis will be identifying needs regarding e.g. integration, evaluation, recommendations of good practice and usability, and directions for sound future research. This analysis will be performed along several cross-thematic threads, and integration of results will be assured by: (a) proposals for exemplars (preliminary plans for development of exemplars are planned for month 5, developed descriptions of potential exemplars are planned for month 11) that will be developed beyond the initial 18-month period; the outcomes of this phase will be presented to the entire Network at the plenary meeting in month 16; (b) a workshop (month 19). Exemplars will be carried out for the duration of the project, and results will be presented at the last plenary meeting (month 43). Outcomes of the WP will also be presented in the network handbook.

UH will be responsible for WP7: named WP leader as at the start of the network (Lola Cañamero)*

WP8 Emotion in Communication

WP8 represents one of the Humaine thematic areas, and as such features integration activities including a workshop (see section 6.1) and joint research activities (see section 6.2, which also reviews key aspects of the current state of the art).

This work package is related to the literature on ‘social influence’, which looks at ways of using or adapting to emotion. That kind of issue underlies many of the obvious applications – teaching, informing, selling, supporting, entertaining, pre-empting problems. Systems in these areas need to know not only how to express and recognise various emotions and emotion-related states (such as boredom or irritation or humour), but also how to use them or avoid them so that desired goals can be achieved. From an applied point of view we can say that future intelligent interfaces will have contextual goals to pursue. They may aim at inducing the user - or in general the audience - to have some beliefs and perform some actions in the real world. They will have to take into account the “social environment”, exploit the situational context, and value emotional aspects in communication. Computational humor production is also of specific relevance in this workpackage.

Joint research activity in WP8 will follow the standard pattern of preparation and consultation, including circulation of potential research topics, followed by preliminary and developed proposals

for an exemplar to be developed later in the project. A workshop in the area will be prepared, though it will not take place until month 24.

ITC-IRST will be responsible for WP8: named WP leader as at the start of the network (Oliviero Stock)*

WP9 Usability

WP9 represents one of the Humaine thematic areas, and as such features integration activities including a workshop (see section 6.1) and joint research activities (see section 6.2, which also reviews key aspects of the current state of the art).

Usability research is a key to relate the work carried out by the Network of Excellence to practical significance and thereby ensuring that activities remain directed towards exploitable results. Usability studies critically review qualities such as the appropriateness and effectiveness of solutions incorporating affective interfaces. The definition of methods and measures for this new subject matter requires collaboration with and input from domain specialists across all different disciplines. On the other hand, experiences with the execution of and the results obtained from implemented studies provide an overall assessment of the state of the art and essential guiding input for activities in the other areas of expertise involved in the task of developing satisfactory emotion-oriented systems.

WP9 will start with the elaboration of the mutual contributions of usability assessment and the other individual areas of expertise in affective interfaces. The results will be documented in a green paper to be presented at the plenary meeting at month 16. Subsequent evaluation activities will lead to the drafting of a white paper document covering methods to analyse scenarios, usability assessment techniques, and strategies for exploitation of usability results to be discussed at the topical workshop scheduled for month 22. Further refinement of the working document reflecting the results of additional empirical activities follows, resulting in the publication of the final white paper recommendations in the network handbook.

KTH will be responsible for WP9: named WP leader as at the start of the network (Kristina Höök)*

WP10 Ethics and good practice

WP10 is concerned with the development of shared infrastructure. The ethical element includes standard integration activities, a workshop (see section 6.1) and joint research activities (see section 6.2, which also reviews key aspects of the problems). It aims towards recommendations for ethical guidelines, and in the later stages these will be folded into the wider effort to establish recommendations for good practice. Only the ethical element of the package will be under way during the first 18 months.

The workpackage depends on establishing working relationships between philosophers and practitioners. Philosophy offers general ethical concepts, and various examples of specific ethical frameworks developed to address the needs of particular areas, from medicine to the media. Practitioners bring ideas about likely applications, and hence about the issues that may arise. They are also subject to various pre-existing legal and ethical constraints. The first phase of the research will involve assembling concepts, issues and concerns from both communities.

The second phase will involve attempting to develop a synthesis that is well enough ordered to be practically useful. That involves challenges at many levels – for instance, whether a sound approach should be framed strictly in terms of the humans involved, or should consider emotion-oriented systems as agents to which standard types of moral requirement attach (e.g. to tell the truth, to avoid inflicting emotional hurt, etc).

OFAI (Paolo Petta)* will have overall responsibility for WP10, with main contributors to the ethical element to be provided by KCL (Peter Goldie)* and QUB (Roddy Cowie)*

9.3 Graphical presentation of work packages

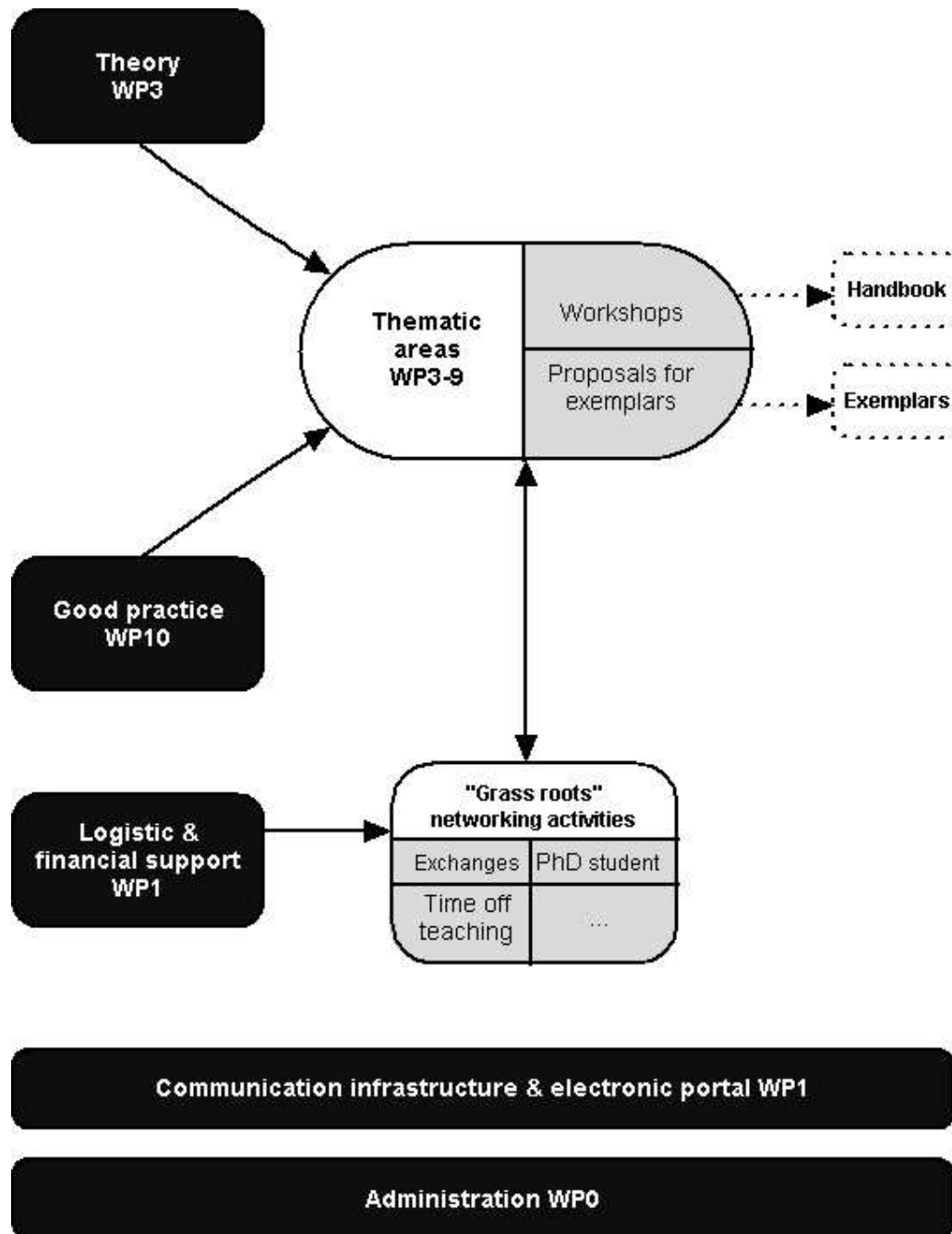


Figure 3 Overview of the workpackage structure of Humaine

9.4 Work package list /overview
Work package list
Joint programme of activities (18 months period month 01 - 18)

Work package No	Work package title	Lead contractor No	Person-months	Start month ¹	End month ²	Deliverable No ³
0	Administration	QUB	33	1	48	D0a-h
1	Training and Outreach	DFKI	18	1	48	D1a-d
2	Plenary sessions	DFKI	30	2	43	D2a-b
3	Theory and Models	UNIGE	96	1	48	D3a-e
4	Signs of Emotion	ICCS	85	1	48	D4a-d
5	Data and Databases	QUB	75	1	48	D5a-e
6	Emotions in Interaction	Paris8	113	1	48	D6a-d
7	Emotion in Cognition & Action	UH	126	1	48	D7a-d
8	Emotion in Communication & Persuasion	ITC-IRST	96	1	48	D8a-d
9	Usability	KTH	52	1	48	D9a-d
10	Ethics and standards	OFAI	19	1	48	D10a-b

NB: in this and the following tables, person-months are given as integers. Contributions of less than 0.5 person-months appear as zero (or blank). Rounding also means that the integer numbers may not add exactly.

¹ Relative start date for the work in the specific work packages, month 1 marking the start of the project, and all other start dates being relative to this start date.

² Relative end date, month 1 marking the start of the project, and all ends dates being relative to this start date.

³ Deliverable number: identified by the number of the WP (0-10) and a letter (a-h) to distinguish deliverables in the same WP.

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Appendix A - Consortium description

A.1 Participants and Consortium

Description of each of the participating organisations, ordered by partner number, short name in brackets.

THE QUEEN'S UNIVERSITY OF BELFAST (QUB)

The QUB team has a strong research profile in the area of emotion and speech prosody. The team is interdisciplinary and has combined strengths in psychology and speech analysis. Members of the team have been partners in European-wide collaborative and interdisciplinary research on machine recognition of emotion and the development of emotion sensitive interfaces. They have collected one of the first, large audio-visual databases of naturally occurring emotion, and have developed sophisticated tools for tagging the perceived affect of spoken utterances. The FEELTRACE tool allows users to trace the emotional content of an interaction over time. They have also developed a speech analysis system (ASSESS) which delivers a statistical analysis of relevant properties of the speech signal. The team have developed techniques for inducing emotion-related states, and have well-equipped laboratories, including a driving simulator which is used to induce emotional states (stress, boredom etc), and equipment for relevant physiological measurement. Their research has been funded under the Fifth and Sixth EU Frameworks (in the projects PHYSTA, ORESTEIA and ERMIS).

DEUTSCHES FORSCHUNGSZENTRUM FUER KUENSTLICHE INTELLIGENZ GMBH (DFKI)

The German Research Center for Artificial Intelligence (DFKI) today is one of the largest nonprofit contract research institutes in the field of innovative software technology based on Artificial Intelligence (AI) methods. DFKI is focusing on the complete cycle of innovation - from world-class basic research and technology development through leading-edge demonstrators and prototypes to product functions and commercialisation. DFKI has more than 180 full-time employees, including 145 research scientists with advanced degrees, as well as around 140 part-time research assistants. DFKI has long-standing experience in several aspects of human-machine interaction research, including emotional speech synthesis (EU projects NECA, SAFIRA), emotional behaviour modelling (MagiCster), multimodal interaction with virtual avatars (Smartkom, Virtual Human), and interface evaluation (COLLATE Evaluation Center). This experience is matched by ambitious research roadmaps in the Language Technology Lab, headed by Prof. Hans Uszkoreit, and the Intelligent User Interfaces Lab, headed by Prof. Wolfgang Wahlster.

INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS OF THE NATIONAL TECHNICAL UNIVERSITY OF ATHENS (ICCS)

The Image, Video and Multimedia Systems Lab (IVML) of The Institute of Communication and Computer Systems (ICCS) at NTUA is a major well-resourced laboratory. The academic staff, headed by Prof. S. Kollias, includes two professors, six post-doctoral researchers, fifteen highly qualified engineers working for their Ph.D, administrative and technical support staff. The most important areas of R&D activities of IVML include: Intelligent Human Computer Interaction and Intelligent agents, Image and Video processing and analysis, Artificial neural network, fuzzy and neurofuzzy technologies, Face, Emotion and Biometric Analysis and Recognition, Natural - Synthetic Hybrid Coding / MPEG-4 standard, 3-D image analysis, reconstruction and visualization systems. IVML has been involved in 50 R&D projects. Twenty-two (22) of them are/were funded by the European Union (under the framework of Eureka, Esprit (6), Race, Biomed-1, Telematics, G7, TMR, Educational Multimedia, HCM (2), Tempus (2), Inco-DC, Leonardo, IST (3)). Forty four of them have finished, while six are in progress.

UNIVERSITE DE GENEVE (UNIGE)

The University of Geneva has 2 groups working on emotion – GERG and MIRALAB.

GERG is situated in the Department of Psychology at Geneva and led by Professor Klaus Scherer who is recognized as one of the world's leading figures in psychological research on emotion. The members of the group (4 researchers and 8 doctoral students) work on theoretical development and empirical research in the affective sciences. They conduct research into many aspects of emotions, with special emphasis on emotion-constituent appraisal processes, expression of emotion and stress in voice and speech, facial expression of emotion, central and peripheral physiological reaction patterns, and subjective experience of emotional processes. Research methods include experimental studies in both laboratory and field settings, using emotion induction and sampling of naturalistic emotions, as well as computer-simulation approaches (modeling emotion, and computerized approaches to the analysis and synthesis of facial expression). Examples of projects related to the Humaine proposal concern the analysis of the relation between emotional experience, appraisal, and facial expression using synthetic stimuli and the mutual understanding, motivation, and problem solving in computer supported communication, collaboration, and learning. GERG has a complete set of laboratories for work on acoustics, nonverbal expression, peripheral psychophysiology, EEG, and state-of-the-art hardware and software for digital signal analysis. The group has vast experience in major funded interdisciplinary projects GERG organized the 37-country cross-cultural, interdisciplinary emotion study (ISEAR), and Klaus Scherer has been a member of EC-funded interdisciplinary projects (e.g., VeriVox) and of the interdisciplinary consortium on Organizational Learning funded by the Daimler-Benz foundation

MIRALab was founded in 1989 by Professor Nadia Magnenat-Thalmann. The group is made up of more than 30 researchers, coming from many different fields -computer science, mathematics, medical field, design, architecture, fashion design, cognitive science, etc. The group is truly an interdisciplinary group, working in the field of computer graphics, computer animation and virtual worlds. Since 1992, the group has participated to more than 25 European Projects. Among them, the latest are INTERFACE (Multimodal Analysis/Synthesis System for Human Interaction to Virtual and Augmented Environments, <http://www.ist-interface.org/>), MESH (Modelling Expressions and Shapes of Human Heads, <http://www.meshproject.com/>), LIFEPLUS (Innovative Revival of Life in Ancient Frescos and Creation of Immersive Narrative Spaces, Featuring Real Scenes with natural looking virtual humans, <http://www.miralab.unige.ch/subpages/lifeplus/>), CAHRISMA (Conservation of the Acoustical Heritage by the Revival and Identification of the Sinan's Mosques Acoustics, <http://www.dat.dtu.dk/cahrisma.htm>).

UNIVERSITY OF HERTFORDSHIRE (UH)

The interdisciplinary Adaptive Systems Research Group, led by Prof. Kerstin Dautenhahn is situated within the Department of Computer Science, and comprises eight permanent academic staff and 15 doctoral students. It carries out research in various aspects of Embodied Artificial Intelligence and Robotics, Socially Intelligent Agents, and Artificial Life. One of the key research areas, led by Dr. Lola Cañamero, is emotion modelling for artefacts, focusing on the following topics: architectures based on emotions and motivations for decision-making (behaviour selection) in autonomous agents and robots; emotion-based learning of affordances in autonomous robots; the evolution of emotional expression and behaviour in artificial agents; the development of affective bonds in artificial social groups; and expressive robotic heads for the study of emotion development and social interactions. Related aspects of research into socially intelligent agents led by Prof. Kerstin Dautenhahn include empathy, learning by imitation, autobiographical memories, social robots, and narrative intelligence. Relevant externally funded projects are VICTEC (EU FP5-IST), investigating the use of empathic virtual characters to remedy bullying in schools, and AURORA (UK EPSRC), exploring the use of robots as social partners for autism therapy. Associated to the group is an Interactive Systems and Robotics laboratory that is particularly suited for experiments involving physical robots; the laboratory

is currently equipped with small-sized robots of various types (e.g., Khepera, LEGO Mindstorms, Koala).

ISTITUTO TRENINO DI CULTURA (ITC-IRST)

The Centre for Scientific and Technological Research (ITC-IRST) aims towards the solution of real problems driven by the need for technological innovation in the economic world. The centre is a point of reference in a scientific panorama collaborating with numerous and prestigious national and international research institutions. Activity at ITC-IRST on emotions is dealt with by the Cognitive and Communication Technologies Division. The research activities of TCC include natural language-based dialogue; natural language generation; information extraction from texts; question answering; development and maintenance of linguistic resources; multimedia and multimodality. Specifically ITC-IRST has focused on a number of emotion studies, with a constructive-experimental perspective. They include work on computational generation of humorous expression, work on modeling persuasion mechanisms, and their role in future interfaces, work on multimodal interfaces that display emotion, such as synthetic faces and speech, work on emotion recognition in language. Members have wide experience in EU funded projects (3rd, 4th and 5th funded Frameworks

Universite de Paris VIII (Paris 8)

The IUT of Montreuil is part of the University of Paris VIII. The “technologies and communications” research group (<http://www.iut.univ-paris8.fr/>), from the LINC-Paragraphe laboratory, was created in April 2000 at the IUT of Montreuil. Research is focused around two main themes: communication and technology. The goal is to define paradigms and interaction models for human-machine communication. In particular the group is interested in defining the necessary bases for a personalized and adapted interaction to each user’s need; that is an interaction in which the content of the information presented to the user is adapted to his/her needs and capacities through the means of adaptive hypermedia and embodied conversational agents. The approach undertaken by the research team is pluri-disciplinary by nature and is based on various fields: heterogeneous databases, computer vision, decision making, fuzzy logic, multi-modality, hypermedia, conversational agent. Several tools have and are being developed to achieve such a goal, namely: representation language of multi-modal behavior, quantification of multi-modal behavior using linguistic values, representation of gesture expressiveness. The group have also developed a platform for creating and animating embodied conversational agents.

OESTERREICHISCHE STUDIENGESELLSCHAFT FUER KYBERNETIK (OFAI)

The Austrian Research Institute for Artificial Intelligence (OFAI) was founded in 1984 and has high international standing. It has a longstanding focus on emotion: in mid-1990, the director of OFAI, Prof. Trapp, selected emotions as a central topic of research. Activities now reach from academic teaching (with compulsory lectures on Emotion in the new Medical Curriculum at the University of Vienna being delivered by OFAI staff); through development of cognitive models and applications of these models in different areas of human-computer interaction; to the development of innovative practical engineering solutions for adaptive and learning systems utilising the Emotional as an inspirational role model. OFAI is represented in the International Society for Research on Emotions (ISRE) by Dr .Paolo Petta.

Completed major funded projects include the “Development and Deployment of Intelligent Systems with Emotional Components” (Austrian Ministry of Science and Transportation, 5FP IST project SAFIRA (Supporting Affective Interactions in Realtime Applications); 5FP IST project NECA (Net Environment for Embodied Emotional Conversational Agents), as well as “Computer-Based Musicology: Studying the Phenomenon of Musical Expression with Artificial Intelligence Methods” funded by the START programme of the Austrian government

KUNGLIGA TEKNISKA HOEGSKOLAN (KTH)

The INVOLVE group at the department of Computer and Systems sciences at Stockholm University/Royal Institute of Technology, is a newly formed group. Kristina Höök started to work at the department as a full professor February 2003 and has three PhD students enrolled in the group so

far: Petra Fagerberg, MSc in Computer Sciences from KTH, Anna Ståhl, MSc in interaction designer from Umeå design school, and Jarmo Laaksohanti, PhLic in Computer and Systems sciences. The focus is on social and affective interaction and narrative intelligence. Kristina Höök previously headed the HUMLE laboratory at SICS where her work centred around user-centred design of social navigation and affective interaction systems. In terms of affective interaction and emotions, she has had a special focus on user studies of such systems. Kristina Höök has worked in the EU-funded SAFIRA project and headed the EU-funded PERSONA

UNIVERSITAET AUGSBURG (UA)

The Lab for Multimedia Concepts and its Applications at Augsburg University is part of the Institute for Computer Science and focuses on affective interfaces, multimedia communication, conversational agents, user modelling, and user motion tracking. To build interfaces that allow for more natural and enjoyable communication between humans and computers, researchers follow a highly interdisciplinary approach that involves not only computer scientists, but also designers, electrical-engineers and cognitive scientists. The Lab has an international profile, having organised a number of international events, such as the ISCA Tutorial and Research Workshop on Multi-Modal Dialogue in Mobile Environments (IDS 2002), the Second Conference on Computational Semiotics for Games and New Media (COSIGN 2002), and a Dagstuhl Workshop on Evaluating Conversational Agents which will take place in early 2004. Strong national and international co-operations with various industrial partners, such as Honda or Siemens AG, in the area of affective virtual characters enhance the competencies of the team.

UNIVERSITA DEGLI STUDI DI BARI (DI-BARI)

<http://aos2.di.uniba.it:8080/IntInt.html>

The Intelligent Interfaces group works in the area of user-adapted interaction. They have studied how computer users may be described in models that are revised dynamically and how computer messages may be generated automatically, by adapting to individual and group characteristics of users. Uncertainty and incomplete knowledge and formal methods to represent and reason on it are the key issues considered. As far as the type of message is concerned, they have dealt with natural language texts, hypermedia and dialogs with Embodied Conversational Agents. The following are ongoing research projects - a cognitive model of mixed emotion activation, which considers how personality and context factors may influence endogenous and exogenous triggering of emotional states; a model of 'natural' argumentation, in which non-strictly rational factors (such as 'deception' and 'emotional state of the two interlocutors') are considered, to study how they affect the argumentation strategy selected and its formulation in natural language; a model of how emotions affect the dynamics of belief and goal activation/deactivation and their prioritization, in emotional dialogs; a standard mark-up language to specify the connection between message content and the way the message should be expressed (in natural language texts or through body signs of ECA); a study of how emotions affect interaction in ubiquitous and mobile computing contexts. The group has a strong interdisciplinary outlook, and have established long-standing cooperations with psycholinguists (to develop inner models of human reasoning), linguists and experts in computer graphics. They have worked with the Experimental Psychology group in the University of Reading to develop studies according to an 'iterative design' method, by performing periodical evaluation studies.

ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE (EPFL)

The Virtual Reality Lab (VRlab), at the Swiss Federal Institute of Technology in Lausanne (EPFL) was created in July 1988 and is directed by Professor Daniel Thalmann. The laboratory includes a staff of 35 people. This group is a world-leading pioneer in research related to Virtual humans since its creation. Focus is on the Modeling and Animation of Interactive and Intelligent Virtual Humans. The user will be able to interact with these intelligent creatures in Virtual Reality and Augmented Reality. More advanced models are being developed for group behaviour, crowds modelling especially in emergency situation, social behaviour, and interaction with Virtual Humans. One challenge is to include all these aspects not only in Virtual Environments but also in Real Environments using Augmented Reality methods. Finally, the group's ultimate research objective is the simulation of

Virtual Worlds inhabited by a Virtual Human Society, where agents will co-operate, negotiate, make friends, communicate, group and ungroup, depending on their likes, moods, emotions, goals, fears, etc. VRlab has a strong international cooperation through several European projects in the areas of Virtual Reality, shared environments, Computer Animation, and Medical applications, and is also involved in 4 national projects.

FRIEDRICH-ALEXANDER UNIVERSITAET ERLANGEN - NUERNBERG (FAU Erlangen)

The Institute for Pattern Recognition at the University of Erlangen-Nürnberg has been working for over 25 years in the area of speech analysis. The Institute is part of the Department of Computer Science within the Faculty of Technology, and consists of a scientific staff of 24 persons, one assistant professor, two associate professors and one full professor. The Institute has a strong record in speech analysis and was centrally involved in the major European Vermobil project. Verbmobil was the first complete speech understanding system which demonstrated the benefit of prosodic information, and the Institute implemented the prosody module. The Institute also developed a shallow semantic analysis module (dialogue act segmentation and classification) within the Verbmobil project. Based on the technology of the Sundial project (ESPRIT project P 2218) members also presented the first conversational dialogue system worldwide hooked up to the public telephone system. Staff are currently working on the detection of emotion: Within the SmartKom project and the EU-project PF-STAR, they are carrying out research on the detection of the emotion of the user, using prosodic/linguistic information as well as facial expression.

UNIVERSITA DEGLI STUDI DI GENOVA (DIST)

The InfoMus Lab, established in 1984 as a part of DIST (Dept of Communication, Computer, and Systems Sciences of the University of Genoa, Italy), carries out scientific research, and design, development and experimentation of multimedia systems for music, dance, theatre, edutainment, museums and cultural institutions (eg science centers). The main research issues include computational models of non-verbal expressive communication with special focus on movement (e.g. dance, full-body movements) and audio (e.g. music), expressive multimodal interfaces for music and performing arts (e.g., dance, CVEs, MR), musical informatics, artificial intelligence and software engineering. The InfoMus Lab also develops multimedia systems for the testing and experimenting of research outputs in real application scenarios with industry, artistic institutions, museums and science centres. The team is widely experienced in major collaborative projects. Research projects related to the HUMAINE proposal include the EU ESPRIT BRA Project MIAMI (Multimodal Interaction for Advanced Multimedia Interfaces),; the Kansei Information Processing (1998): joint research project with Waseda University, Tokyo, on MR applications for interactive museums exhibits involving human-robot multimodal interfaces, the EU IST Project MEGA (Multi-sensory Expressive Gesture Applications 2000 - 2003), which developed the EyesWeb open software platform, the EU IST Project CARE HERE (Creating Aesthetically Resonant Environments for the Handicapped, Elderly and Rehabilitation), the EU TMR MOSART Project (Network of Excellence on "Musical Informatics"); and the COST ConGAS (2003-2005) on research on Gesture in Music Performance.

UNIVERSITY OF HAIFA (HU)

The Center for Interdisciplinary Research of Emotions, founded in 1998, aims to further systematic, integrative, and in-depth understanding of feelings. Research will synthesize work in a wide array of disciplines: philosophical and literary analysis, anthropological observation, psychological and psychiatric research and experimentation, biological investigation and physiological assessment, historical inquiry, and artistic investigation. Behavioral and humanistic research will complement each other in the effort to illuminate the causes, determinants, and consequences of emotional expression and behavior in a variety of social and cultural contexts. The research group attached to HUMAINE focuses on two topics - an integrative framework for describing emotions; and emotions on the Internet. The group aims to investigate whether an emotion can be considered as a general mode (or style) of the mental system. The integrative framework will then be applied to describing emotions in cyberspace. The present project focuses upon a few central emotions that occur in cyberspace, and in

particular romantic love and sexual desire. The nature of these emotions in cyberspace will be examined and compared to their counterparts in offline circumstances.

IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE (Imperial)

Imperial is an internationally recognised centre of excellence for teaching and research, and embodies and delivers world class scholarship, education and research in science, engineering and medicine, with particular regard to their application in industry, commerce and healthcare. The Intelligent and Interactive Systems (IIS) group is part of the Department of Electrical and Electronic Engineering (DEEE) which has approximately 680 students of which approximately 105 are PG research students. The IIS group focuses its research interest on the field of Agent Technology and its applications. Applications which are given particular attention are that of embodied agents, real-time affective interactions, affective ware and context-aware systems, in particular relating to user context and its role in service/interaction personalisation and adaptation. The group has been heavily involved in the analysis and design of enabling technologies to support real-time socially intelligent agents with affective behaviour, synthesis and control. The research group led by Professor Mamdani has considerable research experience contributing in both depth and breadth in designing, developing and deploying agent technology, Multi-Agent systems, personalised agents and artificial intelligent solutions in new service provision. Specific experiences that will help in contributing to the success of the HUMAINE NoE are: KIMSAC (ACTS 030), FACTS (ACTS 300171), MAPPA (ESPRIT EP28831), SAFIRA (IST-1999-11683) SoNG (IST 10192-1999), NexTV(IST-2000-28298), ISIS (IST 2001-37253) and MUFFINS(IST-2001-37248). Participation in these projects brought IIS expertise in the following: :Design of character representation and scripting languages for the integration of multimedia with software agents, Human agent interaction, User modelling and information personalization., Multimedia access through personal persistent agents for agent visual personalisation and animation to achieve affective computing., Design and implementation of embodied agent for real-time affective interactions, Design and implementation of wireless, non-invasive affectiveware for sensing and measuring user physiological changes, Integrating multi-agent systems with an MPEG-4 end-to-end system, Context-awareness, Business Models investigation.

INESC ID - INSTITUTO DE ENGENHARIA DE SISTEMAS E COMPUTADORES: INVESTIGACAO E DESENVOLVIMENTO EM LISBOA (INESC-ID)

INESC-ID, which in Portuguese stands for Institute for Systems and Computer Engineering: Research and Development is a not-for-profit institution dedicated to research in the field of information technology, electronics and telecommunications. Researchers at INESC-ID are in their vast majority university staff and graduate students. INESC-ID initiated activity in the year 2000 as a result of a reorganization of INESC. The former research groups of INESC have been congregated to form INESC-ID, who is owned in large part by IST (a science and technology school of the Technical University of Lisbon) and INESC. An application for INESC-ID to be recognized as a public utility institution has been filed, and is currently being evaluated. The principal objectives of INESC-ID are to conduct cutting-edge research in the fields of information technology, electronics and telecommunications, and to transfer technology to the industry by means of R&D contracts and training courses. The **Group of Intelligent Agents and Synthetic Characters (GAIPS)** of INESC-ID is a world recognized research group in the area of synthetic characters and affective interactions. One of the primary aims of the group is to research and develop systems where affect play a role in the interaction with humans, in particular for learning or entertainment applications, based on multi-agent architectures. The group GAIPS has 18 people (working on several aspects of intelligent agents and affective interactions). The group has been involved in several different projects in the area of affective interactions in particular the projects COLDEX (IST, V Framework), VICTEC (IST, V Framework) and SAFIRA (IST, V Framework), where INESC-ID was the prime contractor.

KING'S COLLEGE LONDON (KCL)

Kings College London brings together individuals of high international standing from very different disciplines. John Taylor (Dept of Mathematics) has had a distinguished career in neural nets, and is now engaged in neural modelling of higher order cognitive processes including consciousness and

multimodal nets for action, emotion and early processing. He is currently involved in two EU funded projects under the IST 5th Framework – ORESTEIA (as part of the Disappearing Computer Initiative) and ERMIS. Jeffrey Gray is a well-known academic attached to the Institute of Psychiatry at KCL. Recent experimental MRI strategies employed at the Institute allow precise examination of the cognitive processing involved in the generation and perception of emotion. Peter Goldie is a member of one of the UK's most prestigious philosophy departments (at KCL). His main philosophical interests are in ethics and the philosophy of mind, and increasingly in aesthetics. He has an enduring interest in emotion and character.

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE (CNRS)

The research group at CNRS bring to HUMAINE expertise in multimodal communication and in spoken language processing. Research on multimodal communication includes typologies of cooperation between modalities, creation / annotation / analysis of corpora of multimodal human-human and human-computer interactions, design of bi-directional multimodal interfaces featuring cooperation between input modalities (e.g. speech and gestures) and output modalities (e.g. specification of 2D embodied conversational agents including emotional tags), and application to user interfaces for autistic people. Research on spoken language processing includes the creation and annotation of spoken dialogs and the design of spoken interactive systems, and the question of perceptual detection and prosodic cues analysis of emotional behavior in a spontaneous speech corpus of real Human-Human dialogs. Future plans concern the relations between emotions and spoken / multimodal behaviors, including the following directions: survey of spoken and multimodal cues of emotional state, creation of multimodal human-human and human-computer corpora including real human-computer interactions / emotion eliciting protocols / theatre / movie samples, specification of mark-up language for the annotation of emotions, use of cues in the multimodal behavior for easing the annotation of emotion in speech, produce knowledge out of multimodal corpora analysis for both the automatic analysis of emotions in user's behavior, and the synthesis of multimodal emotional behavior in embodied agents. LIMSI-CNRS has been involved in several projects such as IST ISLE (International Standards for Language Engineering: annotation of multimodal behavior), IST NICE (Natural Interaction with Computers for Edutainment: multimodal embodied agents for a game application), IST Amitiés (Automated Multilingual Interaction with Information and Services: creation of a corpus of real agent-client dialogs at a Stock Exchange Customer Service Center).

THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF OXFORD (UOXF.CQ)

The University of Oxford is consistently rated as one of the UK's top academic institutions and a premier world institution. Research on emotion is carried out in the Department of Experimental Psychology which received a 5* - the highest possible grade – in the UK 2001 Research Assessment Exercise. Brian Parkinson and Edmund Rolls are recognised as leading international figures in the psychology of emotion. Brian Parkinson is part of the social psychology group at Oxford University which has long been central to research on interpersonal interaction and emotion. His expertise is in emotions in communication and social life. He has led research on affect regulation and the videomediated communication of emotion. He is currently working on a project which assesses the impact of video mediation on real-time emotion-related interpersonal exchanges. Edmund Rolls E. T. Rolls has a research group performing a coordinated approach to the brain mechanisms of emotion using single neuron neurophysiology, neuroimaging, clinical neuropsychology and computational approaches. Parkinson and Rolls are authors of some of the leading books in the psychology of emotion.

THE UNIVERSITY OF SALFORD (USAL)

The Centre for Virtual Environments at the University of Salford is a growing centre with an international reputation (recently awarded a 5* grade - the highest possible grade – in the UK 2001 Research Assessment Exercise). Research is focused on the application of Virtual Environments to a variety of domains, including engineering, construction, medicine and virtual agents. The Agents group at CVE is working in the area of Intelligent Virtual Agents (or synthetic characters). The focus

of the group is on adding intelligence to virtual environments, especially in the form of intelligent embodied agents or synthetic characters. Affective systems and their role in agent architectures and emergent narrative in VEs are topics of current interest. The group plans to take the systems it is building for VEs into the real world using augmented and mixed reality technologies and linking with ambient computing technology for which synthetic characters can provide a strategic interface. The group is led by Professor Ruth Aylett and has wide experience of major funded projects including EU 5th Framework (DIVERCITY, FutureHomes and VICTEC) and UK national grants including a 1.7 million GBP award for the North West Virtual Prototyping Centre. It was a member of the EU Framework V Networks of Excellence AgentLink II and PLANET II.

TEL AVIV UNIVERSITY (TAU)

The group is centered at the Department for Communication Disorders, Tel Aviv University. Members are engaged in a number of ongoing research subjects related to the expression of emotion in speech and its manifestation in physiological measurements. The group also have particular expertise in data collection. They have put together a number of corpora of emotional speech, including a corpus recorded during event recollection, a corpus of anger in naturally occurring Hebrew speech and a corpus of sentence utterances recorded during a computer game that includes various degrees of risk, with the final objective of gaining a sum of money. In the latter, speech was recorded simultaneously with a number of physiological parameters. Acoustic analysis is being carried out.

THE PROVOST FELLOWS AND SCHOLARS OF THE COLLEGE OF THE HOLY AND UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN (TCD)

The TCD group has a particular focus on voice quality and its role in communicating emotion, mood and attitude. The group has been to the forefront in developing novel techniques to enable acoustic voice analysis and has carried out numerous detailed analyses of voice source variation. Its work includes perceptual experimentation using synthesised voice qualities to explore the mapping of voice quality to affect. Research is also oriented towards the provision of better voices in synthesis, capable of better approximating the richly varying human voice source. From this work has developed an interest in the interaction of voice quality and pitch. It is hoped to work towards a new model speech prosody, which encompasses voice quality as well as pitch parameters, and which places the communication of affect at the centre of prosodic function. The group also has a strong interest in the Irish language, and hopes to embark on comparative work on the prosody of affect in Irish and English. Funding for a three-year project on Irish prosody has recently been awarded (funded by the Irish Research Council for the Humanities and Social Sciences , IRCHSS). The group have been partners in a long list of major European and national funded projects and networks including EU funded COST 258 (2000-2001): *The naturalness of synthetic speech*, SPACT, phase 1 and 2 (1995-1998): *Application of speech recognition/synthesis technology in the MIR space station* (funded by the European Space Agency), EU funded VERIVOX (1997-1998): *Voice variability in speaker verification*, CABÓG (1993-1996): *A development system for Irish text-to-speech conversion* (funded by ACCUTRON, Limerick and the Irish-American Foundation), . EU funded ESPRIT/BRA project SPEECH MAPS (1992-1995): *Sound-to-gesture inversion in speech*, EU funded ESPRIT/BRA working group VOX (1992-1995): *The analysis and synthesis of speaker characteristics*, and EU funded ESPRIT/BRA project working group ACCOR I and II (1989-1995): *Articulatory-acoustic correlations in coarticulation*

LA CANTOCHE PRODUCTION (CANTOCHE)

Since 1996, Cantoche has been singled out as one of the world leaders in the animation of interactive characters. Cantoche is grounded in two unique areas of expertise: the artistic field for the creation and animation of characters, and the software development, with its proprietary Agent technologies, Living Actor. More than 100 different characters have been created by Cantoche. For instance, interactive characters such as Victor (for Hewlett-Packard) and Margarite (for Gateway) reside within the computer's operating system helping software, while characters such as Laure and Thomas (Gan Prévoyance) and Méthanie (Gaz of France) can be met on the Internet. Cantoche has also created Bugs Bunny and Daffy Duck characters for Warner Bros CDROMS applications, and the interactive Qmark,

which resides directly within the Microsoft Windows XP operating system. Cantoche have been making great strides toward the integration of a Behavioral Intelligence Engine in the heart of the Living Actor™ technology. This revolutionary system will make it possible to give greater autonomy to the interactive actor, who will automatically create his own behaviors adapted to his texts and messages, in real time. The character will then be sufficiently intelligent to automatically represent his dialogue in gestures, attitudes, and expressions.

FRANCE TELECOM SA (FTRD)

France Telecom R&D is working with numerous partners including universities and manufacturers from all over Europe on over 100 co-operative research projects, which are partially financed by the European Union. These projects are part of the ACTS, ESPRIT and TELEMATICS programs. In the field of human interactions (Human Interaction Division), the multiplication of telecommunications services should result in a radical simplification of their utilization, rather than leading the user into a world where technology would be all-powerful. Exploratory research and studies are conducted upstream in all areas connected with human interaction, i.e. images, movement, sound and voice. Communication habits and modes are analysed to determine basic trends and their evolution. The services of the future are envisioned and invented by working with customers in creativity workshops. Then, those services are tested with groups of users in order to ensure relevance and quality. The following aspects are systematically considered: human interaction, ergonomics, quality and user-friendliness in the access to and the utilization of those services. Moreover, great research efforts are undertaken in order to humanize man-machine interfaces. One aspect of this research is related to emotion and expressiveness. Currently, FTR&D participates in the IST ERMIS project devoted to "Emotionally Rich Man-machine Interaction Services" and two PhD theses dealing with emotion and expressiveness in vocal services are in progress.

T-SYSTEMS NOVA GMBH (TSN)

T-Systems is a division of Deutsche Telekom. The company has a strong research programme which aims to create new solutions for today's marketplaces, as well as developing next-generation models for the telecom, IT and convergence markets of the future. The research group consists of approx. 10 experts from different fields of work (phoneticians, psychologists, speech synthesis and recognition experts, computer scientists, natural dialog specialists) who are working together on emotional human-machine communication. The work will lead to the development of a demonstrator application - an intelligent tutoring system (ITS) in form of an autonomous agent with avatar interface that accounts for users' emotions, has internal emotional states that influence selected action and expresses emotional output. The group bring a valuable market interest and experience to the network through their technology scouting, market scans and usability studies for systems with emotional interfaces.

INSTITUTO SUPERIOR TECNICO (IST)

IST (Instituto Superior Técnico) is a large Engineering Faculty of the Technical University of Lisbon created in 1911. The University has over eight thousand students in several different areas of engineering and in two different campuses. The research and development activities at Instituto Superior Técnico are mainly carried out within Institutes, Departments, Centers and research Groups that integrate teaching and research staff allocated to the various departments of IST. Some of these R&D units are financed by the Ministry of Science and Technology and subject to a periodic scientific evaluation carried out by a panel of well-known international experts. The Department of Informatics at Instituto Superior Técnico was created in 1997 and has around fifty lecturers in several different areas. The area of Intelligent Agents and Synthetic Characters in the Department is coordinated by Prof. Ana Paiva. The primary aim of her group is to research and develop systems where affect play a role in the interaction with humans, in particular for learning or entertainment applications, based on multi-agent architectures.