INFORMATION SOCIETY TECHNOLOGIES (IST) PROGRAMME

Contract for:

Concerted Action / Thematic Network

Annex 1 – "Description of the Work"

Project Acronym:	ECVision
Project Full Title:	European Research Network for Cognitive AI-enabled Computer Vision Systems
Proposal / Contract No.:	IST-2001-35454
Related to other Contract no.:	

Date of Preparation of Annex 1: 8 February 2002

Operative Commencement Date of the Contract:

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1 Project Summary

A2. Cost Summary in Euro (22) (part 1/2)

Participant Role (23)	Participant No (2324)	Member linked to Contractor No.	Participant Short Name (25)	Number of person/months (26)	Number of person/months (26) Sub Total	Personnel Costs (26)	Personnel Costs (26) Sub Total	Travel and Subsistence (26)	Travel and Subsistence (26) Sub Total	Computing (26)	Computing (26) Sub Total	Subcontracting (26)	Subcontracting (26) Sub Total	Subtotal part 1/2	Subtotal part 1/2 Sub Total
CO	1	0	CAPTEC	82.1		564,292		316,500		12,000		0		892,792	
			TOTAL	82.1		564,292		316,500		12,000		0		892,792	

A2. Cost Summary in Euro (22) (part 2/2)

Participant Role (23)	Participant No (2324)	Member linked to Contractor No.	Participant Short Name (25)	Subtotal of part 1/2	Subtotal of part 1/2 Sub Total	Other Specific Project Costs (26)	Other Specific Project Costs (26) Sub Total	Overhead Costs (26)	Overhead Costs (26) Sub Total	Total Costs (27)	Total Costs (27) Sub Total	Requested Contribution from the Commission (28)	Requested Contribution from the Commission (28) Sub Total	Advance payment (29)	Advance payment (29) Sub Total
CO	1		CAPTEC	892,792	892,792	87,708	87,708	196,100	196,100	1,176,600	1,176,600	1,176,600	1,176,600		0
			TOTAL	892,792		87,708		196,100		1,176,600		1,176,600		0	

2 Project Objectives

2.1 Project Goal

The principal goal of ECVision is to promote research, education, and application systems engineering in cognitive AI-enabled computer vision in Europe through focussed networking, multi-disciplinary peer-interaction, targetted identification of priority issues, and wide-spread promotion of the area's challenges and successes within both the academic and industrial communities.

2.2 Project Objectives

The project goal can be realized by achieved by setting up and running a research network with the following objectives:

- Bring together the currently disparate community of researchers in Europe, by consolidating the existing computer vision community and by incorporating research workers in relevant areas of artificial intelligence;
- Raise the profile on this somewhat-neglected and strategically-important area of vision research through programmes of education, training, and information dissemination in journals, conferences, the internet, & the media;
- Create a catalyst by which the distinct efforts in innovation of individual research teams can be amplified by mutual interaction with their peers both at focussed workshops and using a dedicated network information infrastructure;
- Provide a forum for technology transfer with industry by highlighting current capabilities and application successes;
- Provide a vehicle whereby application-oriented requirements can be used to constructively drive research goals; and finally,
- Maximize the effectiveness of future research by identifying a detailed research agenda, addressing basic scientific techniques, systems engineering methodologies, application requirements, computational architectures, and hardware infrastructure.

2.3 Operational Goals

These objectives will be accomplished through four main operational goals:

1. **Research Planning** – identify key challenges, problems, and system functionalities so that the community and the EC can target the critical areas efficiently and effectively. In doing so, ECVision will develop a 'research roadmap' which will identify the key challenges and priority topics, together with plans and timescales for attacking them.
2. **Education and Training** – identify and develop courses, curricula, texts, material, and delivery mechanisms; promote excellence in education at all levels, and foster exchange of ideas through inter-institutional interaction of staff and students.
3. **Information Dissemination** – promote the visibility and profile of cognitive vision at conferences and in journals by organizing special sessions, workshops, tutorials, summer schools, short courses, and by providing links to the work of those in the AI & Robotics communities.
4. **Industrial Liaison** – identify application drivers and highlight any successes, promote research trials, addressing all types of industries: games, entertainment, white goods manufacturers (*e.g.* vigilant appliances), construction (*e.g* smart buildings), medicine (*e.g.* aids for the disabled), *etc.*

In addition, the network will include two support activities:

1. Provision of an **Information Infrastructure** for both computer-supported cooperative work, *e.g.* discussion forums and email distribution lists, and for web-based dissemination of all material generated under the four areas identified above.

2. **Operational management** by a Network Coordinator and Area Leaders in each of the four areas above; these people will constitute the ECVision Executive Committee.

2.4 Project Outcomes

Many results will emerge in the accomplishment of these operational goals. These include:

Research Planning
- Development of position papers on untested theories or advanced ideas
- Contribution of position papers and white papers on research
- Organization of workshops
- Survey of advances in computer vision in the past ten years (to assist the AI community)
- Survey of advances in AI in the past ten years (to assist the computer vision community)
- Development of a research road-map

Education & Training
- Generation of a model curriculum for cognitive computer vision
- Contribution to a text-book on cognitive computer vision
- Contribution of courseware and/or course slides
- Generation of an encyclopedia of cognitive computer vision
- Contribution of M.Sc. and Ph.D. project proposals
- Sponsorship of Best Ph.D. prizes in Cognitive Vision Systems
- Organization of summer schools
- Organization of tutorials (*e.g.* at conferences)
- Identification and sharing of common development environments
- Contribution to VXL image understanding environment and/or the OpenCV library
- Short-term exchange/visits of research staff
- Short-term exchange/visits of post-graduate students

Information Dissemination
- Contribution of existing relevant publications, subject to copyright restrictions
- Contribution of research results (presentations, videos, …)
- Organization of special sessions at conferences
- Sponsorship of Best Paper prizes in cognitive vision systems at computer vision and artificial intelligence conferences
- Organization of special issues in journals and editing special issues of journals
- Contribution to an annotated bibliography with summary of papers
- Periodic distribution of web-site content on CD to all members (this is particularly important if and when high bandwidth data such as video sequences or large pdf files are placed on the site)

Industrial Liaison
- Development of a database of research profiles and application experience in the cognitive vision research community, indexed by application, R&D topics, and industrial sector.
- Creation of a directory of vision vendors, indexed by application, product type, deployed technology, industrial sector.
- Development of a database of application-motivated R&D problems and information on successful and unsuccessful approaches to solutions.
- Creation of a list of techniques and their usefulness (or not) in certain classes of problems.

- Sponsorship of Best Application Development prizes in Cognitive Vision Systems.

Information on the status and outcome of all of the foregoing will be hosted on the ECVision website (www.ECVision.org).

2.5 Measurement of Success

Normally, the success of an RTD project is measured by the manner in which it achieves or produces the deliverables specified in the workplan. Similarly, the ECVision workplan also identifies many useful tangible and intangible outcomes (*i.e.* deliverables) which can be used to assess the success of the network. *However, there is more to success than the completion of each task; real success would be to have these deliverables taken up and used by the community at large.* So, for example, the generation of a model curriculum in Cognitive Vision Systems may well be a very useful deliverable, but real substantive success would involve its widespread use by institutions around Europe and the launch of new courses or programmes on Cognitive Vision Systems. The same is true for many other deliverables.

Thus, we can see that there are two sides to the measurement of success: the delivery of deliverables and the take-up of deliverables. Whilst the consortium of network members is clearly responsible for the former (and will be reviewed accordingly on their performance), the latter is ultimately outside the control of the network. It can exert its best influences but if cannot enforce take-up. However, it can *measure* take-up. We propose to do this by performing annual audits on the incidences of usage or occurrences of cognitive vision systems in the following key indicators:

- Number of modules/courses being delivered on cognitive computer vision.
- Number of M.Sc. and Ph.D. students working on theses in the area of cognitive computer vision.
- Number of industrial applications incorporating some aspect of cognitive computer vision.
- Number of conference and journal papers addressing some issue in cogntive computer vision.
- Number of RTD projects active in the area of cognitive computer vision systems.
- Number of text-books on cognitive computer vision
- Number of research books of cognitive computer vision
- Number of sessions in conferences devoted to cognitive computer vision

Success metrics will be computed as the percentage increase in these indicators, taking the status quo at the launch of the network as the baseline.

In summary, the success of the ECVision network will be subject to quantitative assessment on two complementary bases:

1. The success of the network in production of the deliverables set out in this annex and measured by the conventional review process;
2. The success of the network in encouraging the take-up of these deliverables by the research and industrial communities and measured by the above metrics.

In essence, success can be measured by the extent to which ECVision helps create and develop a well-defined discipline of cognitive vision systems in Europe through the take-up and usage of the tangible outcomes of the network.

3 Participant List

Partic. Role*	Partic. No.	Participant Name	Participant Short Name	Country	Date enter project	Date exit project
C	1	Computer Applied Techniques Ltd.	CAPTEC	Ireland	1	36

*C=Coordinator

Note that CAPTEC is the only participant for contractual purposes only; please refer to Section 5.6 for a full list of the founding members of the network.

4 Contribution to Programme / Key Action Objectives

The IST 2001 Workprogramme, Section IV.2.1 – Real-Time Distributed Systems , Sub-section (ii) – Cognitive Vision systems, contains an action line "To develop robust cognitive vision systems acquiring and using knowledge for decision making. The focus is on adaptive systems, real time platforms and vision architectures permitting the development of computational frameworks, integrating multiple cues for scene modelling and capable of recognising large numbers of different objects. Approaches to achieving cognition such as temporal reasoning and incremental learning should be addressed". The ECVision network directly supports this action line, not as an R&D project, but as a support framework to maximise the likelihood of European success in the development of such systems. In this, it contributes directly to an important Workprogramme objective.

However, to see why such a network is required and to understand how it can achieve its goals, it is necessary to look beyond the workprogramme and to address three issues:

1. The nature of cognitive vision systems and how they differ from and complement conventional computer vision;
2. The reasons why we in Europe (or why anyone else for that matter) have not yet managed to develop cognitive vision systems;
3. The steps we can take to redress the situation.

Strictly speaking, these issues properly belong in Section 6: *Community added value and contribution to EC policies* and they will be dealt with in more depth there. Here, we will simply summarise the key points so that we can better judge the appropriateness of the objectives set out above and detailed in the workplan which follows in Section 9.

First, computer vision as it is practiced today is primarily concerned with acquiring knowledge about the physical organization of the constituents of a spatio-temporal world – one might call it *structural computer vision* – while *cognitive computer vision* is concerned with its purpose and behaviour in the context of a system's goal-oriented activity (see Section 6). As such, in addition to structural capabilities, cognitive vision implies functionalities for:

- Knowledge representation
- Learning
- Reasoning about events and about structures
- Recognition and categorization
- Goal specification

So, why do we need a research network on cognitive AI-enabled computer vision? We can take some pride in the fact that we have made significant progress in Europe in computer vision in the past fifteen

years. However, we also need to recognize that the successes we have achieved have principally been in low-level computer vision and these successes have not been won without casualties. We owe much to a strong focussed specialization in such areas as geometry, feature-extraction, and tracking. In this process of specialization, exposure to and expertise in the many other areas which are necessary to build complete vision systems has not kept pace. We can now do more low-level vision and we can do it better than ever, but we haven't made much progress in the development of a discipline of cognitive vision systems. *One of the primary goals of this network is to provide a forum and a pro-active catalytic mechanism to re-expose these critical systems-oriented areas and to promote research and development in them amongst the academic and the industrial communities.*

5 Membership

5.1 Eligibility for Membership

Membership of ECVision will be open to all research groups and companies in Europe (EU, affiliated states and candidate countries). Groups which are active in the area of cognitive computer vision can become members of the network through submission of an application to the Network Coordinator. This application will then be evaluated by the Advisory Panel and acceptance or rejection will be recommended, as appropriate; see Section 9.5 for a description of the management structure of the network.

5.2 Application for Membership

Applications for participation in network activities should as a minimum include information corresponding to the EU Membership Agreement and a summary of group activities, *i.e.*:

1. Name of group and its affiliation
2. Name of group leader
3. Brief (1-page) summary of current activities
4. Specification of expected contributions to ECVision
5. Specification of expected benefit from participation in ECVision.

5.3 Types of Membership

All members will be assigned either Ordinary Member status (OM) or Sponsored Member status (SM), depending on their level of activity in the network. Ideally, all members should have Sponsored Member status. Only sponsored members will be eligible to apply for limited (partial) sponsorship of their activities by the network. In the first instance, a small number of Sponsored Members will be identified and specific actions derived from the workplan will be agreed. Section 9.1 summarizes the proposed funding for specific actions.

Note that all members, including Ordinary Members, will receive sufficient sponsorship to allow at least one representative to attend a six-monthly network meeting (typically 1.5k € per year). The Coordinator and the Area Leaders are automatically assigned Sponsored Membership status, in the first instance. Members of the Advisory Panel are not automatically assigned Sponsored Membership status.

New members will be admitted on an on-going basis, initially with Ordinary Member status.

Since every technical area of cognitive computer vision is inter-related and is therefore relevant to all members, special interest groups will not be encouraged (apart, that is, from specific contributions to each of the target areas, Research Planning, Education and Training, Information Dissemination, Industrial Liaison)

Sponsored members will have to sign a membership contract with the Coordinator to be eligible for financial support. The CEC will be consulted on these matters prior to set up of new contracts.

Note that the organization of the network and the different rôles and responsibilities of the members are dealt with in a separate section in this annex (see Section 9.1.7 and 9.5.)

5.4 Assessment of Membership Status

The activities and performance of all Ordinary and Sponsored Members will be assessed by the European Commission on a six-monthly basis and their status will be re-designated on the basis of the member's performance in the previous six-month period.

Performance will be assessed primarily on the basis of their contributions to the network. Bearing in mind that contributions to the network should be visible and sharable by all other members, we will adopt a small number of simple metrics based on the member's contributions to the Network website (note that all contributions are moderated by the Network Coordinator):

- Number of lines of HTML contributed per month;
- Number of web-pages contributed per month;
- Number of PDF pages posted per month;

Whilst such a scheme may appear to be quite a blunt instrument, it should be remembered that any activity in which a member is engaged can (and should) be published on the website so that all other members can benefit. Exceptional contributions and circumstances will also be taken into consideration.

The assessment scheme will be administered as follows:

- The Network Coordinator (in his capacity as Data Administrator of the website) will summarise the performance of each member on the basis of a short submission by the member and on the basis of information provided by the webmaster (including quantitative values for each metric);
- The Network Coordinator will then forward these summaries to the European Commission, together with a set of recommendations;
- The European Commission will then decide on any change in membership status;
- The member will be informed of this decision;
- In the event of an appeal, the member or the Network Coordinator can submit additional data and request a re-examination of his or her case.

5.5 Funding of Members Activities

The following table shows the planned funding for the coordinator and the members over the lifetime of the project. Note that the coordinator budget includes network coordination, target area coordination (Research Planning), and information infrastructure.

Summary Budget				
	Year 1	**Year 2**	**Year 3**	**Total**
	€	**€**	**€**	**€**
Coordinator	99100	66700	66700	232500
Members	272400	237800	237800	748000
Coordinator Overheads	48980	35580	35580	120140
Member Overheads	25320	25320	25320	75960
Coordinator Total	148080	102280	102280	352640
Members Total	297720	263120	263120	823960
Overall Total	**445800**	**365400**	**365400**	**1176600**

5.6 List of Founding Members

Status*	Partic. no.	Participant name	Participant short name	Contact	Country
Network Coordinator					
SM	1	Computer Applied Techniques Ltd.	CAPTEC	David Vernon	IRL
Executive Committee and Area Leaders†					
SM	2	University of Bonn Institut für Photogrammetrie	UB	Wolfgang Förstner (EDU)	D
SM	3	INRIA Sophia Antipolis	INRIA	Monique Thonnat (IND)	F
SM	4	Institut National Polytechnique de Grenoble	INPG	Jim Crowley (INF)	F
SM	1	Computer Applied Techniques Ltd.	CAPTEC	David Vernon (RES)	IRL
SM	5	Royal Institute of Technology	KTH	Henrik Christensen (RES)	S
SM	6	University of Edinburgh	UEDIN	Bob Fisher (EDU)	UK
SM	7	PBConsulting Ltd.	PBC	Patrick Courtney (IND)	UK
SM	8	University of Sussex	UoS	Hilary Buxton (INF)	UK
Advisory Panel					
OM	9	University of Karlsruhe	UKA	Hans-Hellmut Nagel	D
OM	3	INRIA Sophia Antipolis	INRIA	Olivier Faugeras	F
OM	10	University of Genoa – DIST	DIST	Giulio Sandini	I
SM	5	Royal Institute of Technology	KTH	Jan-Olof Eklundh	S
OM	12	Microsoft Research, Cambridge & University of Oxford	Oxford	Andrew Blake	UK
OM	12	University of Oxford	Oxford	Mike Brady	UK
Members					
OM	13	Technical University of Vienna	TUV	Walter Kropatsch	A
OM	13	Technical University of Vienna	TUV	Markus Vincze	A
OM	14	Katholieke Universiteit Leuven VISICS & ETH-Z BIWI	KUL & ETH-Z	Luc Van Gool	B/CH
OM	15	University of Hamburg	CSL	Bernd Neumann	D
OM	16	University of Bielefeld	UNIBI	Gerhard Saegerer	D
OM	17	University of Erlangen	UERLN	Heinrich Niemann	D
OM	18	Max Planck Institute for Biocybernetics	MPIK	Heinrich Buelthoff	D
OM	19	University of Freiburg	ALU-FR	Bernhard Nebel	D
OM	20	Université Joseph Fourier Grenoble I	UJF	Catherine Garbay	F
OM	21	Ecole Nationale Superieure des Telecommunications	ENST	Henri Maitre	F
OM	22	University Strasbourg-I Louis Pasteur	ULP	Ernest Hirsch	F
OM	23	University of Utrecht		Jan Koenderink	NL
OM	24	Instituto Superior Técnico	IST	José Santos Victor	P
OM	25	ETH-Z, Perceptual Computing & Computer Vision Group	ETH-Z	Bernt Schiele	CH
OM	26	Ecole Polytechnique Federal de Lausanne	EPFL	Pascal Fua	CH
OM	27	University of Linköping	LIU	Gösta Granlund	S
OM	28	University of Leeds Computer Vision Group	UNIVLEEDS	David Hogg	UK
OM	28	University of Leeds Knowledge Representation Group	UNIVLEEDS	Tony Cohn	UK
OM	29	University of Manchester	ISBE	Chris Taylor	UK
OM	12	University of Oxford	OXFORD	Andrew Zisserman	UK
OM	30	University of Surrey	UniS	Josef Kittler	UK

*Status: OM: Ordinary Member, SM: Sponsored Member.

† Areas are: RES - Research Planning
EDU - Education and Training
IND - Industrial Liaison
INF - Information Dissemination (including Conferences and Publications)

6 Community Added Value and Contribution to EU Policies

6.1 Cognitive Vision – What is it and Why is it Important?

Apart from its role as a support mechanism for RTD projects under Section IV.2.1, Sub-Section (ii), of the 2001 IST Workprogramme, the ECVision network has a strategic importance in its own right. To see this, we need to address three issues:

1. The nature of cognitive vision systems and how they differ from and complement conventional computer vision;
2. The reasons why we in Europe (or why anyone else for that matter) have not yet managed to develop cognitive vision systems;
3. The steps we can take to redress the situation.

Before we say what is meant by 'cognitive vision', we first need to distinguish it from conventional vision. So, let's begin with a definition:

> *The goal of computer vision is to endow a machine with the ability to understand the structure and composition of its physical surroundings through the use of visual data: time-varying two-dimensional projections of light energy reflected off and radiated by the physical objects constituting the three-dimensional physical world.*

This apparently straightforward definition of computer vision side-steps one important question: What does it mean for a computer system (or any system) to 'understand' something? There are two possible answers, each giving a different interpretation of the concept of understanding in the context of vision.

The first interpretation, which we will refer to as structural vision, takes understanding to be the faithful 3-D reconstruction or inference of the physical world which gives rise to the flux of visible light-data that is sensed by the computer vision system. To understand in this sense means to know somehow, with minimal ambiguity, what spatial and temporal configurations of objects give rise to the sensed optical data. Unfortunately, this is a non-trivial problem because, among other things, the very process of sensing the ambient visible light radiation pattern is a projective process with an inherent loss of information. Nonetheless, this problem is tractable and has yielded some success, especially in scenarios that are sufficiently well constrained to satisfy the assumptions upon which a particular approach is based.

The second interpretation of the word 'understanding' goes much further and embraces the possibility of learning and inferring what the constituents of the physical world are used for. That it, it is explicitly concerned both with the structure of the spatio-temporal world and also with its potential purpose and intent. This information is used by the vision system in achieving its goals: that is, the learned 'understanding' is embedded in the context of the vision system's goal-oriented behaviour. Such an interpretation might be termed *cognitive vision*.

In essence, then, structural computer vision is concerned with the physical organization of the constituents of a spatio-temporal world while cognitive computer vision is concerned with its purpose and behaviour in the context of a system's goal-oriented activity.

Structural computer vision is in some sense a very difficult exercise in back-projection: given temporal sequences of 2-D images, reconstruct a plausible time-varying 3-D world model. In itself, this is a huge problem and it might seem foolish to compound it by wanting even more information on the purpose and behaviour of that world. However, this apparent foolishness is necessary for three compelling reasons.

First, There can be little doubt but that the ultimate priority of computer vision is cognition, because only through the realization of systems with such a capability can we fully integrate vision into complete robust intelligent physical systems which can act – and interact – as well as perceive.

Second, because the full-blown structural vision is so difficult (and often ill-posed), approaches tend to apply fairly strong constraints on the types of environment that can be handled by any given approach. This is significant because it usually means that such systems tend not to be re-configurable, robust, or adaptive to new unanticipated visual environments. And, when dealing with the uncertainty that is an inherent part of the real-world in which we live (and in which we hope such systems to operate), this can pose major problems.[1]

Third, it is plausible that we can achieve the goals of cognitive computer vision without actually solving the full structural vision problem – it may not be necessary to have a perfect reconstruction before we can achieve an understanding of organization, purpose, and behaviour of the perceived world. The very presence of cognitive capabilities may be able to compensate for some lack of structural functionality.

So, what are the core capabilities or attributes of a cognitive vision system? Cognitive vision implies capabilities or functionalities for:

- **Knowledge representation** of events and structures. Ideally, the representation should exhibit some form of object or category invariance with respect to events and/or vision system behaviour. Many of the representations in the past have either been too application-specific to be adaptable to general (*i.e.* unanticipated) scenarios or environments or they have been too abstract to be applied in any meaningful way.

- **Learning**. There are two aspects to learning. First, there is *learning to see* (*i.e.* learning about the perceived visual environment.) Second, there is *learning to do* (*i.e.* learning to act and/or learning to achieve goals). It is an open question as to whether both are necessary in a fully-functional vision system.

- **Reasoning** about events and about structures (or some unified combination of both). One might distinguish three types of reasoning: reasoning to facilitate learning, reasoning to facilitate recognition/categorization, reasoning to facilitate hypothesis formation (*e.g.* 'what-if' scenario evaluation to aid system planning).

- **Recognition and categorization**, *i.e.,* mapping to previously-learned or *a priori* embedded knowledge bases. The majority of vision systems today rely on recognition or classification to effect their goals. This makes them inherently application-specific and quite difficult to re-use. Systems are able to recognize instances of particular objects or events (a car or type of car, a table or type of table) rather than being able to identify objects or events as instances of a meta-level concept of car (or road-vehicle) or table (or object-supporting platform). Cognitive vision systems would ideally have this categorizaton capability. It is, however, a difficult issue because objects of the same category can have completely different visual appearances.

- **Goal specification**, *i.e.,* identification of required system behaviour (this is the very essence of application development). Goal specification does not mean simply identifying the required information transformation from sense data to symbolic description – it may well include this but this in itself is inherently insufficient for a cognitive vision system that will typically have a number of often conflicting goals.

Cognitive vision may also require some form of embodiment, autonomy, articulation, or agency but these are somewhat open questions (of exactly the kind that the ECVision will address).

[1] A common approach in machine vision, for example, is to engineer out the uncertainty so that the vision systems perform to their required specifications.

Finally, it is clear that a cognitive vision system should build upon resilient structural – or low-level – functionalities. These functionalities *do not* have to solve the full 4-D reconstruction problem or anything close to it, but they should yield essential 3-D structural information: for example, robust cue and feature extraction (including object segmentation) together with sensor fusion and geometrical analysis.

6.2 The Strategic Importance of ECVision

There are several reasons why we need a research network on cognitive AI-enabled computer vision.

First, and as we noted already, we have made significant progress in Europe in computer vision in the past fifteen years. However, we also need to recognize that the successes we have achieved have principally been in low-level computer vision and this success has not been won without casualties. We owe much to a strong focussed specialization in such areas as geometry, feature-extraction, and tracking. In this process of specialization, exposure to and expertize in the many other areas which are necessary to build complete vision systems has not kept pace. *One of the primary goals of this network is to provide a forum and a pro-active catalytic mechanism to re-expose these critical systems-oriented areas and to promote research and development in them amongst the academic and the industrial communities.*

Second, cognitive vision is a multi-disciplinary area, drawing for example on the disciplines of computer vision, artificial intelligence, cognitive science, and control and systems engineering. To be successful in addressing the problems of cognitive vision, we need a focal point, *i.e.* an identifiable and accessible scientific organization that will allow those who are most active in the area in Europe to exchange ideas and work together on issues that are not project-specific. One of the big difficulties facing the community is actually agreeing what are the scientific problems we face, an obvious precursor to finding solutions. This is also one of the main functions of the network.

In addition, we need a mechanism to promote the area in both the academic and industrial communities through, for example, fostering educational developments (as well as research developments) and bi-directional interaction with industrial interests. We need to engender a realization of the magnitude of the challenge and the potential for success among researchers and practitioners alike.

Why is a network of cognitive vision of strategic importance to Europe? As we have already noted, Europe has been traditionally strong in computer vision and even more-so since the re-emphasis on structural low-level computer vision. This is well-exemplified by the prominence of the European Conference on Computer Vision (ECCV) which in the ten or so years since its inception has become one of the top three events in computer vision worldwide, alongside the IEEE International Conference on Computer Vision (ICCV) and the IEEE Conference on Computer Vision and Pattern Recognition (CVPR). That it has established such a place without formal sponsorship of any kind by professional societies or funding agencies is a remarkable testimony to the excellence of its scientific standards and those of the European vision community. However, that said and with only a few exceptions, we in Europe have not been able to convert our scientific strengths into dominant commercial enterprise. Happily, no-one else in the world has either (yet). We would contend that this is in part due to the lack of development in the engineering science of vision systems, development which may require appropriate advances in high-level – cognitive – vision capabilities. The time is now right to redress this situation and ECVision can play an important part in this, thereby "strengthening the scientific and technological bases of Community industry and encouraging it to become competitive at international level, while promoting all the research activities deemed necessary" [Treaty establishing the European Community, Article 163].

7 Contribution to Community Social Objectives

Since this project concerns the creation of a thematic network of excellence and therefore by definition does not involve any actual development work, the contribution it will make to the community social

objectives will be indirect though the second-order effects it has on the community. That is, it will contribute by promoting, enabling, and enhancing the RTD and industrial exploitation activities of the community in the area, by developing the discipline through education and training, and by promoting the take-up of results through information dissemination and industrial liaison. Consequently, in this section we will focus on some examples of the potential impact of successful research in cognitive vision on members of society in Europe and world-wide so that we can better judge the second-order effects of ECVision.

Impact on Quality of Life, Health and Safety
Cognitive vision systems could be used for recording and interpreting the activities of people handling tools. This could then be applied in enhancing the efficacy of training, through the provision of appropriate trainee-feedback either using augmented reality equipment or via task simulation. It could also be used, for example, in the medical area as an aid to assisted-physiotherapy where the patients movements can be interpreted and assisted to varying degrees as the treatment progresses. Also in the medical field, this type of functionality can be used to provide a new generation of robotic camera to be used in assisting surgeons during live operations.

The development of quasi-autonomous mobility aids for the blind and the disabled – those with impaired but still-functional motor skills who need artificial assistance in achieving their transportation needs – would be significant for the further integration of such people into society in general.

Robust automatic surveillance systems will help improve levels of safety on the roads, in urban areas, and in the home. Crucially, situation assessment and behavioural modelling will allow such systems to alert relevant people to potentially dangerous conditions. For example, a baby-sitting surveillance system might be able to reduce the incidence of cot death by recognizing abnormal sleeping positions or patterns.

In hazardous environments that pose significant dangers to humans, for example when searching for hidden land-mines, the availability of an autonomous robotic system capable of navigating harsh terrains would contribute to the safety of all concerned.

Improving employment
Cognitive computer vision is an enabling technology that can facilitate the development of new applications and the enhancement of existing ones. As such, it will help create new opportunities for employment in the development and marketing of these new applications and systems. Note that this impacts not only the vision industry *per se* but also a much wider variety of companies that use advanced sensing devices. Thus it can contribute in several areas, from the service sector through to the production sector. Furthermore, it can improve the quality of the workplace for those in hazardous environments through the use of vision-enabled remote tele-operation.

Enhancing/preserving the environment and natural resources
The use of advanced computer vision and image processing can help in analysing the structure of un-cut logs in the timber industry, thereby minimising wastage through the use of optimal cut patterns.

Similarly, pollution can be identified in multi-spectral remote-sensed images, helping to manage and reduce the production of emissions.

The modelling of migratory habits of bird-life requires a significant amount of visual input from field visits. The use of cognitive computer vision could assist in this and make much more data available.

Computer vision systems can be used to develop virtual archives of artworks, sculptures, buildings, and other objects of archeological and historical importance. These archives have the dual benefit of allowing more people access to the artefacts whilst at the same time reducing their exposure to potentially damaging situations.

8 Economic Development and Scientific and Technological Prospects

This section addresses three related issues:

1. the potential of ECVision for creating added value in scientific research and development;
2. the potential for enhancing the competitiveness of European industry;
3. the plans for dissemination whereby ECVision will contribute to achieving this potential.

We will treat each of these in turn.

8.1 Added Value in Scientific Research and Development

The current strength in Europe in the field of computer vision has already been noted in this annex. Equally, the infancy of our abilities in the area of AI-enabled cognitive computer vision is clear (it must be emphasised that in this we are no different from the other global trading blocs). The development of a substantive research base in cognitive vision is something that will take considerable effort and can best be achieved by sharing expertise among the member states of the EU. Naturally, conventional collaborative RTD projects have a very significant role to play in this. *However, given that cognitive vision does not actually exist today as a well-defined widely-accepted discipline, a research network of excellence such as ECVision has a pivotal role to play in helping to define and create such a discipline through a consensus-driven process of peer-interaction among all the major players in Europe.* This is the super-ordinate goal of ECVision. Its activities in research planning, education, and training focus exactly on these issues. Furthermore, its activities in information dissemination and industrial liaison form a two-pronged approach to bringing this new discipline to the notice of the wider research community and to the companies who can benefit from it in enhancing existing products and in developing new products and markets. These dissemination plans are fully identified in the workplan.

8.2 Enhancing the competitiveness of European Industry

It has been established already in this annex that the development of products with adaptive robust capabilities for interpreting visual information, especially in unconstrained or every-day environments, is a key goal in all of the major global trading blocs, exactly because the potential for deployment and exploitation is so great. Consider, for example, embedded cognitive vision in domestic appliances which renders them vigilant to user requirements and able to interact naturally and robustly. Consider too the games industry, whose very success depends on creating real-time life-life artificial interaction. In the medical and remedial care industries, perceptual systems can be of tremendous benefit in aiding the independent mobility of the aged and infirm. These are just three examples but it is easy to find many other potential applications of AI-enabled cognitive vision systems:

- Driver support either for monitoring driver behaviour and signalling potentially-dangerous conditions or for fully autonomous control of vehicles;
- Recognition and interpretation of sign language for the aurally-impaired;
- Recognition and categorisation of normal and abnormal behaviours in security-sensitive environments;
- Third-umpire applications for the detection of fouls in many types of sport;
- Understanding of handwriting and hand drawings in communications;
- Counting persons at assemblies (on the street, concerts) both for security and advertising applications;
- Object manipulation in both domestic and industrial environments;
- Detection of ripe fruits and vegetables (edible mushrooms, for example);
- Detection of environmental pollution (use multi-spectral images).

The success we achieve in building a consensual research plan and a programme for education and training, and in having the broader research community take ownership of them, is a key component of the process of creating new enabling technologies for innovative product development. Hand-in-hand with the dissemination and industrial liaison activities, they form a platform from which we can maximise the impact of collaborative RTD by appropriately focussing our efforts.

In all of these areas, any progress achieved through ECVision will have a disproportionate multiplier effect, both on the technology and on the ultimate consumer market through our activities in industrial liaison.

It is imperative that Europe does all that it can to ensure that it has as much of a global competitive edge as possible. Individual RTD projects have an important role to play. However, their Community visibility is inherently limited and a network-based action concerned with the broader goals of establishing the discipline of cognitive vision and identifying the benefits of successful deployment of cognitive vision has an equally-important rôle in achieving long-term economic and S&T development in Europe.

8.3 Plans for Dissemination beyond the Network

Two of the four target activities identified in the workplan are explicitly concerned with the dissemination of the work of the network:

- Information Dissemination
- Industrial Liaison

At the risk of being repetitive, the following are extracts of the Workpackage Descriptions contained in Sections 9.3.3 and 9.3.4):

TA3 – Information Dissemination: Objectives

Gather information not included in the brief of the other Target Areas and coordinate the actual delivery to the community of all information gathered using all available media (electronic, paper, physical interaction at meetings).

TA3 – Information Dissemination: Description of work

There will be two principal lines of activity: information gathering and information dissemination.

Information gathering cover material not targetted by other Target Areas in Research Planning, Education & Training, and Industrial Liaison. Information dissemination will be achieved using three approaches, corresponding broadly to the use of electronic dissemination (ECVision website, electronic newsletter, CSCW interaction), paper-based dissemination (journals), and physical human interaction (conferences and workshops), respectively.

TA3 – Information Dissemination: Deliverables

TA3.1.n Electronic newsletter, published monthly (month n = 1, 2, …, 36)
TA3.2.n Database of existing relevant publications (in PDF or HTML), subject to copyright restrictions (month n = 6, 12, …, 36)
TA3.3.n Annotated bibliography of literature, with summary of papers (month n = 6, 12, …, 36)
TA3.4.n Database of research results (presentations, videos, …) (month n = 12, 24, …, 36)
TA3.5.n Periodic distribution of web-site content on CD to all members (month n = 12, 24, 36)
TA3.6.n Special sessions at conferences (month n = 12, 24, 36)
TA3.7.n Sponsorship of best paper prizes in cognitive vision systems (month n = 12, 24, 36)
TA3.8.n Thematic workshops (month n = 12, 24, 36)

TA3.9.n Special issues in journals (month n = 12, 24, 36)
TA3.10.n Focussed review papers in journals (month n = 12, 24, 36)

TA4 – Industrial Liaison: Objectives

The primary goal of the Industrial Liaison Target Area is to identify application drivers, highlight any successes that are known to exist or that arise over the lifetime of the network, and to promote research trials on industrially-motivated applications. A second goal is to ensure that both researchers and industrialists achieve mutually-consistent expectations of emergent technologies.

TA4 – Industrial Liaison: Description of work

The above objectives will be achieved through frequent bi-lateral meetings with representatives of vision system vendors and end-user application owners leading to the deliverables set out below.

TA4 – Industrial Liaison: Deliverables

TA4.1.n Database of research profiles and application experience in the cognitive vision research community, indexed by application, R&D topics, industrial sector; this database will be developed in concert with that of the Research Planning Target Activity (month n = 6, 12, …, 36)
TA4.2.n Directory of vision vendors, indexed by application, product type, deployed technology, industrial sector (month n = 6, 12, …, 36)
TA4.3.n Database of application-motivated R&D problems and information on successful and unsuccessful approaches to solutions (month n = 6, 12, …, 36)
TA4.4.n List of techniques and their usefulness (or not) in certain classes of problems (month n = 6, 12, …, 36)
TA4.5.n Sponsorship of Best Application Development prizes in Cognitive Vision Systems (month n = 12, 24, 36)

Finally, it is important to note that the success of the ECVision network will be subject to quantitative assessment on two complementary bases:

1. The success of the network in production of the deliverables set out in this annex;
2. The success of the network in encouraging the take-up of these deliverables by the research and industrial communities.

Please refer to Sections 9.5.7 and 9.5.8 (*Quality Assurance* and *Measurement of Success*).

9 Workplan

9.1 General Description

9.1.1 Action plan and time-table

9.1.1.1 Activities

The ECVision network will organize its work in four principal Target Areas (TAs). These are:

- **TA1: Research Planning**
  Identify key challenges, problems, and system functionalities so that the community and the EC can target the critical areas efficiently and effectively. In doing so, it will develop a 'research roadmap' which will identify the key challenges and priority topics, together with plans and timescales for attacking them.

- **TA2: Education and Training**
  Identify and develop courses, curricula, texts, material, and delivery mechanisms; to promote excellence in education at all levels, and to foster exchange of ideas through inter-institutional interaction of staff and students.

- **TA3: Information Dissemination**
  Promote the visibility and profile of cognitive vision at conferences and in journals by organizing special sessions, workshops, and by providing links to the work of those in the AI & Robotics communities.

- **TA4: Industrial Liaison**
  Identify application drivers and highlight successes, promote research trials, addressing all types of industries; games, entertainment, white goods manufacturers (*e.g.* vigilant appliances), construction (*e.g* smart buildings), medicine (*e.g.* communication and mobility aids for the disabled).

In addition, the network will include two distinct Support Activities (SA):

- **SA1: Provision of an Information Infrastructure** for both computer-supported cooperative work, *e.g.* discussion forums and email distribution lists, and for web-based dissemination of all material generated under the four areas identified above.

- **SA2: Operational management** by a Network Coordinator and Area Leaders in each of the four areas above; these people will comprise the ECVision Executive Committee.

ECVision will also include an Advisory Panel comprising senior figures in the research community who can offer guidance and strategic insight as and when required. Although the members of this panel won't be involved in the day-to-day operational management and coordination of the network, they will be consulted on issues of strategic importance.

ECVision will organize a six-monthly research meeting that will focus on each of the four target areas. These meetings will be an important opportunity for the cross-coordination between key-areas and interest groups, and the event will also feature the annual physical Executive Committee meeting. Major efforts will be made to ensure participation by Ph. D students and junior faculty to enable networking across institutions. The budget includes resources for the organisation of the event, partial reimbursement for participation (maximum 750€ / person) and invited speakers. Overall, these meetings account for 26% of the total budget.

9.1.1.2 Timing

All workpackages will be active throughout the lifetime of the project although the effort in some workpackages, e.g. SA1 and SA2, will be concentrated in the first year during the set-up phase.

9.1.1.3 Effort

Coordination
It is anticipated that, once the network in fully operational, the coordinator will need to spend about three months per year on the coordination of the network; more effort will be required at the outset to

ensure that all target areas are successfully launched. The Coordinating Contractor will ensure that the coordinator has no conflicting duties that would diminish his ability to devote the required effort to the network. For network coordination there is also need for secretarial assistance (3 man-months) for reporting, financial administration, reimbursement of network participants (the majority of travel/meeting reimbursements will be administered directly by the Coordinating Contractor.)

Target Areas
The leaders of the target areas will need approximately 1 month per year per area leader for the coordination of actions within the corresponding target area.

Each target area has several associated deliverables that will encapsulate the work of the members of the network in that particular area. For the most part, these deliverables will be based on *pro bono* contributions of the members. However, it is expected that several specific actions will be necessary in order to ensure a cohesive and comprehensive outcome. It is intended to award Sponsored Member status to those members who have demonstrated their willingness and ability to contribute significantly to the work of the network. Sponsored Members will be eligible to apply for funding by ECVision for well-specified actions which, among other things, contribute directly to the deliverables identified in this document. For the purposes of financial management, *notional amounts have been identified for a typical sponsored specific actions and a budget of €6000 has been allocated per action with four actions being funded per year per target area.* This is equivalent to in excess of three man-months of sponsored effort per target area per year. In this way, approximately 30% of the total budget of ECVision is directed at specific actions undertaken by Sponsored Members.

Applications for funding by a sponsored member will be administered by the Network Coordinator who will distribute them for review by the Executive Committee. Awards will be made on the recommendations of the relevant Target Area Leaders and subject to a majority agreement by the member of the Executive Committee. Where majority consensus cannot be reached, the Network Coordinator will have the casting vote.

A fixed upper limit of 750€ / person has been defined for reimbursement of travel, accommodation and subsistence for participation in network events.

In the following, we will describe the work to be done in each of the six workpackages. This is summarized in a workpackage list, a deliverable list, and a one-page summary of each workpackage.

9.1.2 Research Planning

9.1.2.1 Goals

As has been noted several times elsewhere in this annex, the main goals of the Research Planning Target Area are to identify the key challenges, problems, and required system functionalities of cognitive vision systems so that both the community and the EC can focus on the critical areas of research efficiently and effectively. It should be emphasised that the intention is not to co-ordinate research in cognitive vision in Europe but rather to build, by consensus, a picture of the current state-of-the-art in cognitive vision and to construct a 'research roadmap' which will identify the key problems and some potential avenues for attacking them. This roadmap will be multi-dimensional, addressing:

- Functionality (*e.g.* learning, spatial and temporal reasoning, recognition/categorization, representation, goal specification, cue extraction, cue integration, control & feedback issues …);
- Theoretical foundations;
- Algorithmic formulations and complexity issues;
- Implementation & systems engineering;

The construction of this road-map will be achieved using several mechanisms, including:

- Brain-storming workshops;
- Surveys of the scientific communities;
- An iterative process of peer-to-peer consultation, discussion, and synthesis.

Consequently, the road-map will be constructed in an incremental fashion and will yield several other contributing results.

It should be noted that the goal here is to try to leverage greater impact and effectiveness in European research through a shared strategic perspective on the challenges and key issues. We don't expect every member to subsequently adopt a homogeneous approach – such an outcome would be both counter-productive and highly undesirable – but we do expect that every member will achieve some new insights and expertise by participating and contributing to the network and that they will bring these to bear in the successful development on cognitive vision systems.

9.1.2.2 Outcomes

The following is a list of the expected outcomes of the network. Some outcomes will be generated incrementally over the three-year lifetime of the network and, thus, there will be a number of different versions, each being delivered at periodic intervals. This list is not exhaustive and it is likely that other results will arise throughout the lifetime of the network.

- Organization of workshops
  - Meetings focussed on individual areas
  - General brainstorming meetings

  All things being equal, these workshops will be held twice a year (*i.e.* months 6, … 36) with an additional kick-off meeting being held at the start of the project.

- Position papers setting out individual perspectives on cognitive vision. These will be produced on a periodic basis, as circumstances allow, but it is intended to produce at least two per year.

- Survey of advances in computer vision in the past ten years. This is intended to bring those in the AI community up to speed on the current state of the art. This should be produced as early as possible in the life of the network, and certainly by month 6.

- Survey of advances in AI in the past ten years. This is intended to bring those in the computer vision community up to speed on the current state of the art. Again, this should be produced as early as possible in the life of the network, and certainly by month 6.

- White papers on research

  - Overview of cognitive vision
  - Taxonomy of cognitive computer vision techniques
  - Implications for low-level vision
  - Implications for artificial intelligence
  - Implications for robotics
  - Market relevance of computer vision

  These will be produced on a periodic basis, as circumstances allow, but it is intended to produce at least two per year.

- Specification of benchmark applications

  The goal is help identify real practicable achievable applications which would crystalize the key issues in cognitive vision and which would exercise the core functionalities of a complete cognitive AI-enabled vision system.

  This will be produced by month 6.

- Research Roadmap addressing

  - Research priorities
  - Risks
  - Potential gains
  - Potential avenues of investigation

  This will be delivered incrementally, on an bi-annual basis, at months 6, 12, … , 36.

- Database of pan-European research activities and results, including:

  - Research staff
  - Centres and Laboratories
  - Particular areas of expertise
  - Problem areas addressed
  - Theories and techniques
  - Publications
  - Applications
  - Platforms

  This will be delivered incrementally, on an bi-annual basis, at months 6, 12, … , 36.

9.1.3 Education and Training

9.1.3.1 Goals

The principal goals of the Education and Training Target Area are

- to identify and develop model curricula, course texts and teaching material, and delivery mechanisms;
- to promote excellence in education at all levels, and
- to foster exchange of ideas through inter-institutional interaction of staff and students.

These goals will be achieved in stages. The first goal is the development of a model curriculum on cognitive computer vision. The achievement of this goal has the dual advantage of identifying the scope of the subject area and the agreement of a common framework for teaching it. In this endeavour we will follow the approach of the IEEE/ACM Year 2001 Model Curricula for Computing (see http://computer.org/education/cc2001/). This work will involve a considerable amount of interaction amongst the members of the network, both by electronic communication and at dedicated workshops.

Once we have agreed the model curriculum, we will develop appropriate teaching material. It can often be difficult to get people to contribute substantive content for teaching material to open web-based repositories because they are leaving themselves open to subsequent theft of their intellectual property. However, this problem can be alleviated considerably if the material is formally published. To that end, one of the most important goals of this area is the creation of what will hopefully become a standard textbook on cognitive vision. We intend to achieve this by asking members to contribute a chapter to the textbook and a full set of teaching materials.[2] These individual contributions can then be edited into a coherent whole. The text would follow the model curriculum quite closely.

Whilst the development of the curriculum and the textbook is in progress, existing material that members may wish to share will be made available on the network website and a comprehensive list of the teaching programmes of all members will be compiled and published on the website.

There are also other aspects to education and training, particularly at the post-graduate level. The network will part particular attention to the development of this area through the organization of tutorials and summer schools, by sharing ideas for research projects and sharing development platforms, by awarding prizes for post-graduate research, and by supporting short-term exchanges of people (staff and students).

9.1.3.2 Outcomes

- Generation of a survey of existing courses on cognitive computer vision
- Generation of a model curriculum for cognitive computer vision
- Generation of a textbook on cognitive computer vision, published either in paper or electronic form.
- Contribution of courseware and/or course slides
- Generation of an encyclopaedia of cognitive computer vision
- Contribution of M.Sc. and Ph.D. project proposals
- Sponsorship of Best Ph.D. prizes in Cognitive Vision Systems
- Organization of summer schools
- Organization of tutorials (*e.g.* at conferences)
- Identification and sharing of common development environments (software and hardware platforms)
- Contribution to VXL image understanding environment (VXL – the Vision-something-Libraries – is a collection of platform-independent C++ libraries designed for computer vision research; see

[2] The textbook will be published either in paper or electronic form.

www.robots.ox.ac.uk/~vxl) or OpenCV (an open source library of computer vision code optimized for Intel processors; see www.intel.com/research/mrl/research/opencv/)
- Short-term exchange/visits of research staff
- Short-term exchange/visits of post-graduate students

9.1.4 Information Dissemination

9.1.4.1 Goals

Since the mission of the ECVision network is to promote research, education, and application systems engineering in cognitive AI-enabled computer vision in Europe, the gathering and dissemination of information lies at the heart of all its activities. Clearly, all of the other target areas play a large part in the gathering of information, particularly in their focussed areas (research planning, education, training, industrial matters). So too the Information Infrastructure Support Activity will provide the electronic mechanisms for the delivery of that information to the members of the network and to the world at large. In this context, the Information Dissemination Target Area plays a key role both in gathering information not included in the brief of the other target areas and in coordinating the actual delivery to the community of all information gathered using all available media (electronic, paper, physical interaction at meetings).

9.1.4.2 Activities

Information Gathering

This is an umbrella activity to cover the gathering of information not targetted by other target areas in Research Planning, Education & Training, and Industrial Liaison. The types of information will typically include links to information provides by other sources, access to literature and publications such as electronic versions of papers, and annotated bibliographies. Other information will be included as appropriate.

Information Dissemination

ECVision will use three approaches to information dissemination, corresponding broadly to the use of electronic dissemination, paper-based dissemination, and physical human interaction, respectively.

- Electronic Dissemination

  The principal mechanism for the electronic dissemination of information will be the ECVision website (www.ECVision.org).

  However, since most people do not poll websites effectively on a regular basis, ECVision will also publish a quarterly electronic newsletter which will contain a digest of relevant news and links to the appropriate full-lengths articles on the website and other sources, as appropriate.

  Depending on the success or otherwise of the electronic newsletter, a printed version may also be produced. Typically, this would be for a broader less-targetted audience with items of more general interest.

  A CSCW (Computer Supported Cooperative Work) infrastructure will be deployed for electronic interaction (bulletin boards, discussions, …) among the network members.

  Finally, the content of the ECVision web-site will by distributed periodically on CD to all members; this is particularly important if and when high bandwidth data such as video sequences or large pdf and postscript files are placed on the site.

- Journals

ECVision will promote the publication of special issues of leading international journals dedicated to cognitive computer vision. The material for these special issues could be based either on dedicated calls for papers or on papers delivered at ECVision workshops.

In addition, we will endeavour to publish focussed review papers based, for example, on ECVision white papers and position papers produced in the other Target Areas.

- Conferences & Workshops

  ECVision will promote the inclusion of special sessions on cognitive vision at national and international conferences. Typically, one would expect at least three special sessions per year. To assist in this, ECVision will sponsor a number of 'best paper' prizes at conferences for contributions to the science of cognitive vision systems.

  In addition, we will also organize dedicated scientific workshops on the area and contributions will be solicited from both the members of ECVision and others. These workshops do not include the six-monthly ECVision workshops which will be more concerned with the operational issues of ECVision.

9.1.4.3 Outcomes

- Electronic newsletter, published quarterly
- Database of existing relevant publications (in PDF or HTML), subject to copyright restrictions
- Annotated bibliography of literature, with summary of papers
- Periodic distribution of web-site content on CD to all members
- Database of research results (presentations, videos, …)
- Special sessions at conferences
- Sponsorship of best paper prizes in cognitive vision systems at computer vision and artificial intelligence conferences
- Thematic workshops
- Special issues in journals
- Focussed review papers in journals

9.1.5 Industrial Liaison

9.1.5.1 Goals

The primary goal of the Industrial Liaison Target Area is to identify application drivers, highlight any successes that are known to exist or that arise over the lifetime of the network, and to promote research trials on industrially-motivated applications. It is noteworthy that many types of industries need to be addressed in this activity since cognitive vision is likely play a large part in the implementation of intelligent interfaces for an enormous variety of products and systems. Consequently, the industries which stand to gain by the successful development and deployment of cognitive vision systems include, for example, the games and entertainment industry (*e.g.* gesture interfaces), white goods manufacturers (*e.g.* vigilant appliances), the construction industry (*e.g.* smart buildings), the medical industry (*e.g.* aids for the disabled), the security industry (*e.g.* remote monitoring), the automotive industry (*e.g.* monitoring driver behaviour) and so on.

As well as this inclusion of an 'application push – R&D pull' perspective in the activities of the ECVision and the promotion of cognitive vision, a second goal of the Activity Area is to ensure that both researchers and industrialists achieve mutually-consistent expectations of emergent technologies. In the past, vision researchers have often promised much and delivered little, leaving industry frequently disappointed. At the same time, industrial expectations of computer vision have also often been unrealistic, usually because it was assumed that visual abilities comparable to those of the human visual system would be easily achieved. On the other hand, there have been notable successes of industrial exploitation of computer vision, for example in the areas of visual inspection and metrology. These have usually been achieved by well-matched understanding of the true needs of applications and an understanding of the ability of the vision algorithms to deliver robust information.
The only way to establish this mutual understanding is through dialogue between the three relevant communities:

1. Technology providers (*i.e.* the R&D community)
2. Vision system vendors
3. End-user application owners

ECVision will endeavour to foster constructive dialogue with industry along these lines. The central issues of such a dialog will be the following:

- Identification of research and development problems, whose solution might lead to an immediate improvement of existing products.
- Identification of research and development problems, whose solution might lead to new products.
- Identification of new applications and the associated research and development issues.

9.1.5.2 Outcomes

- Database of research profiles and application experience in the cognitive vision research community, indexed by application, R&D topics, industrial sector; this database will be developed in concert with that of the Research Planning Target Activity.
- Directory of vision vendors, indexed by application, product type, deployed technology, industrial sector.
- Database of application-motivated R&D problems and information on successful and unsuccessful approaches to solutions.
- List of techniques and their usefulness (or not) in certain classes of problems.
- Bi-lateral meetings with representatives of vision companies and industrial vision societies, typically six per annum.
- Sponsorship of Best Application Development prizes in Cognitive Vision Systems.

9.1.6 Information Infrastructure

An Information Infrastructure will be put in place for

- computer-supported cooperative work, *e.g.* discussion forums, document exchange, and email distribution lists;

- web-based dissemination of all material generated under the four activities areas set out in the foregoing. This website will be www.ECVision.org and the domain ECVISION.ORG has already been acquired for this purpose.

The majority of the work within ECVision will be carried out through use of this electronic information infrastructure which will provide the following facilities to support ECVision.

Mailing lists:

- A general broadcast list for global information dissemination
- A network list for information distribution to all ECVision members
- E-mail lists for each key-area
- Subscribers to the electronic newsletter

A WWW server that contains general information and all web-based information derived from the deliverables of the four Activity Areas:

- General Information

  - Overview of the ECVision network
  - List of members
  - Forthcoming events
  - Minutes of meetings

- Research Planning

  - Workshop proceedings/reports
  - Position papers
  - Advances in computer vision
  - Advances in artificial intelligence
  - White papers on cognitive vision research
  - Benchmark applications
  - Research roadmap
  - Database of European research

- Education and Training

  - Survey of existing courses on cognitive computer vision
  - Repository of existing courseware and/or course slides
  - Model curriculum for cognitive computer vision
  - Textbook on cognitive computer vision, published either in paper or electronic form
  - Repository of M.Sc. and Ph.D. project proposals
  - Listings of available positions and people seeking positions
  - Annual Best Ph.D. prizes in Cognitive Vision Systems
  - Annual summer school on Cognitive Vision Systems
  - Tutorials
  - Common development environments
  - Contributed code to the VXL image understanding environment and/or the OpenCV library

- Short-term exchange/visits of research staff
- Short-term exchange/visits of post-graduate students

- Information Dissemination

  - Electronic newsletter
  - Database of existing relevant publications (in PDF or HTML), subject to copyright restrictions
  - Annotated bibliography of literature, with summary of papers
  - Database of research results (presentations, videos, …)
  - Notification of special sessions at conferences
  - Best paper prizes in cognitive vision systems
  - Notification of thematic workshops & publication of proceedings
  - Notification of special issues in journals
  - Focussed review papers

- Industrial Liaison

  - Database of research profiles and application experience in the cognitive vision research community, indexed by application, R&D topics, industrial sector; this database will be developed in concert with that of the Research Planning Activity Area
  - Directory of vision vendors, indexed by application, product type, deployed technology, industrial sector
  - Database of application-motivated R&D problems and information on successful and unsuccessful approaches to solutions
  - List of techniques and their usefulness (or not) in certain classes of problems
  - Best Application Development prizes in Cognitive Vision Systems

A collaborative environment to support key-areas and interest groups (CSCW) will also be commissioned. The facility will typically include:

- A discussion forum
- A mechanism for document exchange
- A set of document readers
- Summaries of on-going discussions

The delivery of content of the relevant sections of the web-site will be the responsibility of the individual Target Area leaders. However, the Network Coordinator will act as the overall Data Administrator and he will have final responsible for the general suitability, integrity, and presentation of all data on the website. **All pages on the web-site must be signed off by the Data Administrator before they are formally included on the web-site.** A webmaster will be employed to handle the day-to-day operational management of the web-site.

It is intended that the information infrastructure should be fully operational within three months of the formal initiation of the network (although, naturally, the content will be developed and published incrementally over the life-time of the network).

9.1.7 Operational Management

Since the management of the network is described in detail in Section 9.5, we will just summarize the key points here.

9.1.7.1 Management Structure and Activities

The network management team will comprise the Network Coordinator and eight Target Area Leaders (two per Target Area). Together, these people comprise the Executive Committee and, collectively, it is responsible for the day-to-day management of the network:

- Coordinate across areas
- Organise the six-monthly meeting
- Evaluate membership applications
- Assess performance of members and recommend changes in membership status
- Evaluate the progress of the network and take corrective actions in the event of problems
- Reporting to the Commission
- Review of funding applications by Sponsored Members and approval of sponsored activities (note: the European Commission must give final approval on all sponsored activities).
- Monitor budget

The Coordinator chairs the Executive Committee and is responsible for overall management of the network activities including administrative project management, day-to-day network coordination, monitoring of costs, and submission of deliverables to the European Commission. The network coordinator also represents the Coordinating Contractor and is thus the administrative contact person with responsibility for liaison the European Commission. The Coordinator is responsible for collection and compilation of progress reports, which should be approved by the Executive Committee. The Coordinator will organise, chair and arrange minuting of Executive Committe meetings. In his capacity as Data Administrator, the Coordinator will represent the information infrastructure support activity on the Executive Committee. To ensure maximum of cohesion and to avoid replication of work, the coordinator is an *ex officio* member of all target area sub-committees. In consultation with the Executive Committee, the Coordinator is responsible for evaluation of progress within each of the four areas of activity. Since this is a critical activity, it will be dealt with under a separate heading below.

The area leaders will have overall responsibility for the management of all activities in their respective areas. The responsibility for specific deliverables rests ultimately with the members of the network and, in this context, the role of the leaders is to motivate and coordinate the actual work.

A copy of all deliverables will be collected, stored, and disseminated by the project (using the information infrastructure). A list of available deliverables will be circulated to all members every three months. The partners can then retrieve copies of deliverables using the information infrastructure.

In addition to the Executive Committee, ECVision will also have an Advisory Panel comprising several senior members of the computer vision community. This panel will be able to offer guidance and strategic insight as and when required. Although the members of this panel won't be involved in the day-to-day operational management and coordination of the network, they will be consulted on issues of strategic importance.

9.1.7.2 Quality Control and Assessment of Progress

Responsible persons for all sponsored activities (including Target Area leaders) will forward a written status report to the Coordinator every 6 months. The status report should as a minimum contain the following:

- Summary of activities of each member (including progress metrics set out in Section 3.4)
- Plan for future activities
- Summary of cost (detailed according to standard items)
- Progress / deviations from the project plan

The coordinator will compile status reports and circulate these for a discussion by the Executive Committee. A formal summary of the effort should be compiled and approved by the Executive Committee. The summary report is to be delivered to the Commission representative within two months of the relevant deadline.

In the event of major deviations from the planned activities the Coordinator is required to inform the Commission as soon as possible and a contingency plan should be presented. After consultation with the Commission and the Executive Committee, the Coordinator will implement any actions required to eliminate or reduce the impact of such deviations.

In this context, the coordinator is responsible for quality control and assessment of progress in the four target areas (TA1-TA4) and the two support activities (SA1-SA2). The coordinator is responsible for timely notification of the Executive Committee in the event of lack of progress in any of the sponsored activities. In particular, the Network Coordinator is responsible for changes in the status of membership (from Ordinary Member to Contracting Member, and *vice versa*). As set out in Section 3.4 – Assessment of Membership Status – the Network Coordinator will summarize the performance of each member on the basis of a short submission and on the basis of contributions to the ECVision website. He will then forward a summary, performance measures, and a recommendation to the European Commission, which will then decide on any change in membership or sponsorship status. Members will be informed of this decision. In the event of an appeal, the member can submit additional data and request a re-examination of his or her case.

The Coordinator has the power to discontinue sponsorship of particular activities if they are judged to have no progress or in the event is mismanagement. The Coordinator also has the power, after consultation with the Executive Committee and the Advisory Panel, to replace Area Leaders in the event of mis-management or lack of progress.

9.1.7.3 Measurement of Success

Normally, the success of an RTD project is measured by the manner in which it achieves or produces the deliverables specifed in the workplan. *However, there is more to success than the completion of each task; real success would be to have these deliverables taken up and used by the community at large.* So, for example, the generation of a model curriculum in Cognitive Vision Systems may well be a very useful deliverable, but real substantive success would involve its widespread use by institutions around Europe and the launch of new courses or programmes on Cognitive Vision Systems. The same is true for many other deliverables.

Thus, we can see that there are two sides to the measurement of success: the delivery of deliverables and the take-up of deliverables. Whilst the consortium of network members is clearly responsible for the former (and will be reviewed accordingly on their performance), the latter is ultimately outside the control of the network. It can exert its best influences but if cannot enforce take-up. However, it can *measure* take-up. We propose to do this by performing annual audits on the incidences of usage or occurrences of cognitive vision systems in a number of key indicators (see Section 9.5.8, for details).

In summary, the success of the ECVision network will be subject to quantitative assessment on two complimentary bases:

3. The success of the network in production of the deliverables set out in this annex and measured by the conventional review process;

4. The success of the network in encouraging the take-up of these deliverables by the research and industrial communities and measured by agreed metrics.

9.2 List of Workpackages

Work-package No	Workpackage title	Contractor / member	Person-month	Start month	End month	Phase	No. of Deliv-erables
TA1	Research Planning	1, 5, M	15	1	36	NA	8
TA2	Education and Training	1, 2, 4, M	15	1	36	NA	14
TA3	Information Dissemination	1, 6, 8, M	15	1	36	NA	10
TA4	Industrial Liaison	1, 3, 7, M	15	1	36	NA	5
SA1	Information Infrastructure	1, M	6	1	36	NA	2
SA2	Management	1	21	1	36	NA	2
	TOTAL		87				

9.3 Workpackage Summaries

9.3.1 Research Planning

Workpackage description

Workpackage number :	TA1		**Start date or starting event:**			Month 1	
Participant number:	1	5	M				
Person-months per participant:	3	3	9				

Objectives

The goals of the Research Planning Target Area are to identify the key challenges, problems, and required system functionalities of cognitive vision systems so that the community and the EC can target the critical areas of research efficiently and effectively. It should be emphasised that the intention is not to co-ordinate research in cognitive vision in Europe but rather to build, by consensus, a picture of the current state-of-the-art in cognitive vision and to construct a 'research roadmap' which will identify the key problems and some potential avenues for attacking them.

Description of work

The construction of this road-map will be achieved using several mechanisms, including:

- Brain-storming workshops;
- Surveys of the scientific communities;
- An iterative process of peer-to-peer consultation, discussion, and synthesis.

Consequently, the road-map will be constructed in an incremental fashion and will yield several other contributing results.

Deliverables

TA1.1.n	Workshop & workshop proceeding/report (month n = 6, 12, …, 36)
TA1.2.n	Position paper (month n = 6, 12, …, 36)
TA1.3	Advances in computer vision (month 6)
TA1.4	Advances in artificial intelligence (month 6)
TA1.5.n	White paper on cognitive vision research (n = 6, 12, … , 36)
TA1.6	Benchmark applications (month 6)
TA1.7.n	Research roadmap (month n = 6, 12, …, 36)
TA1.8.n	Database of European research (month n = 6, 12, …, 36)

Milestones and expected result

- First brain-storming meeting
- Road map for research in Europe
- Database of European research

9.3.2 Education and Training

Workpackage description

Workpackage number :	TA2		**Start date or starting event:**			Month 1	
Participant number:	2	4	M				
Person-months per participant:	3	3	9				

Objectives

The goals of the Education and Training target area are to identify existing teaching programmes in cognitive vision and to develop a model curriculum, a comprehensive course text and associate teaching material, to promote excellence in education at all levels, and to foster exchange of ideas through inter-institutional interaction and exchange of staff and students.

Description of work

These goals will be achieved in stages: creation of a repository of existing teaching material; publication of a comprehensive list of the teaching programmes in Europe; development of a model curriculum on cognitive computer vision; development of appropriate teaching material; publication of a textbook on cognitive vision; organization of tutorials and summer schools; dissemination of research projects and development platforms; award of prizes for post-graduate research; support for short-term exchanges of people (staff and students).

Deliverables

TA2.1 Survey of existing courses on cognitive computer vision (month 6)
TA2.2 Web-based repository of existing courseware and/or course slides (month 6 and on-going)
TA2.3 Web-based repository of M.Sc. and Ph.D. project proposals (month 6 and on-going)
TA2.4 Model curriculum for cognitive computer vision (month 12)
TA2.5 Web-based encyclopaedia of cognitive computer vision (month 12)
TA2.6 Web-based listings of available positions and people seeking positions (month 12 and on-going)
TA2.7 Annual Best Ph.D. prizes in Cognitive Vision Systems (months 12, 24, 36)
TA2.8 Annual summer school on Cognitive Vision Systems (months 7, 19, 31)
TA2.9 Organization of tutorials (months 12, 24, 36)
TA2.10 Identification of common development environments (months 12, 24, 36)
TA2.11 Contribution of code to VXL and/or OpenCV (months 12, 24, 36)
TA2.12 Short-term exchange/visits of research staff (months 12, 24, 36)
TA2.13 Short-term exchange/visits of post-graduate students (months 12, 24, 36)
TA2.14 Textbook on cognitive computer vision, (month 36)

Milestones and expected result

- Database of teaching material
- Publication of recommended model curriculum on cognitive computer vision
- Publication of textbook on cognitive computer vision and associated teaching material
- Database of available positions and of people seeking positions.

9.3.3 Information Dissemination

Workpackage description

Workpackage number :	TA3		**Start date or starting event:**			Month 1	
Participant number:	6	8	M				
Person-months per participant:	3	3	9				

Objectives

Gather information information not included in the brief of the other Target Areas and coordinate the actual delivery to the community of all information gathered using all available media (electronic, paper, physical interation at meetings).

Description of work

There will be two principal lines of activity: information gathering and information dissemination.

Information gathering cover material not targetted by other Target Areas in Research Planning, Education & Training, and Industrial Liaison. Information dissemination will be achieved using three approaches, corresponding broadly to the use of electronic dissemination (ECVision website, electronic newsletter, CSCW interaction), paper-based dissemination (journals), and physical human interaction (conferences and workshops), respectively.

Deliverables

TA3.1.n Electronic newsletter, published quarterly (month n = 3, 6, …, 36)
TA3.2.n Database of existing relevant publications (in PDF or HTML), subject to copyright restrictions (month n = 6, 12, …, 36)
TA3.3.n Annotated bibliography of literature, with summary of papers (month n = 6, 12, …, 36)
TA3.4.n Database of research results (presentations, videos, …) (month n = 12, 24, …, 36)
TA3.5.n Periodic distribution of web-site content on CD to all members (month n = 12, 24, 36)
TA3.6.n Special sessions at conferences (month n = 12, 24, 36)
TA3.7.n Sponsorship of best paper prizes in cognitive vision systems (month n = 12, 24, 36)
TA3.8.n Thematic workshops (month n = 12, 24, 36)
TA3.9.n Special issues in journals (month n = 12, 24, 36)
TA3.10.n Focussed review papers in journals (month n = 12, 24, 36)

Milestones and expected result

- A quarterly electronic newsletter
- 5 special issues on cognitive vision research in Europe
- Active participation in organisation of 3 major vision conferences in Europe
- Organisation of 3 thematic workshops
- Publication of 2 review papers

9.3.4 Industrial Liaison

Workpackage description

Workpackage number :	TA4		**Start date or starting event:**			Month 1	
Participant number:	3	7	M				
Person-months per participant:	3	3	9				

Objectives

The primary goal of the Industrial Liaison Target Area is to identify application drivers, highlight any successes that are known to exist or that arise over the lifetime of the network, and to promote research trials on industrially-motivated applications. A second goal is to ensure that both researchers and industrialists achieve mutually-consistent expectations of emergent technologies.

Description of work

The above objectives will be achieved through frequent bi-lateral meetings with representatives of vision system vendors and end-user application owners leading to the deliverables set out below.

Deliverables

TA4.1.n Database of research profiles and application experience in the cognitive vision research community, indexed by application, R&D topics, industrial sector; this database will be developed in concert with that of the Research Planning Target Activity (month n = 6, 12, …, 36)

TA4.2.n Directory of vision vendors, indexed by application, product type, deployed technology, industrial sector (month n = 6, 12, …, 36)

TA4.3.n Database of application-motivated R&D problems and information on successful and unsuccessful approaches to solutions (month n = 6, 12, …, 36)

TA4.4.n List of techniques and their usefulness (or not) in certain classes of problems (month n = 6, 12, …, 36)

TA4.5.n Sponsorship of Best Application Development prizes in Cognitive Vision Systems (month n = 12, 24, 36)

Milestones and expected result

- Database of research profiles and application experience in the cognitive vision research community
- Directory of vision vendors

9.3.5 Information Infrastructure

Workpackage description

Workpackage number :	SA1	**Start date or starting event:**				Month 1	
Participant number:	1,M						
Person-months per participant:	6						

Objectives

An information infrastructure will be put in place for

- computer-supported cooperative work, *e.g.* discussion forums, document exchange, and email distribution lists;

- web-based dissemination of all material generated under the four activities areas set out in the foregoing. This website will be www.ECVision.org and the domain ECVISION.ORG has already been acquired for this purpose.

Description of work

There are three aspects to the work in this workpackage. These are

1. Data administration (*i.e.* editorial responsibility) for the content of the site;
2. Day-to-day maintenance of the content
3. Installation and maintenance of the information infrastructure

Note that the delivery of content of the relevant sections of the web-site will be the responsibility of the individual Activity Area leaders.

Deliverables

SA5.1 CSCW infrastructure operational (month 3)
SA5.2 Website core structure implemented (month 3) – content will be added incrementally as it becomes available

Milestones and expected result

- CSCW and Website operational

9.3.6 Management

Workpackage description

Workpackage number:	SA2	**Start date or starting event:**				Month 1	
Participant number:	1						
Person-months per participant:	21						

Objectives

The aim of the activity is to provide the needed resources and activities for coordination and monitoring of the activities within the network to ensure progress and timely delivery of the deliverables specified in the contract. The activity is also responsible for the overall coordination within the network.

Description of work

The effort includes the work of the Coordinator to ensure network level coordination. The Coordinator will work closely with the Executive Committee and the Advisory Panel to ensure maximum strategic and operational cohesion at a European level. The activity further includes the coordination of between the coordinator and the work delegated to area leaders. Specific responsibilities include:

- Collation and preparation of 6-monthly management reports
- Organization of six-monthly Executive Committee meetings
- Organization of six-monthly Network Workshops
- Processing and reimbursement of members costs
- Preparation of cost statements
- Processing of applications for funding by sponsored members
- Collation and processing of reviews of member status
- Collection and distribution of deliverables
- Assessment of Target Area progress and implementation of corrective action

Deliverables

SA2.1.n Periodic management report (month n = 6, 12, … 30)
SA2.2 Final report (month 36)

Milestones and expected result

M1.n: Six-monthly Executive Committee meeting (month n = 6, 12, …36).

9.4 List of deliverables

Deliverable No[3]	Deliverable title	Delivery date [4]	Nature [5]	Dissemination level [6]
TA1.1.n	Workshop proceeding/report; n = 6, 12, …, 36	n	R	PU
TA1.2.n	Position paper; n= 6, 12, … , 36	n	R	PU
TA1.3	Advances in computer vision	6	R	PU
TA1.4	Advances in artificial intelligence	6	R	PU
TA1.5.n	White paper on cognitive vision research; n = 6, 12, … , 36	n	R	PU
TA1.6	Benchmark applications	6	R	PU
TA1.7.n	Research Roadmap; n = 6, 12, … , 36	n	R	PU
TA1.8.n	Database of European research; n = 6, 12, … , 36	n	D	PU
Deliverable No	**Deliverable title**	**Delivery date**	**Nature**	**Dissemination level**
TA2.1	Survey of existing courses on cognitive computer vision	6	R	PU
TA2.2	Web-based repository of existing courseware and/or course slides	6	D	PU
TA2.3	Web-based repository of M.Sc. and Ph.D. project proposals	6	D	PU
TA2.4	Model curriculum for cognitive computer vision	12	R	PU
TA2.5	Web-based encyclopedia of cognitive computer vision	12	D	PU

[3] Deliverable numbers in order of delivery dates: TA1.1 – TA1.n

[4] Month in which the deliverables will be available. Month 0 marking the start of the project, and all delivery dates being relative to this start date.

[5] Nature of the deliverable:

R = Report
P = Prototype
D = Demonstrator
O = Other

[6] Dissemination level:

PU = Public
PP = Restricted to other programme participants (including the Commission Services).
RE = Restricted to a group specified by the consortium (including the Commission Services).
CO = Confidential, only for members of the consortium (including the Commission Services).

TA2.6	Web-based listings of available positions and people seeking positions	12	D	PU
TA2.7.n	Annual Best Ph.D. prizes in Cognitive Vision Systems; n = 12, 24, 36	n	O	PU
TA2.8.n	Annual summer school on Cognitive Vision Systems; n = 7, 19, 31	n	O	PU
TA2.9.n	Organization of tutorials; n = 12, 24, 36	n	R	PU
TA2.10.n	Identification of common development environments; n = 12, 24, 36	n	R	PU
TA2.11.n	Contribution of code to the VXL and/or OpenCV; n = 12, 24, 36	n	R	PU
TA2.12.n	Short-term exchange/visits of research staff; n = 12, 24, 36	n	R	PU
TA2.13.n	Short-term exchange/visits of post-graduate students; n = 12, 24, 36	n	R	PU
TA2.14	Textbook on cognitive computer vision	36	R	PU
Deliverable No	**Deliverable title**	**Delivery date**	**Nature**	**Dissemination level**
TA3.1.n	Electronic newsletter, published quarterly; n = 1, 2, …, 36	n	D	PU
TA3.2.n	Database of existing relevant publications (in PDF or HTML), subject to copyright restrictions; n = 6, 112, …, 36	n	D	PU
TA3.3.n	Annotated bibliography of literature, with summary of papers; n = 6, 12, …, 36	n	D	PU
TA3.4.n	Database of research results (presentations, videos, …); n = 12, 24, …, 36	n	D	PU
TA3.5.n	Periodic distribution of web-site content on CD to all members; n = 12, 24, 36	n	D	PU
TA3.6.n	Special sessions at conferences; n = 12, 24, 36	n	R	PU
TA3.7.n	Sponsorship of best paper prizes in cognitive vision systems; n = 12, 24, 36	n	O	PU
TA3.8.n	Thematic workshops; n = 12, 24, 36	n	R	PU
TA3.9.n	Special issues in journals; n = 12, 24, 36	n	R	PU
TA3.10.n	Focussed review papers in journals; n = 12, 24, 36	36	R	PU

Deliverable No	Deliverable title	Delivery date	Nature	Dissemination level
TA4.1.n	Database of research profiles and application experience in the cognitive vision research community, indexed by application, R&D topics, industrial sector; this database will be developed in concert with that of the Research Planning Target Activity; n = 12, 24, 36	n	D	PU
TA4.2.n	Directory of vision vendors, indexed by application, product type, deployed technology, industrial sector; n = 6, 12, … , 36	n	R	PU
TA4.3.n	Database of application-motivated R&D problems and information on successful and unsuccessful approaches to solutions; n = 6, 12, … , 36	n	D	PU
TA4.4.n	List of techniques and their usefulness (or not) in certain classes of problems; n = 6, 12, … , 36	n	R	PU
TA4.5.n	Sponsorship of Best Application Development prizes in Cognitive Vision Systems; n = 6, 12, … , 36	n	O	PU
Deliverable No	**Deliverable title**	**Delivery date**	**Nature**	**Dissemination level**
SA1.1	CSCW infrastructure operational	3	D	PU
SA1.2	Website core structure implemented – content will be added incrementally as it becomes available	3	D	PU
Deliverable No	**Deliverable title**	**Delivery date**	**Nature**	**Dissemination level**
SA2.1.n	Periodic management report; n = 6, 12, … , 36	n	R	PU
SA2.2	Final report from ECVision	36	R	PU

9.5 Management

9.5.1 Overall Structure

The success of the network depends ultimately on the good-will and commitment of the individual members who comprise the network. However, there is also a need for people who are willing to take the lead in coordinating both the individual areas of activity and the overall operation of the network as a whole. Without this leadership, the network will not achieve the cohesion within and between Target Areas, cohesion which is needed to achieve the goals that the network has set for itself. Furthermore, the network must be able and ready to anticipate new developments and respond to unforseen demands. Finally, the work of the network must monitored and assessed, with status reports being prepared and submitted the Commission on a regular basis.

An Executive Committee, comprising the Network Coordinator and eight Area Leaders (two for each Target Area) will carry out these management tasks. In some instances, it will perform these responsibilities collectively; in other instances, they will be performed by individual members of the Committee.

In addition to the Executive Committee, ECVision will also have an Advisory Panel comprising several senior members of the computer vision community. This panel will be able to offer guidance and strategic insight as and when required. Although the members of this panel won't be involved in the day-to-day operational management and coordination of the network, they will be consulted on issues of strategic importance, such as changes in status of membership of ordinary members, sponsored members, and area leaders.

9.5.2 Executive Committee

The Executive Committee is responsible for the day-to-day management of the network:

- Coordination across areas
- Organization of the six-monthly meeting
- Evaluation of membership applications
- Assessment performance of members
- Evaluation of the progress of the network and implementation of corrective actions in the event of problems
- Reporting to the Commission
- Review of funding applications by Sponsored Members and approval of sponsored activities (note: the European Commission must give final approval on all sponsored activities).
- Monitoring of the budget

The coordinator chairs the Executive Committee.

It is expected that the activities of the Executive Committee will, in the main, be carried out using the electronic information infrastructure. The Executive Committee will have two physical meetings every year in conjunction with the six-monthly network meeting.

The Executive Committee will comprise the following members (in his capacity as Data Administrator, the Coordinator will represent the information infrastructure support activity on the Executive Committee) – see next page.

Note that all decisions and actions taken by the Executive Committee will be made known to the members via the ECVision website and any other appropriate method.

Executive Committee Membership	
Coordinator	David Vernon, CAPTEC
TA1: Research Planning	Henrik Christensen, Royal Institute of Technology David Vernon, CAPTEC
TA2: Education and Training	Wolfgang Förstner, University of Bonn Bob Fisher, University of Edinburgh
TA3: Information Dissemination	Hilary Buxton, University of Sussex Jim Crowley, Institut National Polytechnique de Grenoble
TA4: Industrial Links	Monique Thonnat, INRIA Sophia Antipolis Patrick Courtney, PBConsulting Ltd.

9.5.3 Area Leaders

There are two leaders in each of the four target areas – see above. This allows the leaders to share responsibilities and provide mutual backup.

The area leaders will have overall responsibility for the management of all activities in their respective areas. The responsibility for specific deliverables rests ultimately with the members of the network and, in this context, the role of the leaders is to motivate and coordinate the actual work.

9.5.4 Network Coordinator

The network coordinator is responsible for both the administrative project management and the day-to-day network coordination.

The network coordinator also represents the Coordinating Contractor and is thus the administrative contact person with responsibility for liaison the European Commission. All communication between the project and the Commission is directed through the Coordinator. The Coordinator is responsible for collection and compilation of progress reports, which should be approved by the Executive Committee. The Coordinator shall organise, chair, and arrange minuting of Executive Committee meetings.

A copy of all deliverables should be collected, stored, and disseminated by the Network Coordinator (using the information infrastructure). A list of available deliverables will be circulated to all members every three months. The partners can then retrieve copies of deliverables using the information infrastructure.

To ensure maximum of cohesion and to avoid replication of work, the coordinator is an *ex officio* member of all target area sub-committees.

The coordinator is also responsible for quality control and evaluation of work in the four target areas (TA1-TA4) and the two support activities (SA1-SA2). The coordinator is responsible for timely notification of the Executive Committee in the event of lack of progress in any of the sponsored activities (see Section 3.1.7 – Quality Assurance).

Furthermore, the Network Coordinator is responsible for changes in the status of membership (from Ordinary Member to Contracting Member, and *vice versa*). As set out in Section 5.4, the Network Coordinator will review each member on the basis of a short submission and on the basis of their contributions to the ECVision website. He will then forward a summary, performance measures, and a recommendation to the European Commission, which will then decide on any change in membership or sponsorship status. Members will be informed of this decision. In the event of an appeal, the member can submit additional data and request a re-examination of his or her case.

Applications for funding by a sponsored member will be administered by the Network Coordinator who will distribute them for review by the Executive Committee. Awards will be made on the recommendations of the relevant Target Area Leaders and subject to a majority agreement by the

member of the Executive Committee. Where majority consensus cannot be reached, the Network Coordinator will have the casting vote.

The Coordinator has the power to discontinue sponsorship of particular activities if they are judged to have no progress or in the event is mismanagement. The Coordinator also has the power, after consultation with the European Commission, the Executive Committee, and the Advisory Panel, to replace Area Leaders in the event of mismanagement or lack of progress.

A full list of the responsibilities of the Network Coordinator can be found in Section 9.3.6, *Management Workpackage Description*.

9.5.5 Advisory Panel

The *rôle* of the Advisory Panel is to offer guidance and strategic advice as and when required. In particular, members of the panel will be sent all six-monthly progress reports and will invited to comment on the nature and direction of the network's progress. The Advisory Panel is also responsible for the final approval of admission of new members.

The Advisory Panel will comprise the following members:

Advisory Panel
Andrew Blake, Microsoft Research, Cambridge
Mike Brady, University of Oxford
Jan-Olof Eklundh, Royal Institute of Technology
Olivier Faugeras, INRIA Sophia Antipolis
Hans-Hellmut Nagel, University of Karlsruhe
Giulio Sandini, University of Genoa – DIST

9.5.6 Conflict Resolution

In case of conflicts between two or more network members on matters concerning the network, the Executive Committee is informed. The Coordinator will then initiate a one-month negotiation phase and arrange that an Executive Committee member be elected as convening negotiator to help resolve the conflict. If negotiations fail and no solution is found within the one month period, the conflict will be resolved by a vote among the Executive Committee. In the situation of a tie the vote of the Coordinator determines the final decision.

9.5.7 Quality Assurance

Responsible persons for all sponsored activities (including Target Area leaders) are required to forward a written status report to the Coordinator every 6 months. The status report should as a minimum contain the following:

- Summary of activities (including progress metrics set out in Section 5.4)
- Plan for future activities
- Summary of costs (detailed according to standard items)
- Progress and deviations from the project plan

The coordinator is required to compile status reports and circulate these for a discussion among the Executive Committee. A formal summary of the effort should be compiled and approved by the Executive Committee. The summary report is to be delivered to the Commission representative within two months of the relevant deadline.

In the event of major deviations from the planned activities the Coordinator is required to inform the Commission as soon as possible and a contingency plan should be presented. After consultation with the Commission and the Executive Committee, the Coordinator is required to implement any actions required to eliminate or reduce the impact of such deviations.

9.5.8 Measurement of Success

There is a clear need to incorporate some measure for assessing the success of the ECVision network, both for the network so that it can use it as feedback to adapt and improve its activities, and for the Commission so that it has some indication of the return on investment of public funds.

Normally, the success of an RTD project is measured by the manner in which it achieves or produces the deliverables specifed in the workplan. Similarly, the ECVision workplan also identifies many useful tangible and intangible outcomes (*i.e.* deliverables) which can be used to assess the success of the network. *However, there is more to success than the completion of each task; real success would be to have these deliverables taken up and used by the community at large.* So, for example, the generation of a model curriculum in Cognitive Vision Systems may well be a very useful deliverable, but real substantive success would involve its widespread use by institutions around Europe and the launch of new courses or programmes on Cognitive Vision Systems. The same is true for many other deliverables.

Thus, we can see that there are two sides to the measurement of success: the delivery of deliverables and the take-up of deliverables. Whilst the consortium of network members is clearly responsible for the former (and will be reviewed accordingly on their performance), the latter is ultimately outside the control of the network. It can exert its best influences but if cannot enforce take-up. However, it can *measure* take-up. We propose to do this by performing annual audits on the incidences of usage or occurrences of cognitive vision systems in the following key indicators:

- Number of modules/courses being delivered on cognitive computer vision.
- Number of M.Sc. and Ph.D. students working on theses in the area of cognitive computer vision.
- Number of industrial applications incorporating some aspect of cognitive computer vision.
- Number of conference and journal papers addressing some issue in cognitive computer vision.
- Number of RTD projects active in the area of cognitive computer vision systems.
- Number of text-books on cognitive computer vision
- Number of research books of cognitive computer vision
- Number of sessions in conferences devoted to cognitive computer vision

Success metrics will be computed as the percentage increase in these indicators, taking the status quo at the launch of the network as the baseline.

In summary, the success of the ECVision network will be subject to quantitative assessment on two complementary bases:

5. The success of the network in production of the deliverables set out in this annex and measured by the conventional review process;
6. The success of the network in encouraging the take-up of these deliverables by the reasearch and industrial communities and measured by the above metrics.

In essence, success can be measured by the extent to which ECVision helps create and develop a well-defined discipline of cognitive vision systems in Europe through the take-up and usage of the tangible outcomes of the network.

10 Appendix A – Consortium Description

Status*	Partic. no.	Participant name	Participant short name	Contact	Country
Network Coordinator					
SM	1	Computer Applied Techniques Ltd.	CAPTEC	David Vernon	IRL
Executive Committee and Area Leaders†					
SM	2	University of Bonn Institut für Photogrammetrie	UB	Wolfgang Förstner (EDU)	D
SM	3	INRIA Sophia Antipolis	INRIA	Monique Thonnat (IND)	F
SM	4	Institut National Polytechnique de Grenoble	INPG	Jim Crowley (INF)	F
SM	1	Computer Applied Techniques Ltd.	CAPTEC	David Vernon (RES)	IRL
SM	5	Royal Institute of Technology	KTH	Henrik Christensen (RES)	S
SM	6	University of Edinburgh	UEDIN	Bob Fisher (EDU)	UK
SM	7	PBConsulting Ltd.	PBC	Patrick Courtney (IND)	UK
SM	8	University of Sussex	UoS	Hilary Buxton (INF)	UK
Advisory Panel					
OM	9	University of Karlsruhe	UKA	Hans-Hellmut Nagel	D
OM	3	INRIA Sophia Antipolis	INRIA	Olivier Faugeras	F
OM	10	University of Genoa – DIST	DIST	Giulio Sandini	I
SM	5	Royal Institute of Technology	KTH	Jan-Olof Eklundh	S
OM	12	Microsoft Research, Cambridge & University of Oxford	Oxford	Andrew Blake	UK
OM	12	University of Oxford	Oxford	Mike Brady	UK
Members					
OM	13	Technical University of Vienna	TUV	Walter Kropatsch	A
OM	13	Technical University of Vienna	TUV	Markus Vincze	A
OM	14	Katholieke Universiteit Leuven VISICS & ETH-Z BIWI	KUL & ETH-Z	Luc Van Gool	B/CH
OM	15	University of Hamburg	CSL	Bernd Neumann	D
OM	16	University of Bielefeld	UNIBI	Gerhard Saegerer	D
OM	17	University of Erlangen	UERLN	Heinrich Niemann	D
OM	18	Max Planck Institute for Biocybernetics	MPIK	Heinrich Buelthoff	D
OM	19	University of Freiburg	ALU-FR	Bernhard Nebel	D
OM	20	Université Joseph Fourier Grenoble I	UJF	Catherine Garbay	F
OM	21	Ecole Nationale Superieure des Telecommunications	ENST	Henri Maitre	F
OM	22	University Strasbourg-I Louis Pasteur	ULP	Ernest Hirsch	F
OM	23	University of Utrecht		Jan Koenderink	NL
OM	24	Instituto Superior Técnico	IST	José Santos Victor	P
OM	25	ETH-Z, Perceptual Computing & Computer Vision Group	ETH-Z	Bernt Schiele	CH
OM	26	Ecole Polytechnique Federal de Lausanne	EPFL	Pascal Fua	CH
OM	27	University of Linköping	LIU	Gösta Granlund	S
OM	28	University of Leeds Computer Vision Group	UNIVLEEDS	David Hogg	UK
OM	28	University of Leeds Knowledge Representation Group	UNIVLEEDS	Tony Cohn	UK
OM	29	University of Manchester	ISBE	Chris Taylor	UK
OM	12	University of Oxford	OXFORD	Andrew Zisserman	UK
OM	30	University of Surrey	UniS	Josef Kittler	UK

*Status: OM: Ordinary Member, SM: Sponsored Member.

† Areas are: RES - Research Planning
EDU - Education and Training
IND - Industrial Liaison
INF - Information Dissemination (including Conferences and Publications)

Note: in certain cases, the same participant is listed twice with two different contact persons; in other cases, there are two different participants from the same institution. The former is the case if the contact persons are in the same centre or laboratory in a given institution; the latter is the case if the contact persons are in different centres or laboratories in a given institution.

The following is a list of the profiles of each institution participating in ECVision, ordered by participant number.

10.1 Computer Applied Techniques Ltd. (CAPTEC)

CAPTEC is a high-technology Irish owned company that specialises in advanced software development, image processing products and applications. Its staff comprises MSc and PhD level graduates in a variety of engineering and scientific disciplines. Aerospace related work is one of CAPTEC's main areas of activity with successful involvement in several European Space Agency (ESA) projects including the Hipparcos, ISO, SOHO, Huygens and XMM satellites. In the ISO and SOHO projects, CAPTEC was responsible for the development of the on-board attitude and orbit control software, pioneering the use of the Ada language for on-board satellite software development in Europe.

CAPTEC's products include:

- MAVIS – Image Processing Software. Over 150 high performance image processing functions in an easy to use library for PC C/C++ developers. Supports image acquisition, processing, visualization, analysis and many standard file formats.
- RICA – Reversible Image Compression Algorithm. This is a patented state-of-the art lossless image compression method currently implemented as a software utility for the PC platform. It accepts DICOM and other image formats, typically achieving 4:1 compression on greyscale medical images.
- LIAISON – Teleradiology System. This MS-Windows based software allows image acquisition and interactive teleradiology sessions between terminals over any TCP/IP based network.
- MCS – Multimedia Conferencing System. This is a sophisticated multi-point application to present diagnostic data to a large audience for clinical conferences. A wide range of diagnostic data is supported, including CR, Angiography, Ultrasound, ECG, Blood Pressure, Nuclear Medicine, Scanned X-Ray films and Patient Notes, etc.

In the past year, the company has been engaged in the following major development projects:

- Development of an interface for the Multimedia Display System (MDS) for integration with a 3rd party Radiology Information System (RIS).
- Multimedia application for Cardiology Conferencing (CCS) using the PC/Windows platforms.
- Software implementation of a Reversible Image Compression Algorithm (RICA) on the PC platform.
- On-board satellite control software for the European Space Agency's XMM mission.
- Independent software verification of on-board satellite software developed by a European supplier for a joint ESA / NASA mission.

10.2 University of Bonn (Institute for Photogrammetry)

The Institute for Photogrammetry at Bonn University is doing research in computational vision and digital photogrammetry. The group, which is active in this field since 1990, currently has 10 researchers and graduate students. 12 PhD thesis came out of the group in the last 5 years.

The main topic since nearly 10 years is automatic image interpretation, especially automatic building extraction from single and multiple images. The goal is to develop models which on one hand are generic enough to cover a large range of real buildings and on the other hand specific enough to allow automatic analysis. Two aspects have been in focus: (1) semantic models for interpreting aerial images are a key in reaching the required level of abstraction and to generate results which can be used in geoinformation systems; here, in cooperation with the Computer Science Department generic models of buildings on the basis of CSG-models have been developed and successfully applied; (2) The integration of geometry and statistics appears to be the key for consistent geometric reasoning

when reconstructing polyhedral type objects from images. We are currently building a toolbox for statistically uncertain geometric reasoning (SUGR) which helps us in grouping in 2D and 3D. Moreover we investigate Markoff-random fields and Bayesian networks for modelling reasoning under uncertainty.

Our future work is directed towards integrating semantics, geometry and statistics into one system. Here the aspect of control of vision algorithms and the interface with human operators will play a central role. The work on performance characteristics of vision algorithms and on semiautomatic building extraction is a first step into this direction of automatic interpretation of aerial images.

10.3 INRIA Sophia Antipolis

INRIA –l'Institut National de Recherche en Informatique et Automatique – is a French research institute studying information and computer science and technology. This research allows scientific development to be used for technological progress, for creating employment and wealth and for new uses in response to socio-economic needs. INRIA has a decentralized organization (5 Research Units), its small autonomous teams, and regular evaluation enable INRIA to develop its partnerships, with 47 research projects out of 87 shared with universities, grandes Ecoles and research organizations. It is also strengthening its involvement in the development of research results and technology transfer: 600 R & D contracts with industry and 40 technology companies have been born of the Institute.

Within INRIA, the RobotVis research project aims to develop the theory and practice of machine visual perception. To this end, the team is building mathematical and computational tools and testing results against real applications and performance in biological systems.

In order to solve a given visual perception task, we must first answer the following questions:

-What information is to be extracted from images and what sort of mathematics allows this ?
- What are the uses of these methods and what experiments can adequately validate them?
- And what computing architectures will execute these algorithms in real-time in a given application?

Within this general framework we mainly focus on brain mapping, geometric vision modelisation and spatio-temporal visual events analysis.

10.4 Institut National Polytechnique de Grenoble (Project PRIMA, Laboratoire GRAVIR)

The PRIMA group is part of the GRAVIR Laboratory, CNRS UMR 5527, part of the CNRS Federation of Reseach Units, IMAG - FU 001. GRAVIR is co-dependent on the Institut National Polytechnique de Grenoble (INPG), the University Joseph Fourier (UJF), the French CNRS, and INRIA Rhônes Alpes. The PRIMA research team includes three professors, two post-doctoral researchers, an engineer, and a team of 5 doctoral students.

PRIMA has as its goal the development of techniques for integrating perception, action and reasoning, with applications to the perception of human action. Project PRIMA has developed a new approach to visual perception and recognition based on discrete representations of local appearance The project is currently applying these techniques to problems of object recognition, recognition of faces and facial experssions, gesture recognition, and recognition of human activities. Applications include computer assisted communications and man-machine interaction.

Project PRIMA currently participates in the European IST Project VISOR BASE, FET Disappearing Computer Initiative Projet GLOSS, IST Project DETECT, IST Project FAME, and the thematic network FGNet.

As a joint research unit depending on the Institut National Polytechnique de Grenoble (INPG), the University Joseph Fourier (UJF), the French CNRS, and INRIA Rhônes Alpes, laboratory GRAVIR must sign contract through one of its four parent organisations. The contracting partner for ECVision will be the I.N.P. Grenoble.

10.5 Kungl Tekniska Högskolan (Royal Institute of Technology)

The Computational Vision and Active Perception (CVAP) group at KTH is doing research in computational vision, robotics and related problems in geometric modeling and computing. The group was formed in 1982 and has now almost 30 researchers, graduate students and visiting scientists.

Seeing Robots: A central research theme at CVAP is the development of a computer based seeing agent capable of using vision in its interaction with the environment, for *e.g.* manoeuvring, navigating, grasping and recognizing things. This work is being implemented as "seeing robots" and addresses basic issues on gaze control, attention, figure-ground segmentation, cue integration, and recognition, as well as systems and control issues.

A second theme that underpins much of this and other work concerns early vision processing and the computation of scene characteristics. Considerable efforts are being devoted to feature and structure extraction at multiple scales. One of the goals is to develop the notion of a visual-front-end, which can provide a first processing layer for the mentioned seeing agent.

Visual Navigation: Another central topic deals with the derivation geometric invariants and their use in deriving scene structure and in tasks such as visual navigation. Properties invariant under perspective and projective transformations can be used to establish image correspondence and to tracking. They also provide a means for model indexing in visual recognition. The latter problem is also studied using other approaches, *e.g.* based on appearance and also involving learning. The overall goal is to include also these techniques and capabilities in our long-term work on the seeing agent.

In addition to these efforts the group is also developing frameworks and computational environments for performing geometric reasoning and analysis as well as for representing geometric objects such as surfaces and volumes. This work has potential applications in computer vision but is also aimed at the study and teaching of geometry as such.

10.6 University of Edinburgh (Division of Informatics)

The effort proposed here will be undertaken in the Machine Vision Unit, which is part of the Institute for Perception, Action and Behaviour, which has been investigating topics in computer vision, mobile robotics and assembly robotics for over 20 years. The Instutute consists of 5 permanent academic staff, and is one of six Institutes within the Division of Informatics. The Division consists of about 400 active researchers, including 65 permanent academic staff. In recent reviews, the Department was awarded both top Research and Teaching ratings by the UK government.

The Machine Vision Unit has been investigating range data, 3D vision and object recognition systems for over 15 years, including:

1. development of three range sensors (including two hand-held one), subpixel stripe detection algorithms and algorithms for eliminating spurious reflections from metallic parts,
2. range data analysis for built environment reconstruction,
3. automatic surface model acquisition from range data,
4. use of constraints in computer vision applications, and
5. 3D geometric modeling for computer vision.

The Unit currently has 3 funded range data projects investigating:

1. a partner in the current CAMERA network, investigating use of constraints in architectural recovery, scan planning and surface hypothesis,
2. precise automatic geometric model acquisition of manufactured objects from shown examples and user-given constraints, and
3. a UK funded project investigating acquisition of architectural models.

The total value of the grants held in the group are about 300,000 Euros per year.

The Machine Vision Unit has also been active in the development of online computer vision teaching materials. The three most heavily used items are:

- The HIPR2 image processing teaching resources, including JAVA-based interactive exploration: `http://www.dai.ed.ac.uk/HIPR2/+`.
- CVonline, a community contributed online encyclopedia of computer vision: `http://www.dai.ed.ac.uk/CVonline/`.
- Edinburgh's online dictionary of computer graphics terms: `http://www.dai.ed.ac.uk/homes/rbf/grdict.htm`

10.7 PBConsulting Ltd.

PBConsulting is a small technology consultancy established in Germany in 2001. It advises on the development of new applications and systems using image analysis. It works with clients in the area of tile inspection and technology assessment.

10.8 University of Sussex (School of Cognitive and Computing Sciences)

The School of Cognitive and Computing Sciences ('COGS') at the University of Sussex grew out of a pioneering multi-disciplinary centre for research into intelligent systems and the mechanisms underlying them. It is one of the few centres in the UK where an interdisciplinary approach to the study of Computing and Cognitive Science is encouraged. Artificial Intelligence and Neuroscience are areas in which Sussex is exceptionally strong, a view supported by the results of the last three national Research Assessment Exercises in which the Computer Science and Artificial Intelligence (CSAI) group in COGS received the highest rating (5). The COGS research groups have made pioneering contributions to computer vision, genetic algorithms, artificial neural networks, simulation of adaptive behaviour, robotics and artificial life. A joint venture with COGS and the Centre for Neuroscience at BIOLS has led to the recent opening of the Sussex Centre for Computational Neuroscience and Robotics. The School includes research groups of international standing in the areas of Computer Vision, Neural Networks, and related Simulation of Adaptive Behaviour and Artificial Life who together share well equipped laboratory space.

10.9 Universität Karlsruhe (TH) – Institut für Algorithmen und Kognitive Systeme (IAKS)

IAKS is one among eight institutes of the Fakultät für Informatik, one of the top-ranking and largest German academic institutions in computer science. The research group on `Kognitive Systeme (KOGS)' within the IAKS addresses all problems related to algorithmic understanding of image sequences. This research covers the entire range from capturing video signals, through signal and image processing, in particular the detection and tracking of moving bodies, the transformation of geometric results into conceptual representations, their exploitation for robot control, and the generation of textual descriptions of temporal developments in the recorded scenes. Many years of experience in control of disassembly robots and road vehicles by model-based computer vision have been accumulated within `KOGS'. In addition to numerous publications, this knowledge has been transferred directly to industrial applications, in particular via a cooperation with the Fraunhofer-Institut für Informations- und Datenverarbeitung (IITB) at Karlsruhe.

Members of KOGS have been involved in large national and international projects, for example INSIGHT I+II, PROMETHEUS, VIEWS, VIGOR.

10.10 University of Genova – Dipartimento di Informatica, Sistemistica e Telematica (DIST)

The Dipartimento di Informatica, Sistemistica e Telematica (DIST) of the University of Genova is composed of approximately 47 persons including 32 persons with permanent teaching position and research position, and 15 persons providing administrative and technical support. The participation to the network will be through the LIRA-Lab (Laboratory for Integrated Advanced Robotics). LIRA-Lab main research themes are in the field of artificial vision with particular emphasis on aspects of learning and sensori-motor coordination from the engineering as well as the computational neuroscience perspective. Ongoing projects are related, specifically, to the exploitation of visual information for gaze control, and in the learning of visually guided manipulation. The experimental experimental set-ups currently available include: 1) 3 binocular robot heads one of which with 5 d.o.f.; 2) Retina-like cameras with wide Field of View optics (140 deg); 3) 2 anthropomorphic robot arms. 4) Hardware and software controllers. LIRA-Lab expertise results from past participation to national and EU-supported projects (ESPRIT and FET projects P419-IMU, VOILA, VAP2, SVAVISCA, NARVAL, CVS, OMNIVIEWS), TIDE project IBIDEM and the participation in TMR networks SMART and VIRGO. DIST has been prime contractor of many EU-supported projects.

10.11 University of Oxford – Robotics Research Group (RRG) of the Department of Engineering Science.

The Department of Engineering Science is large by the standards of most UK universities. It currently comprises 65 academic staff, 100 research assistants, more than 200 research students, and more than 600 undergraduate students. It publishes some 300 scientific papers annually and attracts research support from over 140 companies and agencies. It has consistently achieved top UK government ratings for research excellence. It enjoys the position of a premier graduate school, attracting numerous top-quality graduate students each year, many on scholarships such as the Rhodes, Commonwealth etc. The department provides excellent mechanical, electrical and computing technician services, and access to first class library facilities.

The RRG is one of the largest and best known in its field in Europe, with five faculty and around seventy researchers in total. The group has been involved in a number of previous Esprit BRA's (FIRST, INSIGHT, SECOND, INSIGHT-II, VIVA,IMPACT) as well as ACTS Project AC074 VANGUARD. It is currently involved in the EC LTR Project Vibes, and the EC development project SCREEN. Its faculty have consulted widely for major companies such as Siemens, IBM, GE and Sharp, and enjoy extensive industrial support for their research. Government support has included substantial grants from the Engineering and Physical Sciences Research Council, the Department of Trade and Industry and the UK Defence Research Agency. The RRG has extensive experience with standard computer vision and image processing techniques through applications ranging from satellite images (determining rural areas) through to inspection of agricultural products (detecting weeds). Members of the RRG have won many major prizes: the Marr Prize (ICCV) five times, SPIE Medical Image Analysis prize, and the UK best thesis award in Computer Science four times. Members of the group have started several companies (e.g. Guidance Control Systems, Mirada Solutions Ltd., Oxford Biosignals Ltd.) and have been awarded many patents. Members of the RRG have authored numerous monographs: Numerous research monographs and edited collections of articles. The most recent of these include *Mammographic Image Analysis* (Brady & Highnam, Kluwer), *Active Contours* (Blake & Isard, Springer)***;*** *Analogue Neural VLSI* (Tarassenko, with Prof. A. Murray - Edinburgh); *A Guide to Neural Computing Applications* (Tarassenko); *Vision Algorithms: Theory and Practice* (Zisserman, Triggs and Szeliski; Springer); *Multiple View Geometry in Computer Vision* (Hartley and A. Zisserman; CUP. Recently, the Medical Vision Laboratory, which forms part of the RRG, was

awarded an £8M EPSRC-MRC Interdisciplinary Research Consortium (IRC)[7], which Professor Brady directs. Dr. Alison Noble has won a MRC career development award, the only one in a department of engineering. Professor Brady has been elected FRS, FREng, FIEE, and was awarded the Institution of Electrical Engineers' Faraday Medal – its highest award – largely for his work on medical image analysis, and the US IEEE Millennium Medal for the UK. Professors Zisserman and Murray have been awarded personal chairs, and Dr. Fitzgibbon has a Royal Society Research Fellowship.

10.12 Technical University of Vienna (Institute of Flexible Automation)

Pattern Recognition and Image Processing Group (PRIP)
Institute of Computer Aided Automation

The Pattern Recognition and Image Processing Group was founded in the year 1990 and is headed by Prof. Kropatsch. It is concerned with the theoretical foundations of the field and selected applications in natural and technical sciences both in teaching and in research.

The group plays an active role in various national and international activities. It coordinated from 1994 to 2000 an Austrian wide research program in the field of digital image processing and pattern recognition and has many active cooperations with other university institutes within Austria and abroad. The group coordinates an ERASMUS-Program and has organized international conferences (among them DAGM 1994, ICPR 1996 and ICANN 2001).

PRIP participates in the IST-Project 3D Murale (EC 5th Frame Program), project partners are Brunel University, ETH Zürich, Leuven University, Eyetronics, Imagination and TU-Graz.

Since 2000 PRIP is leading two out of five research areas within the K+ Competence Center Advanced Computer Vision (ACV).

The research activities of the group include theoretical and application oriented research. The areas of active theoretical research are: Graph-based Image Analysis; 3-D Computer Vision; Hierarchical Representations and Robust Methods; Neural Networks and Adaptive Methods; Appearance based Object Recognition.

Application oriented research using the results from the theory is done in the following areas: Micro-array Image Analysis in Biotechnology; Art History; Computer Aided Classification of Ceramics; Industrial Vision; Image Databases; Image Compression; Face Recognition.

Institute of Computer Aided Automation
The Institute of Flexible Automation is part of the Electrical Engineering Department at the Vienna University of Technology. INFA employs 32 persons most of them researchers graduated in the fields of Electrical and Mechanical Engineering, Business Management, Physics, and Computer Science. INFA strongly emphasises the close co-operation with industry. As a consequence three quarters of the employees are directly funded by national, European and American industry.

The expertise of INFA comprises holistic simulation of manufacturing, technology planning, metrology and quality insurance, and sensing in automation and robotics. The largest group (Sensing for Robotics) within INFA is funded by industry and research grants and developed expertise in machine vision over the last eight years. These projects use the experience of INFA in visual inspection, automated quality assurance, colour imaging processes, high-speed controlled shuttering and vision-based control of motion. A few of the industrial partners of INFA are FESTO, AVL, IAEA, Daimler Chrysler, Rauscher, Rockwell Automation, and Wagner-Birò.

[7] This was one of five successful IRC bids out of 120 applications. It involves Oxford, Manchester, UCL, and King's (Guy's).

The Sensing for Robotics Group at INFA is focused on enhancing the capability of robots and automation equipment using video and range cameras. The national research project Portime (1996 to 2001) has the goal of devising robust cue integration methods for real-time tracking and finding (task-driven recognition). Knowledge about the target is used to focus the attention and to reduce the processing burden. These results have been exploited and enhanced in the Esprit project RobVision (1998-2000), which developed integration techniques for an active vision system to navigate a climbing robot into a ship section. With the shortly starting ActIPret project, INFA works in a consortium to interpret activities of expert users and to build up an indexable activity plan. Using the cognitive ability of the vision system it will become possible to understand the expert's activities. The present approaches focus on task/context-driven vision, on specialised/focused processing and on the integration of multiple cues.

In summary, the vision of INFA is to develop a cognitive vision system that enables personal robot tasks such as bringing objects and loading the dish washer in home environments. The technical goal is therefore to develop robust perceptive vision methodologies and techniques for tracking and object finding.

10.13 ETH-Z BIWI & KUL Visics

The group involved is the Computer Vision Group 'BIWI' of the Department of Information Technology and Electronics of the ETH Zurich. The group consists of about 20 researchers. The main topics of research are texture analysis and synthesis, gesture recognition and tracking, animation, recognition and cognitive vision, and medical image processing. The group is currently involved in four European IST projects and its member are of ten different nationalities. Other major projects include interdisciplinary ETH projects on wearable computing and the design and building of networked CAVEs for remote collaboration, as well as a Swiss-wide project (NCCR) on medical image processing. Members of the group have already won several ETH medals for outstanding PhD work.

The group at Katholieke Universiteit Leuven who will be partner in the ECVision network is the group Visics -- VISion for Industry, Communications, and Services -- which is part of the Center for the Processing of Speech and Images at the ESAT department (Electrical Engineering). The team has about 25 members, five of whom are postdoc. The focus of research is on object recognition, cognitive vision, 3D shape extraction and manipulation, visual inspection, and remote sensing. The group has ample experience with European collaboration, and has been involved in several IST projects. The group has received several prizes for its work, including a Golden Eye Award, a David Marr Prize, two TechArt Awards, a Krypton nomination, and several Barco prizes for master and PhD Theses.

10.14 University of Hamburg, CSL

The Cognitive Systems Laboratory (CSL) is one of the major research units within the Department of Computer Science (FB Informatik) at Hamburg University. In its 30 years of research and teaching the unit has attained international recognition in Computer Vision, Knowledge Representation and related areas of Artificial Intelligence.

The research team currently comprises16 scientists and 2 technicians engaged both in basic research and application oriented work with industrial partners. There is close cooperation with two further AI groups at the same department (headed by Prof. Habel and Prof. v. Hahn).
In Computer Vision the work of CSL on natural-language description of dynamic scenes belongs to the pioneering contributions to the field. Current work is focussed on knowledge-based prediction and formal methods for spatial and temporal reasoning.

10.15 University of Bielefeld, UB

Introduction

The Research Group for Applied Computer Science is part of the Department of Computer Science within the Faculty of Technology. The group participates in several graduate programs (`Task-orientated Communication', `Structure Formation', `Bioinformatics', and `Strategies and Optimization of Behaviours'), the International Graduate School in `Bioinformatics and Genome Research', and the Collaborative Research Center `Situated Artificial Communicators'.

The Applied Computer Science Group is conducting research in the area of pattern analysis, computer vision, and speech understanding. Common goal is to compute a symbolic description for real sensor signals, which is appropriate for a given task. Currently the problem domains of man-machine communication using the modalities vision and speech, dialog systems and applications to the field of natural sciences are investigated.

The research group has a staff of 20 PhD students, 2 post-doctoral researchers, 1 assistant professor and 1 full professor.

Research Focus

The main research activities of the group concern problems in the field of pattern recognition, automatic signal interpretation, cognitive systems, and computer vision.

A considerable amount of the research efforts are carried out within the Collaborative Research Center `Situated Artificial Communicators' which is to model the ability of a human being to understand visual and acoustic information, to speak, and to plan and execute actions. To fulfil the requirements of this demanding project statistical and knowledge-based methods are combined in a hybrid system. Especially techniques for object recognition, modelling of mechanical assemblies, qualitative modelling of spatial relations, recognition of manipulation actions, integration of speech and vision processing using a probabilistic reasoning calculus, and architectures for large distributed pattern analysis systems are developed.

A further focus of research is concerned with the development of techniques for the intelligent navigation in digital image databases. In order to formulate the database queries on a natural way, multimodal interaction by gesture, speech, and keybord/mouse is investigated. Besides the low-level vision tasks we concentrate on intelligent strategies which dynamically learn from the user's feedback the relevant aspects of the current and future queries. In addition we work with mosaic images to provide a compact representation for scene exploration. Our research is primarily focused on developing appropriate algorithms and heuristics for generating mosaics and suitable data structures for representing them. The experience gained from building complex artificial communicators, developing intelligent retrieval systems, and working with mosaic images can directly be used for the proposed project.

Further research activities in our group are the development of spoken language dialogue systems, video-based handwriting recognition, the analysis of biological images, and flexible protein docking.

Connections with industry

In addition to these projects several cooperations with industrial partners in the fields of image databases (DTS GmbH), content-based image retrieval (ADAM OPEL AG, Infineon Technologies AG, Honda Research & Development Europe), mobile internet services (Bertelsmann AG), image analysis (DaimlerChrysler AG), analysis of nuclear magnetic resonance spectra (BASF AG), analysis of microarray images (Epigenomics GmbH), and man machine interaction (Boehme Datentechnik) are being pursued.

10.16 University of Erlangen (Institute for Pattern Recognition)

The Institute for Pattern Recognition from the University of Erlangen has been working for 20 years in the area of image processing and analysis. Currently research is done in 3D object recognition, 3D object tracking, optimal sensor data acquisition and fusion, camera calibration, 3D reconstruction, image-based object and scene modelling, augmented reality, and medical image processing:

- Optimal camera parameter selection is one current research goal in several applications. This includes optimal viewpoint selection for object localization and recognition, gaze control for robot self-localization and optimal focal length selection in object tracking. Extensions in reinforcement learning and an information theoretic framework have been developed to select optimal sensor data to solve a given problem. Closely related is the problem of sensor data fusion for which particle filter approaches are exploited.

- Appearance-based 3D object recognition is done using statistical and eigenspace approaches as well as neural networks. For the statistical methods, object models are represented by mixture densities of object appearance or features in the eigenspace, with respect to camera geometry, lighting, colour, and object size.

- Structure from motion approaches have been applied for reconstruction of plenoptic scene models (lightfields) from sequences of hand-held cameras. The new technique serves as an alternative to classical geometric descriptions of object scenes. In computer vision plenoptic models are used as scene models for self-localization of robots, and as object model for training statistical classifiers and for viewpoint selection. In medical image analysis plenoptic models are used in computer-aided endoscopy.

- Motion detection and tracking has been studied in several other projects. Active contours and active rays have been used for real-time object tracking in natural scenes. Iterative state estimation is done using particle filter (e.g. CONDENSATION algorithm).

- Image analysis has been done using a knowledge base represented by a semantic network with parallel or sequential control and an object-oriented implementation.

- Service robots in health care environments and in general autonomous mobile systems is one area of application, where the developed algorithms are implemented and tested in natural scenes. This includes object recognition and tracking and vision-based self-localization.

All implementations of image processing algorithms are now done in an object-oriented programming environment which was designed and realized during the last ten years.

10.17 Max Planck Institut für Biologische Kybernetik (Max Planck Institute for Biological Cybernetics) MPIK

The Max Planck Institute for Biological Cybernetics (MPIK) is one of the 81 independently organized research facilities of the Max Planck Society that carry on basic research in the interests of the general public. Since 1993 the thematic focus of the institute is the understanding of cognitive processes. In the Cognitive Human Psychophysics department about 30 biologists, computer scientists, mathematicians, physicists and psychologists work on psychophysical and computational aspects of object and scene recognition, categorization of objects, cue integration and spatial cognition. Computer graphics and virtual reality technology are used to carry out psychophysical experiments in a closed perception-action loop using a motion platform. Haptic recognition of objects is studied in a haptic lab using force-feedback haptic simulators. Face recognition is studied in a face lab using a set of more than 200 laser-scanned 3D head models. Results from this research have already been applied to machine vision systems for the automatic synthesis of faces and facial expressions. Next year the physiological, psychophysical and computational research in the institute will be complemented with a

new department (Theory of Cognitive Processes) that will have its main focus on statistical learning theory.

10.18 University of Freiburg (Laboratory for Foundations of Artificial Intelligence)

The Laboratory for Foundations of Artificial Intelligence at the Albert-Ludwigs-University exists since 1996. The research group has expertise in the following research areas relevant for the proposed network:

- Qualitative spatio-temporal representation and reasoning (as part of the priority programme 'Spatial Cognition' of Deutsche Forschungsgemeinschaft): We analyze the computational complexity of existing qualitative calculi (such as Allen's interval calculus, the topological calculus RCC-8 and the double cross calculus), design reasoning algorithms and combine different formalisms. In addition we investigate alternative formalisms such as planar graphs with topological constraints. This research is funded by DFG. [See also http://www.informatik.uni-freiburg.de/~sppraum/]

- Multi-robot systems in dynamic environments aka 'RoboCup'. We have designed and implemented a team of robotic soccer agents in the F2000 RoboCup league that won the worldchampionship in 1998, 2000 and 2001. The success of the team is based on its superior self-localization method based on laser range finders and on its flexible action selection mechanism. This research is funded by DFG and SICK. [See also http://www.cs-freiburg.de]

- Efficient action planing: In the past three years, we have designed and implemented two planning systems -- IPP and FF -- which won the respective planning system competitions at the international AIPS planning conferences in 1998 and 2000. They are both based on advanced search techniques that allow to generate actions plans with a size two orders of magnitue larger than planning system in the last decade could generate. [See also http://www.informatik.uni-freiburg.de/]

10.19 Université Joseph Fourier (Laboratoire TIMC)

The TIMC laboratory (Techniques de l'Imagerie, de la Modélisation et de la Cognition) is part of the IMAG Institute, a federative research center evolving from UJF (Grenoble Scientific University), CNRS (National Center for Scientific Research) and INPG (Grenoble Polytechnic Institute), and fostering fundamental and applied research in the field of Computer Sciences and Applied Mathematics. The TIMC laboratory is also a CNRS Associated Unit (UMR n° D 5525). The laboratory has a permanent interdisciplinary research staff of about 50 people with expertise in mathematics, computer science, medicine and biology. Its main objective is to contribute to progress in the health care domain, by fostering advanced research in the field of biomedical information processing and data modelling. The laboratory is organised into a number of research groups, one of which will participate in the project, under the responsability of C. Garbay : the Integrated Cognitive Systems Group.

The group is aimed at designing systems able to develop complex interaction schemes with their physical and human environments for the modeling, simulation and solving of complex problems. The keywords for such design are the ones of cooperation, adaptation and distribution. Two different metaphors are being currently studied : the cognitive metaphor, according to which the emphasis is rather on the symbolic representation of knowledge and tasks, and the biological metaphor according to which the emphasis is rather on the capacity to adapt and evolve dynamically in an unknown and unpredictable environment.The group has been concretely involved in projects dealing with user modelling, knowledge acquisition, cytological diagnosis and medical image interpretation and

processing. Distributed Artificial Intelligence methods are used to support the designing approach and to highlight the role of interaction in the development of complex solving strategies. The group currently comprises 2 graduates and 6 undergraduates researchers from various disciplines (software engineering, biomedical engineering and medicine).

10.20 Ecole Nationale Supérieure des Télécommunications (GET/ENST)

GET/ENST principle vocation is to train engineers for the public and private sectors of IT. ENST's activities cover all the fields relative to information and communications sciences and techniques. It is located in Paris. It is associated with CNRS (URA 820)

The Signal and Image Department (TSI) is one of the 4 departments of ENST; it consists of about 45 permanent academic staff and 50 Ph'D candidates. The Image Analysis and Understanding Group (TII Group) has been investigating image processing, image analysis, pattern recognition, 3D object acquisition and processing for over 25 years. It consists of 8 academic staff and 15 Ph'D candidates. Its main theoretical background is with Morphological Mathematics, Markov Random Fields, Wavelets theory, Fuzzy Sets and Evidence Theory, Spatial Reasonning, Image Fusion theory, *etc.*

The Group currently develops 3 main applications:

1. Aerial and satellite image processing with a special attention to 3D modeling and mapping of urban areas, cartography, data fusion and interpretation.
2. Medical Image Processing and mostly 3D brain imaging from multi modalities, for both anatomical and functional applications
3. Museum objects processing (painting, sculptures, archeological objects, etc.) for archiving, archiving, dissemination and high quality display.

10.21 École Nationale Supérieure de Physique de Strasbourg - Université Strasbourg-I Louis Pasteur (Laboratoire des Sciences de l'Image, de l'Informatique et de la Télédétection UMR-CNRS 7005) (MB 22)

The **University of Strasbourg-I** (Université Louis Pasteur or ULP) is one the largest scientific universities in France. As an Engineering Faculty of the University Strasbourg-I, the **École Nationale Supérieure de Physique de Strasbourg** (ENSPS) has to contribute strongly to R&D activities and this, often, in cooperation with industry (in particular in topics addressed in this annex such as image processing, machine vision and computer sciences). Research hosted by the faculty is thus strongly linked with engineering sciences (Computer Sciences, Automation, Electronics, Photonics, Information Processing, Bioengineering, etc.). The research structures on site group about 250 persons (half of them are research staff, professors and assistant professors, the others being Ph.D. students and technical staff). The Institute concerned by this project is the **Laboratoire des Sciences de l'Image, de l'Informatique et de la Télédétection** (LSIIT, UMR-CNRS 7005), the largest Institute hosted by the ENSPS, with following research departments (nearly 100 persons, half of them being permanent staff) :

* A. Computer based Geometry and Graphics (Discrete geometry for image sciences, spatio-temporal modeling and animation, formal methods for geometric modeling),
* B. Models, Image and Vision (Discrete geometry for image analysis, spatio-temporal multi-image evaluation, illumination and light-matter interactions, comparison of images, machine vision and knowledge extraction from images, development of ultra high speed full resolution CCD sensors and expert systems for low level vision),
* C. Vision Based Control and Automation (Visual perception and robotics, vision based control),
* D. Remote Sensing (Radiometry and spatialisation).
* E. Parallel and distributed computing.
* F. Bio-informatics.

As far as this project is concerned, Department B (5 professors, 8 assistant professors, an engineer, 8 Ph.D. students and a variable number of temporary staff (e.g. students working towards their Master Thesis) will mainly be involved around its research topics on architectural developments for computer

vision systems and on theoretical foundations for the comparison of real images with conceptual (synthetic) images. Specifically, the interaction between image synthesis and image analysis is investigated. The main objective of this group is to contribute to the development of generic knowledge based computer vision relying on multiple view integration, data fusion, active vision and knowledge based feature extraction. Privileged application fields are metrology, medical imagery and virtual/augmented reality. Lastly, the department is tightly coupled with Transfer Centers and sets up presently a demonstration center for Computer Vision.

10.22 Universiteit Utrecht (Helmholtz Institute)

The main effort of the Helmholtz Institute is concentrated on information processing in the human brain related to perception of the environment. This includes the study of sensing, perception, motor control, and perceptual-motor integration. It is important to realise that all these parts are closely interrelated. Motor systems can aid perception by serving as a vehicle for active exploration of the environment, such as during manual exploration of an object. Motor systems, however, may also deteriorate sensory information and thus interfere with perception. Motor control and perception are studied as different manifestations of the same information processing system.

The efforts of the Helmholtz Institute cover vision and hearing as well as haptic, equilibrium, proprioceptive and electroreceptive systems. These sensory systems are the major carriers of information enabling animals and humans to gain knowledge about their environment. Specific knowledge, skills and techniques with respect to the different parts are brought together in the institute. A major aim is to profit from the variety of approaches. The contributions of all participants is needed to approach the main problems in the perception of natural and artificial sensory environments.

In modern society, human beings are confronted with untraditional forms of sensory information such as computer graphics, sound machines and virtual environments. Applications are already found in the areas of medicine, navigation, entertainment, process control, etc. The new forms of information provide unprecedented opportunities for healthy and as well as impaired people. For instance, think of medical imaging, simulation of working environments, aids for auditory or visually impaired people. The new forms of sensory information pose many challenging problems. Questions include how we should present new types of information in order to be useful and how we can learn to interact with new sensory environments. To solve these problems we will need and use techniques from psychology, psychophysics, biophysics, electrophysiology and neural networks. In the institute we use these techniques in the study of the perception-action cycle. These studies will provide an important base for the design and evaluation of artificial sensory environments.

10.23 IST/ISR – Instituto Superior Técnico (Instituto de Sistemas e Robótica)

The Instituto Superior Técnico (IST) is the largest and oldest engineering school in Portugal, with a large record of participation in international researcher projects. At the research level, the work described in this project will be carried out at the Computer Vision Lab (VisLab) of the Instituto de Sistemas e Robótica (ISR).

ISR is a national research organization established in 1991 involving a total of 127 scientists, 61 of which hold a PhD degree. ISR is an institution that intervenes in the areas of Computer Vision, Robotics, Automation, Control, Signal Processing, Aeronautics, Physical Acoustics and Energy Management and Production, with an emphasis on Systems Theory. It comprises 3 laboratories: Lisbon, Porto and Coimbra. The Lisbon laboratory is integrated in the Instituto Superior Técnico (IST).

The VisLab has been involved in various research projects in areas related to Computer Vision and Robotics. It has solid expertise in several problems, particularly in the areas of vision based control,

active vision and vision-based navigation. The group has been involved in a number of projects where principles of biological vision systesm (e.g insect vision) have been studied and applied in the context of robotics and vision, in general.

10.24 Swiss Federal Institute of Technology Zurich (ETH Zurich)

The Perceptual Computing and Computer Vision group has been founded in the fall 1999 at ETH and is headed by Professor Bernt Schiele. Currently the group includes 7 PhD students and a varying number of master students. The main research topics of the group are perceptual computing and sensor integration from a multitude of sensors. More specifically the group is interested in statistical learning methods, integration of multi-modal sensor data, perceptual computing, computer vision, robotics, wearable computing, and ubiquitous computing. The group is particularly interested in developing methods which work under real-world conditions. Selected publications can be found on the following webpage: http://www.vision.ethz.ch/schiele. The application areas are in the fields of robotics, wearable and ubiquitous computing.

10.25 Ecole Polytechnique Federale de Lausanne (EPFL)

Research at the Computer Graphics Laboratory (LIG) is oriented towards the simulation of Autonomous Virtual Humans in Virtual Worlds. We emphasize the aspects of motion control and the simulation of high-level behaviors based on physical laws, artificial intelligence, and autonomous agent technology. We develop models for autonomy and perception based on real and virtual sensors: visual, auditive, and tactile. We also develop multimodal interactions with Virtual Humans. There are 6 main Research areas at LIG: Motion Control, Artificial Life and Behavioral Animation, Shared Virtual Environments, Vision and Augmented Reality, Body deformations, and Standards for body description and animation (VRML, MPEG-4).

10.26 Linköping University (Computer Vision Laboratory)

The Computer Vision Laboratory (CVL) at Linköping University is doing research in computer vision, signal processing, robot vision and learning. CVL was formed in 1982 and has about 15 researchers, doctorate students and visiting scientists.

CVL is participating in a major project, WITAS: The Wallenberg laboratory for research on Information Technology and Autonomous Systems. The funding of the entire project is about 15 M Euros over 7 years. The research goal of this project is to do high quality research on topics which are relevant to the design of autonomous systems. The system goal is to develop an intelligent autonomous helicopter, and to demonstrate its performance before the end of 2003.

Other projects involve:

- Content based search in image databases
- A high performance learning architecture
- Unrestricted, view independent recognition of 3-D objects

The lab has also developed web based teaching tools for interactive education in computer vision. In 1983 members of the lab started a company ContextVision, which is today listed on the stock exchange.

The Computer Vision Laboratory has participated in several international cooperation projects such as in the ESPRIT programme and the EUREKA programme, as well as in The International Consortium for Medical Imaging Technology, ICMIT.

10.27 University of Manchester (Division of Imaging Science & Biomedical Engineering)

ISBE is the Image and Signal Computing research group of the Division of Imaging Science and Biomedical Engineering (ISBE) at the University of Manchester in England. This multi-disciplinary research group draws on knowledge from physics, mathematics, computing, bioscience and clinical medicine to develop new ideas and methods with applications in health, industry and commerce. The research of the group involves applying computer modelling and pattern recognition techniques to the analysis and interpretation of a wide range of images and signals. The Image and Signal Computing research group of ISBE was originally set up in 1977 as the Wolfson Image Analysis Unit and is one of the longest established computer vision groups in the UK. It has been at the forefront of development of many developments in image analysis including automated chromosome analysis, active shape models, active appearance models, mammographic prompting, visual inspection of printed circuit boards, and neuro-imaging. It was rated 5 (out of 5) in the last research assessment (RAE 96). It has secured extensive research council funding, from both the biological sciences and engineering and physical sciences council, totalling about 2 million Euro per year. The group presently encompasses over 50 staff and students, including 20 involved in image analysis. The group is run by Professor Chris Taylor who holds joint appointments in the Departments of Medical Biophysics and Computer Science and has been involved in machine vision research for 30 years. Current activities include computer vision, medical image analysis, face recognition, industrial inspection and signal interpretation in critical care. In recent years there has been significant progress in the automatic interpretation of images of human faces. The applications of such techniques includes: access control, behaviour monitoring, expression recognition, image enhancement, synthesis, database indexing, and many others. Existing techniques tend to address each of these areas individually, producing highly specific solutions to well-constrained problems. The aim of the Faces work is to develop a generic approach to all these applications, providing a single, unified system capable of performing any face interpretation task in a wide range of circumstances, from high-resolution stills to low-resolution and noisy video images.

The group has an active faces group led by Prof. Chris Taylor and comprises one research fellow, two research assistants and 2 PhD students. The group has developed generic shape modelling techniques suitable for human faces. The group has been awarded best paper prizes for its work in facial modelling at both Face and Gesture (Japan, April 1998) and the European Conference on Computer Vision (ECCV, Germany, June 1998).

Currently ISBE is involved in the EU UFACE project (User friendly access control systems for financial and healthcare applications) which aims to develop and demonstrate user friendly secure access control in physical access control healthcare. This will be done by combining a facial biometric with a smart-card to create a personalised token which will be integrated into the emerging biometric interface standards.

Via its technology transfer company, Visual Automation Ltd, it is also involved in the IST training project PCCV (performance characterisation of computer vision techniques June 2000- Sept 2002). This project includes activities to collate information on and to distribute data sets of use in testing, assessing and validating computer system methods for specific applications and application classes. Another related project is in behaviour analysis of laboratory animals (Characterising Behavioural Phenotypes Using Automated Image Analysis), in particular rats and mice. The aim is to be able to detect and recognise specific behaviours in solo and paired animals. This is nationally funded (1999-2002) and is in collaboration with a pharmaceutical company.

10.28 Leeds University (School of Computing)

The School of Computing at Leeds University is one of the largest research-based computer science departments in the UK. Within the School, the Computer Vision and Knowledge Representation groups have been in existence for over 10 years and now have a total of nine permanent members of academic staff.

The Computer Vision group has pioneered the development and application of spatio-temporal dynamical models for the analysis of images depicting non-rigid objects such as people and animals. Early work on tracking has developed into a broader interest in behaviour, with application to surveillance, animal husbandry, and human-computer interaction. A key feature of this work is the acquisition of object and event models from video corpora using statistical learning procedures. The overall approach is aimed at producing systems that are robust, scaleable and autonomous - essential requirements in most applications. This work is funded by grants from the EU, UK research councils and industry.

The Knowledge Representation group has developed a variety of calculi for handling qualitative spatial information, including the well known RCC mereotopological language and calculi for handling orientation information and for dealing with vagueness, uncertainty and granularity changes. The group is concerned not only with underlying ontological issues, but also with developing both theoretically complete calculi but also decidable and tractable subsets for efficient reasoning. The group has collaborated with the Computer Vision group in applying qualitative spatial calculi to video interpretation.

10.29 University of Surrey (UniS)

The Centre for Vision, Speech and Signal Processing (CVSSP) of the University of Surrey (UniS) is one of the UK largest group in image analysis and computer vision. Research in the Centre for Vision, Speech and Signal Processing (CVSSP) focuses on image interpretation and understanding.
The Centre enjoys international reputation for its contributions to engineering science of image processing and to machine perception system design methodology. In many research topics it is acknowledged as a leading player, including sensory data representation and, in particular, the identification of significant attributes for sensory data interpretation. Its expertise includes

- contextual decision
- percpetual grouping based on the Hough transform and hypothesis testing
- scene evolution modelling and control of perception
- self optimisation of computer vision systems
- 3D modelling

The Centre successfully participated in a number of EU projects in computer vision (VAP, VAP2, RETINA, SAM) image communication (SCALAR), visual inspection (AVIS, ASSIST), personal identity verification (M2VTS). As part of the M2VTS project CVSSP recorded a large multimodal database for research in biometric personal identity verification.

11 Description of the Participants (Ordered by Participant Number)

11.1 Biographical Sketch for David Vernon

David Vernon (1958) graduated in Engineering from Dublin University, Trinity College, in 1979, beginning his career with Westinghouse Electric Inc. where he worked as a system software engineer until 1981. He was appointed a Lecturer in the Dublin University, Trinity College, in 1983. From 1991 to 1993, he worked as a Scientific Officer in the European Commission and from 1994 to 1995 he was responsible for the development of a university-wide policy on information systems at Trinity College. He was appointed to the Chair of Computer Science at the National University of Ireland, Maynooth, Ireland, in 1995 where he was also Head of Department. Since 1999, he has been working free-lance in the Middle East. He was the Programme and General Chair of the Sixth European Conference on Computer Vision (ECCV) in Trinity College Dublin in 2000. His recent research activities have been concerned mainly with the use of Fourier repesentations for image analysis and with the characterization of facial shape for reconstructive surgery. He is the author of two books on computer vision and a co-editor of three others. He has published over eighty papers in the fields of computer vision and computer science. Professor Vernon is a past Fellow of Trinity College Dublin, he is a Chartered Engineer, and a Professor of Computer Engineering.

11.2 Biographical Sketch for Wolfgang Förstner

Wolfgang Förstner was born in 1946. Since 1990 he is a full professor of photogrammetry and the director of the Institute for Photogrammetry at the University of Bonn. He received his diploma and Ph.D from Stuttgart University, Germany in 1971 and 1976. After secondary education, 1971-1974, and work at the Survey Department Nordrhein-Westfalen, Dept. for Automation,1974-1977, he was Research Assistant at the Institute for Photogrammetry at Stuttgart University from 1977-1989.
He is responsible for the education in photogrammetry, image understanding, remote sensing and GIS of students in surveying engineering and for those students from computer science, who take photogrammetry and image understanding as second subject. The lectures include introductory and basic courses (40 students per year) and advanced courses (5-15 students per year). Since 1996 he has supervised 15 Ph.D students and 18 Diplom theses.

He co-authored three papers which received the DAGM-Award (Deutsche Arbeitsgemeinschaft für Musterekennung) in 1989, 1998 and 2000, and also in 2000, he received the "Gino Cassinis" award, sponsored by the Italian Society of Topography and Photogrammetry (SIFET), for his contribution to the enhancement of mathematical and statistical foundation of Photogrammetry.

11.3 Biographical Sketch for Monique Thonnat

Monique Thonnat is a Monique Thonnat (1957) is Director of Research at INRIA in Sophia Antipolis. She received in 1980 a diploma of engineer ENSPM and a DEA (Master thesis) in Signal and Spatio Temporal Systems from University of Marseille. In 1982 she received her PhD degree in Optics and Signal Processing from University of Marseille III. Her PhD was prepared in the Spatial Astronomical Laboratory of CNRS. (Subject : interactive data reduction methods for astronomical plates: background restitution and radial velocity computing). In 1983 she joined INRIA (French National Institute for Research in Computer Science and Control) in Sophia Antipolis on French Rivierra as full time research scientist (Chargée de recherche 1ère classe) in the PASTIS group headed by M. Berthod. She became Director of Research in 1991 then in 1992 she created the Orion action and in 1995 the Orion project, a multi-disciplinary research team at the frontier of computer vision, knowledge-based systems, and software engineering.

Monique Thonnat is author or co-author of more than 70 scientific papers published in international journals or conferences. During 3 years (from 1979 to 1982) she worked on image processing

techniques for astronomy in the Spatial Astronomical Laboratory of CNRS. In Marseille. Then in 1983 she moved to INRIA where she worked on pattern recognition and artificial intelligence techniques for complex object recognition (as galaxies, zoopanktons or fishes) and on computer vision for the automatic interpretation of 3D stereo data of indoor scenes or of road scenes (Prometheus). She also developed computer vision and knowledge-based systems for automating the construction of image processing systems (OCAPI). Her more recent research activities involve the conception of new technics for the reuse of program (or program supervision) and on image understanding techniques for the interpretation of video sequences. Monique Thonnat has supervised 11 PhD theses . She teaches computer vision and artificial intelligence in universities and in several High Engineer Schools. She is directly involved in the application of her research in the industrial domain; in particular in the framework of european projects (Eureka Project PROMETHEUS, Esprit Project PASSWORDS, Esprit Project AVS-PV, Esprit Project AVS-RTPW, Climate and Environment Project ASTHMA, IST project ADVISOR).

11.4 Biographical Sketch for Jim Crowley

James L. Crowley holds the post of Professor at the Institut National Polytechnique de Grenoble (INPG). He teaches courses in Computer Vision, Signal Processing, Pattern Recognition and Artificial Intelligence at l'Ecole National Superieure d'Informatique et de Mathematiques Appliques (ENSIMAG). Within the Laboratory GRAVIR of the Institut IMAG, Professor Crowley directs the project PRIMA. PRIMA has as its goal the development of techniques for observation of human action, with applications to intelligent environments and man-machine interactoin. Project PRIMA has developed a new approach to visual perception and recognition based on representations of local appearance. The project is currently applying these techniques to problems of object recognition, recognition of faces and facial experssions, gesture recognition, and recognition of human activities. Applications include computer assisted communications and man-machine interaction.

From 1995 to 2001, Professor Crowley has coordinated the DG XII TMR network SMART II whose subject is the development of techniques for surveillance and monitoring. He has recently served as founder and coordinator ot the European Computer Vision Network (ECVnet), the EC "Network of Excellence" in Computer Vision. He has served as the technical coordinator of project ESPRIT basic research project BRA 3038/EP 7108, "Vision as Process" from 1989 to 1995. The VAP Project developed active vision heads, model architectures for real time continuously operating computer vision systems, and a theory of control of perception.

In the area of mobile robotics, Professor Crowley has developed systems for world modeling and navigation using computer vision and ultrasonic range sensors. Versions of these systems have been used in several commercial mobile robot navigation systems.

Professor Crowley has edited two books, four special issues of journals, and over 150 articles on vision and mobile robotics. He ranks number 1675 in the CiteSeers most cited authors in Computer Science - April 2001 (ResearchIndex).

11.5 Biographical Sketch for Henrik I. Christensen

Henrik I. Christensen (1962) is a full professor of computer science and the director of the Centre for Autonomous Systems, at the Royal Institute of Technology. He received M. Sc. EE and Ph. D. degrees from Aalborg University, Denmark in 1987 and 1989, respectively. He was a research associate and associate professor at Aalborg University, 1989-1996. In addition he has held visiting positions at Oak Ridge National Laboratory and University of Pennsylvania. Dr. Christensen has been involved in a significant number of EU projects including BR-3038-Vision as Process, EP-7108-Vision as Process II, and the TMR Networks SMART, CAMERA, and VIRGO. Dr. Christensen has published more than 120 papers in the areas of vision, robotics, control and artificial intelligence. He is an associate editor of IEEE Trans. of PAMI, Machine Vision and Applications, International Journal of Pattern Recognition and Artificial Intelligence, AI Magazine, Robotics and Autonomous Systems, and MIT

Series on Autonomous Robots and Intelligent Agents. His primary research interests are in system integration, active vision, and hybrid dynamic systems.

11.6 Biographical Sketch for Bob Fisher

Robert B. Fisher received a B.S. with honors (Mathematics) from California Institute of Technology (1974) and a M.S. (Computer Science) from Stanford University (1978). He received his PhD from University of Edinburgh (1987), investigating computer vision in the Department of Artificial Intelligence. Dr. Fisher is a Reader in the Division of Informatics at the University of Edinburgh and is the Director of the Institute of Perception, Action and Behaviour. His research covers topics in high level and 3D computer vision, and has coauthored or editted 6 books and published more than 150 research papers. Recently, he was the General Chair of the Int. Symp. on Virtual and Augmented Architecture. He directs research projects investigating three dimensional model-based vision and automatic model acquisition of industrial objects and buildings. He teaches general and industrial vision courses for undergraduate, MSc and PhD level students.

11.7 Biographical Sketch for Patrick Courtney

Dr Patrick Courtney has been managing the activities of Vision Automation Ltd. since 1997 and is member of the board of directors. Prior to that he worked at ITMI, part of the Cap Gemini Group in France for 4 years, managing international RTD projects (with between 5 and 7 partners) for the European Space Agency between 1995 and 1998. He served on the management board of the EC-funded Computer Vision network of excellence ECVnet, with particular responsibility for the benchmarking activity. He has 5 years post-doctoral research experience in computer vision at the University of Sheffield (UK) where he served as work-package leader for an ESPRIT 3 project. He has over 25 publications in the area, and has organised or served on the committee of 5 workshops on the topic of performance characterisation of vision techniques for applications. He is a member of the IEEE, ACM and BMVC and is an action editor of Videre. He teaches at the EPSRC PhD summer school in vision. He acted as a reviewed for a number of EU funded trial projects applying vision technology. Specific expertise: The particular expertise relevant to this project is in working in and coordinating European projects, computer vision technology transfer.

11.8 Biographical Sketch for Hilary Buxton

Hilary Buxton is Professor of Visual Intelligence, University of Sussex. She has a background in cognitive science BSc (Bristol) and PhD (Cambridge), and research on temporal aspects of perception. This research has developed computational theory for both human and machine vision systems, resulting in publication of more than 100 journal and conference papers. Past projects focussed on biological motion understanding under JCI, medical visualisation under IED, and visual reasoning and control in advanced vision systems under ESPRIT project `Visual Inspection and Evaluation of Wide-area Scenes' (VIEWS) (RFs Shaogang Gong and Paddy Toal) and EPSRC project `Behavioural Analysis for Visual Surveillance' (RF Richard Howarth). More recently, she was principal investigator of EPSRC project `ISCANIT: Identity Recognition and Intentional Tracking' (RF Jon Howell) and HCM Network on `Parallel Modelling of Neural Operators for Pattern Recognition' (PAMONOP) and is principal investigator of i3 ESE project on `PUPPET: Educational Puppet Theatre of Virtual Worlds' (RFs Pat George and Malcolm McIllhagga) and new IST project `ActIPret: Interpreting and Understanding Activities of Expert Operators'. She is also currently supervisor of seven DPhil research students which include EPSRC award for the evolution of visuo-motor control (Anil Seth), BBSRC CASE award with BT for biological modelling of multi-sensor orienting behaviour (Jon Bird), active camera control (Hanson Schmidt-Cornelius), visual modelling with dynamic neural networks (Paul Wilkin), genetic algorithm optimisation (Gabriela Ochoa). New projects include modelling of dynamic vision with generative neural nets (Helen Vassilakis) and visual attention modelling using contextual information maximisation principle (KangWoo Lee).

11.9 Biographical sketch for Hans-Hellmut Nagel

Hans-Hellmut Nagel received a 'Diplom in Physik' (1960, Universität Heidelberg), a Dr. rer. nat. (Physik, Universität Bonn 1964), and the 'Habilitation in Physik' (1970, Universität Bonn). In the sixties, he worked at CERN, at MIT, and at the Deutsche Elektronen-Synchrotron (DESY, Hamburg) before becoming one of the first 'Professor für Informatik' at the Universität Hamburg in 1971. There he started a research group on 'Kognitive Systeme', addressing in particular image sequence evaluation with an eye on adapting Artificial Intelligence approaches to the extent possible.

In 1983, he became director of the Fraunhofer-Institut für Informations und Datenverarbeitung (IITB) at Karlsruhe in a joint appointment as 'Professor für Informatik an der Universität Karlsruhe (TH)'. Since then, he has been responsible for many projects in basic, applied, and contract research in the areas of Computer Vision, Artificial Intelligence, and Pattern Recognition. Currently, he acts as coordinator of the CogViSys project sponsored by the European Community.

He has been elected Fellow of the IEEE, of the IAPR, of the ECAI, and has been asked to serve on editorial boards of numerous top ranking international scientific journals.

11.10 Biographical Sketch for Olivier Faugeras

Olivier D. Faugeras is a Research Director at INRIA in the Sophia Antipolis Research Unit, and the leader of the ROBOTVIS Group. He is a member of the French Academy of Sciences.

Current work and related interests include 3D reconstruction of human brain activity from Magnetic (MEG) and Electrical (EEG) data, processing of Brain MR images, application of Differential Invariants and Partial Differential Equations to Computer Vision and Shape Analysis, motion and stereo analysis .

He is involve in the Mapawamo (using advanced techniques of fMRI processing, compare the visual systems in men and monkeys), Insight2+ (understanding of monocular 3D perception) and CogViSys (understanding of the interplay between low level visual perception and high level knowledge; Application to sign language understanding) projects.

11.11 Biographical Sketch for Jan-Olof Eklundh

Jan-Olof Eklundh is since 1986 a professor of computer science at KTH, specializing in computer vision and robotics. He graduated in mathematics at Stockholm University, 1970, and then held positions at the Swedish Defense Research Institute, and during 1977-79, at the University of Maryland. In 1982 he joined KTH, where he 1996 was one of the initiators of the Centre for Autonomous Systems. He has been a partner in numerous EU projects, including 6 ESPRIT projects and 2 TMR networks. Professor Eklundh was 1995-99 Dean of the School of Electrical Engineering and Information Technology at KTH. He is a member of the Royal Swedish Academy of Engineering Science and of the Swedish Research Council for Engineering Science. His research interests cover a broad range of topics in computational vision, image processing, and robotics, including behavioural aspects of perception and perceptually guided autonomous systems.

11.12 Biographical Sketch for Giulio Sandini

Giulio Sandini is a Full Professor at DIST University of Genova, where he teaches the course of "Natural and Artificial Intelligent Systems" for the biomedical, electronic, and informatics curricula offered by the Faculty of Engineering. He spent many years in neurophysiology labs in Italy and the USA where he conducted experiments on different aspects of visual perception. Since 1980 Giulio Sandini has been with the Faculty of Engineering of the University of Genova where he established one of the first Computer Vision groups in Italy and currently coordinates the activity of researchers at

LIRA Laboratory. Giulio Sandini has been a member of programme committees and chairman and co-chairman of international conferences and workshops. He is/was principal investigator of EU-funded projects since 1985. Among them: projects: P419, P2502 (VOILA) SVAVISCA, BRA project P3274 (FIRST) and VAP-II, TIDE project IBIDEM, TMR projects VIRGO and SMART.

11.13 Biographical Sketch for Andrew Blake

Andrew Blake graduated in 1977 from Trinity College, Cambridge with a B.A. in Mathematics and Electrical Sciences. After a year as a Kennedy Scholar at MIT and two years in the defence electronics industry, he studied for a doctorate at the University of Edinburgh which was awarded in 1983. Until 1987 he was on the faculty of the department of Computer Science at the University of Edinburgh and a Royal Society Research Fellow. From 1987 to 1999, he has been on the faculty of the Department of Engineering Science in the University of Oxford, where he ran the Visual Dynamics Research Group, became a Professor in 1996, and and was a Royal Society Senior Research Fellow for 1998-9. In 1999 he moved to Microsoft Research Cambridge as Senior Researcher working in Machine Learning and Perception, while continuing to be associated with the University of Oxford as Visiting Professor of Engineering.

His main research activities are in computer vision. He has published several books including "Visual Reconstruction" with A.Zisserman (MIT Press), "Active Vision" with Alan Yuille (MIT Press) and "Active Contours" with Michael Isard (Springer-Verlag). He has twice won the prize of the European Conference on Computer Vision, with R. Cipolla in 1992 and with M. Isard in 1996, and was awarded the IEEE David Marr Prize (jointly with K. Toyama) in 2001. He has served as programme chairman for the International Conference on Computer Vision in 1995 and 1999, and is on the editorial boards of the journals "Image and Vision Computing", the "International Journal of Computer Vision" and "Computer Vision and Image Understanding". He was elected a Fellow of the Royal Academy of Engineering in 1998.

Recent research work with colleagues at Microsoft Research is looking at audio-visual control of cameras in video communications systems.

11.14 Biographical Sketch for Michael Brady

Professor Michael Brady FRS, FREng BP Professor of Information Engineering at the University of Oxford. Professor Brady's degrees are in mathematics (BSc and MSc from Manchester University, and PhD from the Australian National University). At Manchester University, he was awarded the Renold Prize as the outstanding undergraduate of his year. Professor Brady combines his work at Oxford University, where he founded the Robotics Laboratory and the Medical Vision Laboratory (MVL), with a range of entrepreneurial activities. He is Director of the recently announced EPSRC/MRC Inter-disciplinary research consortium on “From Medical Images and Signals to Clinical Information[8]”. He was appointed Senior Research Scientist of the MIT Artificial Intelligence Laboratory in 1980, and founded its world famous robotics laboratory. In 1985, he left MIT to take up a newly created Professorship in Information Engineering. Professor Brady serves as a non-executive director and Deputy Chairman of Oxford Instruments plc, as a non-executive director of AEA Technology, and, until recently, Isis Innovation (Oxford University’s intellectual property company). Professor Brady is a founding Director of the start-up companies Guidance and Control Systems, Oxford Medical Image Analysis (OMIA), and Oxford Intelligent Visualisation and Analysis (OXIVA). Professor Brady is the author of over 275 articles in computer vision, robotics, medical image analysis, and artificial intelligence, and the author or editor of nine books, including: Robot Motion (MIT Press 1984), Robotics Science (MIT Press 1989), Robotics Research (MIT Press 1984), and *Mammographic Image Analysis* (Kluwer, January 1999). He is Editor of the Artificial Intelligence Journal, and

[8] The IRC involves Oxford University, UCL, King’s College London (including Guy’s Hospital), and the University of Manchester. It also involves clinicians from over 30 specialities and is supported by over 20 companies. The chair of the Industrial Advisory Group will be Professor Will Stewart FREng, who is also a member of the Advisory Panel of the Department of Engineering Science.

founding editor of the International Journal of Robotics Research. He is a member of the Editorial Board of fourteen journals, most recently Medical Image Analysis. Professor Brady was elected a Fellow of the Royal Academy of Engineering (UK) in 1991 and a Fellow of the Royal Society (UK) in 1997. He is a Fellow of the Institution of Electrical Engineers and a founding Fellow of the Association of Artificial Intelligence, and a Fellow of the Institute of Physics. He is a member of the Conseil Scientifique de l'INRIA France. He has been awarded honorary doctorates by the universities of Essex, Manchester, Liverpool, Southampton, and Paul Sabatier (Toulouse). He was awarded the IEE Faraday Medal for 2000 and the IEEE Third Millennium Medal for the UK.

11.15 Biographical Sketch for Walter G. Kropatsch

Prof. Walter G. Kropatsch was born on January 23, 1953, Leibnitz, Austria. Dr.techn. (PhD) on Registration of Satelite Images with Maps from Technical University in Graz in 1982. Habilitation on Image Pyramids and Curves from University of Innsbruck in 1991. Since 1990 Full Professor and head of first Austrian research group on Pattern Recognition and Image Processing ('PRIP') at Vienna University of Technology. Before: Research positions at Center for Automation Research, University of Maryland, USA; University of Innsbruck, Technical University of Graz, Joanneum Graz, A. Several projects including an Austrian joint research program (1994-1999) resulted in more than 160 scientific publications with 74 articles in refereed conferences and 15 journal articles.

11.16 Biographical Sketch for Markus Vincze

Markus Vincze received the Diplomingenieur degree from the Vienna in 1988 and the Master of Science from the Rensselaer Polytechnic Institute, Troy, U.S.A., in 1990, both in mechanical engineering with emphasise on robotics. He received the PhD in 1993 from Vienna University of Technology in Robotics. With a grant from the Austrian Academy of Sciences he spent post-doc years at HelpMate Robotics Inc., with J.E. Engelberger, and at the Yale University with Prof. G.D. Hager working on robust real-time tracking methods. Since 1995 he is leading the Sensors for Robotics Group at INFA. With national and EU-grants he employs five to seven researchers in this group. He was co-ordinator of the RobVision project, which had the successful final demonstration in December 2000. He is now free to devote all his efforts to ActIPret. Mr. Vincze serves as reviewer for the EU, the German research fund, journals such as IEEE Transactions on Robotics and Automation, IJRR, FAIM, several conferences including IEEE ICRA, IROS, and SIRS. He published 45 papers in refereed journals and conferences in the area of vision and together with G.D. Hager he edited a book on "Robust Vision for Vision-based Control of Motion". Beginning fall 2001 he will coordinate the "Cognitive Vision Project" ActIPret – Activity Interpretation, within the same Action Line as ECVision.

11.17 Biographical Sketch for Luc Van Gool

Luc Van Gool is professor at the University of Leuven in Belgium and the ETH in Zurich, Switzerland. At both places he leads a group working on Computer Vision. He also teaches computer vision at both universities. With his teams he is and has been involved in more than 15 European projects, of which he has coordinated several. He also was a board member of ECVNet, the European Computer Vision Network of Excellence, for which he has taught a CV course that was broadcast throughout Europe by satellite. He has received several prizes, including a David Marr Prize and an IST European Technology Prize through the spin-off company Eyetronics, of which he is a co-founder. He has served as a program committee member and reviewer for several international conferences. He is a member of the editorial boards of several journals (e.g. Int. Journal on Computer Vision, Pattern Analysis and Applications, etc.). He has been a member of the Research Council of the University of Leuven.

11.18 Biographical Sketch for Bernd Neumann

Prof. Bernd Neumann is full professor at the Department of Computer Science and head of the Cognitive Systems Laboratory. He holds a diploma in Electrical Engineering (Darmstadt/Germany) and a M.S. and Ph.D. from MIT/USA. He has been engaged in a broad spectrum of Computer Vision and AI work for more than 30 years resulting in numerous publications. Since 1988 he is also the head of the AI Laboratory within the Department of Computer Science. As such he is responsible for AI application developments in cooperative projects with industrial partners.

As an experienced AI specialist he has been frequently engaged in program comittees, as a referee, tutorial lecturer, invited speaker and consultant in several countries. From 1985 - 1988 he has been the chairman of the German Society for Artificial Intelligence. In 1992 he has been the program chairman of the European AI Conference ECAI-92. He is member of the Scientific Advisory Board of the German Research Institute for Artificial Intelligence (DFKI) and the Swedish Research Institute ISIS in Linkoping. Since 1997 he is the Chair of the IFIP Technical Comitee for Artificial Intelligence (TC12).

11.19 Biographical Sketch for Gerhard Sagerer

Gerhard Sagerer holds a chair in computer science and is Vice-Chancellor of the University of Bielefeld. He received the diploma and the Dr.-Ing. degree in computer science from the University of Erlangen-Nuernberg, Erlangen, Germany, in 1980 and 1985, respectively. In 1990 he received the venia legendi in computer science from the Technical Faculty of this university. He has held positions at the Institute for Pattern Recognition of the University of Erlangen-Nuernberg and the Bavarian Research Centre for Artificial Intelligence. Additionally he has been a visiting professor at the Department of Computer Science and the Centre for Visual Sciences of the University of Rochester. Dr. Sagerer is associate Editor of the IAPR Pattern Recognition Letters. He has published more than 150 technical papers in the areas of speech and image processing with applications in medicine and industrial scenes and is author of two books on knowledge representation for image understanding and on the architecture of speech dialog systems. His fields of research are computer vision and speech understanding including artificial intelligence techniques and the application of pattern understanding methods to natural science domains.

11.20 Biographical Sketch for Heinrich Niemann

Heinrich Niemann obtained the degree of Dipl.-Ing. In Electrical Engineering and Dr.-Ing. at the Technical University Hannover in 1966 and 1969, respectively. During 1966/67, was a graduate student at the University of Illinois, Urbana. From, 1967 to 1972, he was with the Faunhofer Institut für Informationsverarbeitung in Technik und Biologie, Karlsruhe, working in the field of pattern recognition and biological cybernetics. During 1973-1975, he was teaching at Fachhochschule Giessen in the Department of Electrical Engineering. Since 1975, he has been Professor of Computer Science at the University of Erlangen-Nürnberg, where he was dean of the engineering faculty of the university from 1979-1981. Since 1988 he is also head of the research group 'Knowledge Processing' at the Bavarian Research Institute for Knowledge Based Systems (FORWISS), and he was on the board of directors for six years. Since 1998, he is also speaker of a 'special research area' (SFB) entitled 'Model-Based Analysis and Visualization of Complex Scenes and Sensor Data' funded by the German Research Foundation (DFG).

His fields of research are speech and image understanding and the application of artificial intelligence techniques in these fields. He is on the editorial board of Signal Processing, Pattern Recognition Letters, Pattern Recognition and Image Analysis, Journal of Computing and Information Technology, and Computers and Electrical Engineering. He is the author or coauthor of seven books and about 400 journal and conference contributions as well as editor or coeditor of 24 proceedings, volumes and special issues. He is a member of DAGM, ESCA, EURASIP, GI, IEEE, and VDE.

11.21 Biographical Sketch for Heinrich Bülthoff

Heinrich Bülthoff (1950) is Director at the Max Planck Institute for Biological Cybernetics in Tübingen, Germany and Honorary Professor at the Eberhard-Karls-Universität Tübingen. He studied biology in Tübingen and Berlin and received his doctoral degree in 1980. He spent 3 years as a visiting scientist at the Massachusetts Institute of Technology and joined the faculty of the Department of Cognitive and Linguistic Sciences at Brown University in 1988. In 1993 he was elected Scientific Member of the Max Planck Society. Dr. Bülthoff has published more than 100 articles in scholarly journals in the areas of object and face recognition, integration of visual modules, sensorimotor integration, autonomous navigation and artificial life. He is currently engaged in joint research projects with scientists at Brown University, the Massachusetts Institute of Technology, the NEC Research Institute, Oxford University, Tübingen University, the University of Minnesota, the University of Western Ontario, the University of Texas and the Weizmann Institute of Science. Dr. Bülthoff's scientific career was strongly influenced by his early physiological and theoretical investigations into orientation behavior and object detection in flies. These fundamental biological experiences remained a driving force even after his interests shifted to the psychophysical and computational aspects of higher-level visual processes, especially questions dealing with the demands that everyday visual tasks place on the human observer, and to how the knowledge gathered from these experiments could be implemented into cognitive vision systems.

At the moment Dr. Bülthoff is involved in the following two EU projects: COGVIS: IST-2000-29375, and COMIC: IST-2001-32311.

Heinrich Bülthoff has been elected to membership in the following societies: the Computer Society of the IEEE (1998), the Society of Neuroscience (1987), the Optical Society of America (1986), and the Association for Research in Vision and Ophthalmology (1985).

11.22 Biographical Sketch for Bernhard Nebel

Bernhard Nebel received his Ph.D. (Dr. rer. nat.) from the University of Saarland in 1989. Between 1982 and 1993 he worked on different AI projects at the University of Hamburg, the Technical University of Berlin, ISI/USC, IBM Germany, and the German Research Center for AI (DFKI). From 1993 to 1996 he held an Associate Professor position (C3) at the Computer Science Department of the University of Ulm. Since 1996 he is Professor (C4) at Albert-Ludwigs-Universität Freiburg and head of the Laboratory for Foundations of Artificial Intelligence.

Bernhard Nebel is a member of the IJCAI Inc board of trustees, and the co-chair of the graduate school on and Machine Intelligence at Albert-Ludwigs-Universität.

Among other professional services, he served as the Program Co-Chair for the 3rd International Conference on Principles of Knowledge Representation and Reasoning (KR'92), as the Program Chair for the 10th German Spring School on AI (KIFS'92), as the Program Co-chair for the 18th German Annual Conference on AI (KI'94), as the Tutorial Chair of the 15th International Joint Conference on Artificial Intelligence (IJCAI'97), as the General Chair of the 21st German Annual Conference on Artificial Intelligence (KI'97), and as the Program Chair for the 17th International Joint Conference on Artificial Intelligence (IJCAI'01). In addition, he is a member of the editorial boards of Artificial Intelligence and AI Communication, Research Note, editor of Artificial Intelligence, a member of the advisory board of Journal of Artificial Intelligence Research, and the chair of the advisory board of Künstliche Intelligenz.

Bernhard Nebel is author and co-editor of 6 books and proceedings, as well as author and co-author of more than 80 refereed papers on Aritifical Intelligence in scientific journals, books, and conference proceedings.

11.23 Biographical Sketch for Catherine Garbay

Dr. Garbay was born in Paris in 1954. She graduated from Institut National Polytechnique de Grenoble as a Computer Science Engineer (1977) and obtained her PhD degree in 1979 from this institution. She obtained the degree of "Docteur es Sciences" from the Université Joseph Fourier and from the INPG, Grenoble in 1986. She is now employed by the CNRS as Research Associate. She was responsible for the creation, in 1988, of the SIC (Integrated Cognitive Systems) group. She is responsible of a federative national structure called GDR I3 "Information - Interaction - Intelligence".She has been involved in several european research projects in the framework of
the CEE DGXIII AIM (Advanced Informatics in Medicine) and Telematics programmes and has been involved several times in the refeering process of these programmes. She has been organizing the 6th European Conference on "Artificial Intelligence in Medicine" (AIME'97) in Grenoble in 1997 and is a member of the scientific programme committee of this conference. She is a member of the advisory board of the IEEE Trans. on Biomedical Engineering and Artificial Intelligence in Medicine journals and the editor-in-chief of a recently founded french journal entitled "Revue I3 - Information - Interaction - Intelligence". She is adjunct-director of the CNRS department "Information and Communication Science and technology".

11.24 Biographical sketch for Henri Maitre

Henri Maitre was born in 1948. He his a professor of Image Processing and Head of the TSI department at ENST. He received the engineering degree from the Ecole Centrale de Lyon, France, in 1971, and the Docteur es Sciences degree in Physics from the University of Paris VI in 1982.
He has taught digital picture processing since 1973 at the Ecole Nationale Superieure des Telecommunications (ENST) in Paris, as an Assistant Professor, an Associate Professor and a Full Professor since 1982. He his Associate Editor of IEEE-SPL and Pattern Recognition, Member of the IEEE-IMDSP Committee. He his a member of the Comité National du CNRS for Section 07 (Computer Science and Signal Processing). His research includes work on image analysis, image understanding and computer vision, and applications in the domains of satellite and aerial image processing, medical image processing, and processing of documents issued from the fine-arts. He has supervised over 45 Ph.D. theses.

11.25 Biographical Sketch for Ernest Hirsch

Dr. Ernest Hirsch is Professor for industrial computer sciences at the University of Strasbourg-I Louis Pasteur (ULP) and the École Nationale Supérieure de Physique de Strasbourg (ENSPS). He obtained an Engineering Degree in 1977, a PhD in Acoustics from the University of Strasbourg in 1980 and a "Doctorat d'Etat es Sciences (habilitation)" from the same University in 1984. He acted from 1979 to 1983 as Part time teaching assistant and from 1983 to 1991 as Assistant Professor at the University of Strasbourg. He got an appointment as Professor in 1991. As far as research is concerned, he undertook firstly research and development in acoustical image reconstruction techniques and serviced then as a researcher in the field of fundamentals in colloid sciences. During a research stay in Germany at the Fraunhofer Institute for Information and Data Processing (FhG-IITB) at Karlsruhe, he reoriented his research interests towards image processing and computer vision. He heads currently Department B on models, image and vision of the Laboratoire des Sciences de l'Image, de l'Informatique et de la Télédétection (LSIIT UMR-CNRS 7005). He is also in charge of the international relations at the ENSPS/ULP and recently took over the head of the Graduate School on Engineering Sciences of the University. His research interest are in image analysis, computer vision, parallel and/or distributed system architectures, networking, knowledge-based systems, comparison of CCD images with conceptual data, vision based inspection and metrology and the application of virtual/augmented reality to maintenance. He has good experience in European projects, was project manager of several R&D Projects and presently acts regularly as an evaluator and reviewer for the CEC. Since he is active in research, he has published around 100 papers in either reviewed journals or conferences.

11.26 Biographical Sketch for Jan Koenderink

Jan J. Koenderink graduated in Physics and Mathematics in 1967 at Utrecht University. He has been associate professor in Experimental Psychology at the Universiteit Groningen, then in 1974 returned to the Universiteit Utrecht where he presently holds a chair in the Department of Physics and Astronomy. He founded the Helmholtz Instituut in which multidisciplinary work in biology, medicine, physics and computer science is coordinated.

He has received an honorific degree (D.Sc.) in Medicine from the University of Leuven and is a member of the Royal Netherlands Academy of Arts and Sciences. He participates in the editorial boards of a number of scientific journals, scientific boards of international conferences and scientific institutes.

Research interests include cognitive science, ecological physics and machine intelligence.

11.27 Biographical Sketch for José Santos-Victor

Jose Santos-Victor (1965) is an Assistant Professor at the Instituto Superior T*e*cnico (IST), Lisbon and a researcher at the Instituto de Sistemas e Robotica (ISR). He has founded the Computer Vision Lab (VisLab) at IST/ISR. His main research topics are Computer Vision and Robotics with an emphasis on Vision based navigation and the relationship between visual perception and action. He was the principal investigator in a number of national and international R&D projects in the areas of Computer Vision and Robotics. He was the principal investigator for the participation of IST in various international research projects (NARVAL, Omniviews, Mirror, SMART, etc)

11.28 Biographical Sketch for Bernt Schiele

Prof. Bernt Schiele obtained a MSc in computer science from the University of Karlsruhe, Germany, and a DEA in computer science from the ENSIMAG in Grenoble, France, both in 1994. Also in 1994 he was visiting researcher at CMU, Pittsburgh, PA, USA. In 1997 he obtained his PhD from INP Grenoble, France. Between 1997 and 1999 he was postdoctoral associate at the MIT Media Laboratory, Cambridge, MA, USA. Since September 1999 he is Assistant Professor at the computer science department at ETH. Between 1999-2000 he was appointed Visiting Assistant Professor at the MIT Media Laboratory. Bernt Schiele has published about 40 papers in computer vision, robotics, wearable computing and context modeling.

11.29 Biographical Sketch for Pascal Fua

Pascal Fua joined the faculty of EPFL and the Computer Graphics Laboratory in 1996. Before that, he worked at SRI International and at INRIA Sophia-Antipolis as a computer scientist. He holds a degree from Ecole Polytechnique, Paris, and a Ph.D. in Computer Science from the University of Orsay. His research interests include optimization-based techniques for image processing and synthesis, the use of information theory in the area of model-based vision and the design and implementation of systems for vision and simulation. He is currently involved in a number of IST European Project and has (co)authored over 0 publications in refereed journals and conferences.

11.30 Biographical Sketch for Gösta H. Granlund

Gösta H. Granlund received the M.S. and Ph.D. degrees in Electrical Engineering from Chalmers Institute of Technology, Gothenburg, Sweden, in 1966 and
1970 respectively. In 1974 he received the Docent degree from Chalmers Institute of Technology.

From 1966 to 1970 he was working with SAAB Electronics Division on computer systems and control systems, as well as working on his Ph.D. thesis at Chalmers Institute of Technology. In 1970 he came to MIT, first as a postdoctoral fellow and later employed as a member of the research staff, where he worked on biomedical image analysis, such as automatic karyotyping of chromosomes. In 1972 he became Associate Professor of Electrical Engineering at Linköping University, Sweden. He spent 1974-1975 as a Visiting Professor at MIT. Since 1982 he is Professor of Electrical Engineering at Linköping University. During the academic year 1990-1991 he was again visiting at MIT.

Dr. Granlund is Head of the Computer Vision Laboratory of Linköping University, working on various image processing problems such as reconstruction, multidimensional information representation, adaptive feedback and relaxation methods, learning systems and hierarchical parallel processing structures. He has co-authored or contributed to 4 books on Computer Vision methods. He has written or co-authored more than 120 articles or conference papers within the field of Computer Vision and Pattern Recognition, and he has given international courses within this field. He has 8 patents.

Dr. Granlund is a member of several professional societies, and he is a member of the editorial board for several international journals. He has also been working as a consultant for several international companies in the field of Image Processing and Pattern Recognition.

11.31 Biographical Sketch for David Hogg

David Hogg (1954) is Professor of Artificial Intelligence and Pro-Vice-Chancellor at the University of Leeds. He graduated from the University of Warwick with a BSc in Applied Mathematics and from the University of Western Ontario with an MSc in Computer Science, before joining the Plessey company as a Systems Analyst. In 1978 he started his PhD research in computer vision at the University of Sussex, where he went on to become a Lecturer within the School of Cognitive and Computing Sciences in 1984. David Hogg was appointed as a Full Professor at the University of Leeds in 1990.

His research has focused on the development and application of spatio-temporal models within computer vision, dealing especially with 3D models, stochastic processes and automated learning. He is a regular reviewer for the major computer vision journals and has served on the programme committee for the principal international conferences in the field.

11.32 Biographical Sketch for Tony Cohn

Tony Cohn (1954) is Professor of Automated Reasoning and Head of the School of Computing at the University of Leeds. He graduated from the University of Essex with a BSc in Computing and a PhD in Computer Science. He spent 10 years as a lecturer at he University of Warwick before moving to Leeds in 1990. He was appointed as a Full Professor at the University of Leeds in 1996.

His major research interest is in Knowledge Representation and Reasoning, and is currently President of KR Inc., the body responsible for the international KR conferences, and Conference Chair for IJCAI'03, the major international AI conference. Since the beginning of the 1990s, he has focussed his research on qualitative spatial and spatio-temporal reasoning which has a variety of potential applications, including high level interpretation visual data.

11.33 Biographical Sketch for Chris Taylor

Prof. Taylor obtained a BSc in Physics and PhD at the University of Manchester. He has been Director of the Wolfson Image Analysis Unit of the department of Medical Biophysics (now ISBE) at the University of Manchester since 1980 and full Professor since 1990. He is chairman of the British Machine Vision Association and sits of numerous national research strategy committees (Foresight ITEC Panel, Foresight Health and Life Sciences Panel, chair of Foresight Health Informatics Working Party). He is on the editorial board of the journal Medical Image Analysis and chair of the UK Institute

for Health Informatics and the North of England Institute for Health Informatics. He has attracted over 10M euro in public and industrial research income and published over 200 articles in peer reviewed journals and conferences.

11.34 Biographical Sketch for Andrew Zisserman

Prof. Andrew Zisserman joined the Department of Engineering Science, University of Oxford in 1987, and is a University Research Lecturer. He leads the Visual Geometry Group. He is Principal Investigator at Oxford for EC Esprit Projects Vibes and CogViSys and for two further research grants funded by UK research agencies. He has authored over 90 papers in Photogrammetry and Computer Vision and is author/editor of 8 books. He is on the editorial board of two international Computer Vision journals, and on the IEEE PAMI awards committee. He has recently been program co-chair for the International Conference on Computer Vision, and an area chair for the Conference on Computer Vision and Pattern Recognition. He was awarded the IEEE Marr Prize in 1993, together with Drs Forsyth, Mundy and Rothwell, for research on recognizing object classes from single images; and awarded the Marr Prize for the second time in 1998, together with Drs Fitzgibbon and Torr, for research on multiple view geometry.

11.35 Biographical Sketch for Josef Kittler

Prof. Josef Kittler (BA in Electrical Engineering, 1971, Ph.D. in Pattern Recognition, 1974, and ScD in 1991, all from University of Cambridge) joined the University of Surrey in 1986. He has more than 30 years of experience in pattern recognition and computer vision. He contributed to the methodology of attribute selection, contextual decision making and, most recently, to multiple expert fusion and statistical hypothesis testing with many applications in image processing and computer vision. He participated in a number of EU projects in computer vision (VAP, VAP2, RETINA,SAM) image communication (SCALAR), visual inspection (AVIS, ASSIST), and personal identity verification (M2VTS, BANCA).

He serves regularly as a member the scientific programme committees of international conferences on pattern recognition, image processing and computer vision. He has published more than 400 papers, including more than 130 in international journals. He is on the editorial board of several international scientific journals, including Image and Vision Computing, Machine Vision and Applications, Pattern Recognition Letters, Pattern Analysis and Applications, and International
Journal of Pattern Recognition and Artificial Intelligence.

12 Appendix B – Contract Preparation Forms