European Cooperation
in Science and Technology
- COST -

Secretariat

Brussels, 8 December 2011

COST 4174/11

MEMORANDUM OF UNDERSTANDING

Subject :	Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action IC1106: Integrating Biometrics and Forensics for the Digital Age

Delegations will find attached the Memorandum of Understanding for COST Action as approved by the COST Committee of Senior Officials (CSO) at its 183rd meeting on 30 November 2011.

MEMORANDUM OF UNDERSTANDING
For the implementation of a European Concerted Research Action designated as

COST Action IC1106
INTEGRATING BIOMETRICS AND FORENSICS FOR THE DIGITAL AGE

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

1. The Action will be carried out in accordance with the provisions of document COST 4154/11 "Rules and Procedures for Implementing COST Actions", or in any new document amending or replacing it, the contents of which the Parties are fully aware of.

2. The main objective of the Action is the stimulation of an innovative and timely cooperation between two established research communities: the biometrics community and the forensics community. The goal is the imaginative integration of their skills and activities to create a new, vibrant and highly effective community capable of developing novel solutions in the fight against crime.

3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 68 million in 2011 prices.

4. The Memorandum of Understanding will take effect on being accepted by at least five Parties.

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

A. ABSTRACT AND KEYWORDS

"Forensics is the application of a broad spectrum of sciences to answer questions of interest to a legal system. This may be in relation to a crime or a civil action" [Wikipedia]. Since many such questions boil down to identifying, or verifying the identity, of people allegedly involved in some action, a clear relationship exists between forensics and biometrics. Biometrics developed a number of techniques which can clearly facilitate the identification of people involved in criminal actions or civil incidents. Thus, although the two communities have traditionally often operated in relative isolation, there are many scenarios where the synergic cooperation of multimodal biometrics and forensics can be successfully applied. To address such multifaceted areas it is important to develop an interdisciplinary network with complementary competences, to foster the birth of a new community which can develop novel technological solutions to crucial issues and new challenges in forensic science.

This Action will promote new partnerships, will provide education and training, will contribute to develop new standards and best practices, will produce awareness of the potential benefits of advanced technologies for evidence analysis in forensic cases and will stimulate improved mutual understanding of collaborative working models linking the academic and industrial sectors.
Keywords: Forensics, Biometrics, Identification, Video Surveillance, Pattern recognition

B. BACKGROUND

B.1 General background

This COST Action addresses two distinct thematic research topics but with mutual intersections and a strong potential for cross-fertilization: Biometrics and Forensics. Although the two disciplines have an enormous potential jointly to attack a number of longstanding and emerging challenges, their communities – to their mutual detriment - have often operated in relative isolation.

Biometrics is a relatively novel science aiming to study and design technological solutions to evaluate quantitatively the characteristics of the human body (both behavioural and physical) for its categorization. In the last two decades, *Biometrics* has developed rapidly towards maturity, providing a number of practical solutions for a variety of applications.

Forensics is a well established science aiming to assist criminal investigations and subsequently to provide legal evidence of a crime in a court.

The Biometrics field is characterised especially by its interdisciplinarity since, while focused primarily around a strong technological base, effective system design and implementation often require a broad range of skills encompassing, for example, human factors, data security and database technologies, psychological and physiological awareness, and so on. Also, the technology focus itself embraces diversity, since the engineering of effective biometric systems requires integration of image analysis, pattern recognition, sensor technology, database engineering, security design and many other strands of understanding.

On the other hand, Forensics benefitted over the last two centuries from the cross fertilization from other science areas such as chemistry, biology, mathematics, mechanics as well as human anatomy. Forensics has produced well defined procedures and protocols to sample and rigorously analyse data from the field to deliver objective measurements.

A striking example of successful cooperation between biometrics and forensics is represented by practical AFIS systems for on-line fingerprint identification. Another is the automatic identification of human faces from a watch list of criminals. This Action will promote analogous advances.

Today's digital era is providing new computing solutions to assist forensics but also new threats and challenges, which cannot be solved with traditional approaches. An example is the exponential growth of social networks which, in addition to their intended positive function, have also been exploited by the unscrupulous to assume fraudulent identities. New identification technologies and pattern recognition algorithms offer ways to provide proof of identity in these cases. Other identity-related scenarios include attacks on security systems and the identification of abnormal/dangerous behaviours from remote cameras.

In summary we point to two crucial lines of action:

1. Biometrics providing new algorithmic and technological solutions to current forensic problems;
2. Coupling forensic and advanced Audio-Visual Understanding techniques to address novel and foreseen digital threats.

The aim of this COST Action is to foster the creation of a new scientific community, which includes excellence in different domains ranging from forensic science, to pattern recognition, computer science, digital networking and legal science. No other EU or national funding opportunities could be leveraged to the same objective, because the scope of this Action is to bridge an existing gap between two different communities with the aim of fostering a closer cooperation also in these areas where it has been impossible or impractical till our days.

This COST Action will promote scientific events, such as new workshops and thematic conferences embracing both forensic and biometric topics; it will organize thematic training schools covering both biometrics and forensics issues; it will facilitate the mutual exchange of researchers, particularly Early Stage Researchers, through the scrupulous use of the Short Term Scientific Missions. This COST Action network will endeavour to make effective research proposals to be funded for reaching the research goals planned by the Action program itself.

A major expected benefit is to expose researchers from both communities to real forensics problems and technological solutions already developed in biometrics.

Three main practical benefits are expected from this Action:

1) **Scientific**: The U.S. National Academy of Science report "Strenghtening forensic science in U.S.: a path forward" (www.nap.edu/catalog.php?record_id 589) reports (with the exception of DNA) a lack of science in forensics in all branches. Cross-European working is therefore essential to develop a strong new interdisciplinary community, to establish and disseminate good practice, and to stimulate novelty and interdisciplinarity in exploiting scientific possibilities. Scientifically robust and imaginative approaches will have huge benefits. From the forensics perspective it will improve and strengthen methods towards scientific solutions, and from the research perspective it will drive the efforts to applied topics.

2) **Networking:** This is essential to future development, and indeed many of this COST Action participants already have strong connections with key *national bodies* (e.g. Scientific Investigation Office of Arma dei Carabinieri in Italy, National Policing Improvements Agency in UK, etc) and the European Network of Forensic Science Institutes (ENFSI). Circulation of researchers and methods will provide a shared scientific basis to develop homogeneous approaches to forensic matters on a *transnational* basis throughout Europe.

3) **Educational**: The central element is development of effective mechanisms for the support of Early Career Researchers (ECR), including young forensic scientists, through the Short Term Scientific Mission (STSM) instrument and training schools. We see this as a key driver of future success and sustainability. High level education of future forensic experts must integrate traditional skills with modern tools, such as image and audio signal processing. With an adequate understanding of the underlying methods use of existing tools, adapting them to individual practitioner needs, or innovating custom tools implementing forensic investigations will be more efficient.

B.2 Current state of knowledge

Forensic science is defined as the body of scientific knowledge and technical methods used to solve questions related to criminal, civil and administrative law. Forensic science focuses in particular on the demonstration of the existence and the investigation of an infringement, on the individualization of a perpetrator and on the description of a modus operandi. Biometric technologies are the set of automated methods used for the recognition of individuals using their physiological and behavioural traits.

Forensic biometrics can be defined as the scientific discipline that makes use of the biometric technologies for the demonstration of the existence and the investigation of infringements, the individualization of perpetrators and the description of modus operandi. These tasks are embedded in several forensic processes: forensic investigation, forensic evaluation, forensic intelligence, automated surveillance and forensic identity management.

Methods like the forensic anthropometry (Bertillon), the forensic dactyloscopy (Galton) and le portrait parlé (Reiss) exploiting physiological and behavioural traits exist from the end of the 19th century and have been used for the individualization of perpetrators of criminal infringements and the remote transmission of the information relevant for individualization. From the 1960's the development and implementation of the concept of automatic fingerprint identification system (AFIS) represents the first forensic biometric development, with the automation of the identity verification process, and later the automation of the first step of the individualisation process (selection/rejection of candidates). In the 1980's the discovery of forensic DNA profiling led to the development and implementation of similar processes: identity verification process from DNA reference material and individualisation process from biological traces.

In the 1990's the development of computer science and signal processing allowed for a performance breakthrough of biometric technologies, offering practical solutions for access control based on several modalities: iris, fingerprint, voice and face. Speaker recognition, face recognition and gait recognition became of interest for forensic biometrics, as a consequence of the development of mobile telecommunication and surveillance technologies (CCTV). During the same decade the first solutions integrating biometric technologies and the Bayesian inference framework were proposed for forensic individualisation, with the aim of ensuring a logical and transparent approach for the evaluation of the biometric forensic evidence.

In the last decade interest has arisen in so-called *soft biometric modalities*, based on biometric features such as height, weight, gender, hair, skin and clothing colour. This interest is mainly due to their availability of data, allowing capture without constraint that is a prerequisite in surveillance environments. However, their limited typicality enhanced the necessity to consider the fusion of several modalities. Some aspects of this technological progress are potentially interesting for forensic biometrics, for example the estimation of the body height and body weight from individuals present on still and live images. Attempts to combine the contributions of several biometric modalities are not only of interest for forensic biometrics but for forensic science in general, as it refers to the analogous question of the combination of forensic evidence.

The critical gap – which the present Action addresses – is an analysis of all the forensic processes that can integrate biometric technologies, in order to understand their specificities and translate them in clear needs for the biometric community to be able to propose specific solutions.

B.3 Reasons for the Action

The reason for the Action is that the forensic and biometric communities are not fully aware of the activities of the other community. The forensic communities implements forensic technologies within forensic processes that are not fully clear for the biometric community. Several forensic processes can make use of biometric technologies:

- **Evidence evaluation**. Likelihood ratio-based method to quantify the evidential value of biometric traces

- **Forensic investigation**. List of putative sources of biometric traces from one or several combined modalities
- **Forensic Intelligence**. Grouping of putative sources of biometric traces on basis of one or several combined modalities
- **Surveillance**. Capture of biometric traces and detection of putative sources on the basis of one or several combined modalities
- **Forensic ID management / ID Verification**. ID infrastructure and management, ID processes (create, challenge (access control / ID verification) and end an identity)
- Obtaining and using biometric evidence from the multimedia content available on social networking sites is a promising forensic activity for which the forensic community lacks biometric solutions. On the other hand the biometric community has developed technologies that are still not fully implemented in all the possible forensic processes.

The Automatic Fingerprint Identification Systems (AFIS) offer a good example in this respect. The AFIS are constituted of large-scale biometric databases and fingerprint feature extraction and comparison algorithms. These data and technologies are used to serve 3 forensic processes: the forensic ID management process (create and end identities, challenge identities (10 prints to 10 prints comparison)), the forensic investigation process (1 mark to many 10 prints) and the forensic intelligence process (1 mark to many marks). All the basic components exist in the current AFIS in order to develop a forensic evaluation process within these systems. This would allow the fingerprint examiners to exploit the resources of large-scale databases and automatic technology to help to achieve a more objective evaluation of the fingermark forensic evidence. For unknown reasons this debate has not yet taken place: this Action will ensure that it does and that the outcomes are appropriately focused and implemented.

Other areas of overlap between biometrics and forensics which need to be properly addressed with mutual competences and knowledge interchange are the following:

- The continuing research as to the extent to which fingerprints as coded in AFIS systems are unique to individuals.

- The role of the human operator in comparing the results of automated processing of fingerprints, facial images, etc; identifying best practice, developing standards for the ergonomic design of workstations and understanding of cognitive processes which may aid or detract from the integrity of human matching.
- Systems engineering approaches to the application of biometric recognition in a forensic context
- Coding of scars, marks and tattoos; and a quantitative assessment of their contribution to identification or verification of identity
- The role of international standards and codes of practice to support research as well as in the interchange of forensic information
- Establishing robust test procedures (on the lines of work undertaken in the testing of biometric devices, software and systems in the ISO 19795 series of standards)
- Development of privacy-enhancing techniques to reduce privacy invasion in the collection and processing of material relating to people who are only incidentally involved in a capture event (e.g. processing a video stream in a crowded public place, where many hundreds of individuals are involved).

This COST Action represents an ideal opportunity for the two communities to join, to understand each other's needs, challenges and opportunities in a realistic manner. These synergies will lead to the develop of a coherent joint vision and its dissemination across disciplinary and geographical borders.

B.4 Complementarity with other research programmes

This COST Action has a significant complementarity with the Marie Curie project Bayesian Biometrics for Forensics (BBfor2) that concentrates on the use of the likelihood ratio based model for forensic evaluation of biometric evidence. This COST Action will be a good platform to extend the dissemination of the results of the BBfor2 projects to end users.

On the other hand, this Action will be complementary also to other EU projects in the area of Biometrics and Forensics. Among them, the TabulaRasa project, specifically developing technologies to combat spoofing, impersonation and other biometric deceiving techniques. Also the BEST network addressed some of the relevant topics in biometrics to be faced in this Action.

A non exhaustive list of EU projects closely related to this Action, is the following:

- Worldwide Observatory of Malicious Behaviours and Attack Threats (WOMBAT)
- Intelligent Information System Supporting Observation, Searching and Detection for Security of Citizens in Urban Environment (INDECT)
- Automatic Detection of Abnormal Behaviour and Threats in Crowded Spaces (ADABTS)
- Suspicious and Abnormal Behaviour Monitoring Using a Network of Cameras & Sensors for Situation Awareness Enhancement (SAMURAI)
- Digital Image and Video Forensics (DIVEFOR)
- Visual Analytic Representation of Large Datasets for Enhancing Network Security (VIS-SENSE)
- Bayesian biometrics for forensics (BBFOR2)
- BEST
- Tabula Rasa
- HUMABIO project http://www.humabio-eu.org/publications.html
- HIDE Homeland security, Biometric Identification and Personal Detection Ethics
- RISE Rising Pan European and International Awareness on Biometrics and Security Ethics
- REWIND: Reverse Engineering of Audio-Visual Content Data

The key generic distinction (complementarity) between the present Action and the projects listed above is that the existing research programs are primarily focused on the development of technology and expertise for *individual* and pre-identified topics, while the present Action places emphasis on the *integration of multiple* topics. A substantive benefit of the latter is that this will highlight gaps between techniques, which might otherwise be exploited by criminal elements, and thereby promote activities to address such deficiencies.

C. OBJECTIVES AND BENEFITS

C.1 Main/primary objectives

The aim of this Action is the stimulation of an innovative and timely cooperation between two established research communities: the biometrics community (focused on the reliable identification of individuals) and the forensics community (focused on the broad application of science to crime investigation). The goal is the imaginative integration of their skills and activities to create a new, vibrant and highly effective community capable of developing novel solutions in the fight against crime. The key characteristic embraced by this Action will be its multidisciplinarity, building on excellence in domains ranging from conventional forensic science, to computer science, system engineering, pattern recognition, digital networking, behavioural science, and legal issues.

This Action will deliver concrete examples of collaborative research, promote new and vibrant partnerships across geographic and disciplinary boundaries, will create a self-sustaining network of highly engaged researchers and practitioners, encourage mobility, enhanced experiential learning and high quality training opportunities for young researchers and develop a new perspective and radical vision for how criminal investigation is to be conducted in the digital age.

C.2 Secondary objectives

- Establish creative partnerships based on complementarity between experts from the traditional biometrics, forensics and Criminal Justice communities. ***Example:*** *Capability for enhanced capture, processing and analysis of partial latent fingerprints/palmprints and enhanced relationship to evidential value in criminal proceedings*
- Establish mechanisms for sharing of knowledge, best practice and novel approaches to forensic investigations based on perpetrator identification. ***Example****: Increase understanding of how the ageing process impacts on the quality of acquired identity evidence and the maintenance of comparative databases*

- Greater integration between researchers, practitioners, formal agencies within the Criminal Justice system and relevant industrial players engaged in the criminal investigation enterprise**.** ***Example****: Annual Workshop to bring together policy makers, end users and researchers to discuss the exploitation of research results and new perspectives generated by the Action*
- Identify and remove barriers to forensic reference data sharing in different modalities (e.g. moving beyond traditional fingerprint evidence). ***Example:*** *Address and balance the technical, legal and social challenges of sharing, for example, iris data*
- Ensure constructive networking and cross-fertilisation of innovative ideas. ***Example:*** *Knowledge exchange via workshops which integrate the constituent research communities, ensuring programme structure which promotes integration of ideas within sessions and interdisciplinary understanding*
- Greater innovation and cross-disciplinarity in the training of practitioners by instigating Training Schools which erase the traditional boundaries between different topics in different disciplines. ***Example:*** *Summer Schools for ESRs and practitioners*
- Enhanced experience for ESRs through the vigorous adoption of the STSM instrument. This is to be seen as a key function and high priority. The Action will set up a small Team (sub-group of the Management Committee) to publicise, recruit, approve and monitor STSM activity. Crossing the traditional biometrics/forensics boundary will be a principle which will be enthusiastically embraced. ***Example****: Proactive, dedicated sub-group (STSM committee elected at the beginning of the Action) within the MC to promote appropriate STSM activity*
- Create awareness of the possibility and limits of current and emerging biometric technologies to the end-users.
- Structure the knowledge of the end-users in order for them:

    - to define their needs in function of the current state-of-the-art in biometrics and in forensic science;
    - to equip them to interact optimally with the forensic biometric industry and the researchers to communicate the real needs of investigation.

C.3 How will the objectives be achieved?

Operation of the Criminal Justice System (the natural domain of forensic investigation) is, despite the obvious merits of cross-national (e.g. pan-European) legislation and attempts to harmonise good practice, still very closely bound to national structures and policies. Especially at the level of translating new scientific ideas into practical uptake, it is essential to exploit the opportunities which this Action provides to support networking, ensuring the rapid sharing, development and integration of ideas and emerging knowledge for the greater good. While maximising the speed and efficiency with which ideas can move from the Laboratory to the practice of criminal investigation, it is also true that the breaking down of barriers (at the core of this Action) – across national borders, across actors within the domain, and between the two traditionally distinct communities – must create an arena within which new connections, mutually supportive interactions, and fundamentally new ways of addressing difficult problems, not to mention the creative tensions which emerge from the juxtaposition of alternative perspectives, can flourish. This will be achieved by means of the dissemination plan based on interdisciplinary workshops, conferences and meetings, as well as by means of the annual Action training school and topical seminars.

Furthermore, by engaging with the key experts in each contributing field, who are likely to found in different countries within the COST-relevant region (**Example***: Automated writer identification in Germany (biometrics), forensic document analysis in France (forensics), local roadside ID protocol development by NPIA in UK (user delivery*)) is essential in creating the highly interactive, unified and emergent community of expertise which is our vision.

C.4 Benefits of the Action

- Create a new community of expertise bridging and unifying the repository of knowledge and skills currently dispersed between two largely separate disciplines and diverse user groups
- Promote new partnerships between researcher/researcher, researcher/practitioner, researcher/end user etc which, because expertise can be drawn from the best qualified actors across national boundaries and across disciplines, can be maximally creative, timely and capable of addressing key challenges and barriers to greater effectiveness and efficiency.

- The cooperative environment and the creative climate induced by the networking and collaboration opportunities provided will stimulate new research directions.
- Provide education and training within a new and productive framework, especially for Early Stage Researchers and practitioners who will carry forward the legacy of the Action in the future.
- Produce awareness of the potential benefits of advanced technologies (biometrics, machine learning, computer vision, etc.) for evidence analysis in forensic cases.
- Stimulate improved mutual understanding of collaborative working models linking the academic and industrial sectors.
- Support emerging practical solutions to key challenges currently encountered in identity-related crime investigation.
- Definition of new standards and best practices in the application of biometric technologies in forensics and court cases.
- Support for continuing education and training of professional, policy makers, ESRs and PhD students in the understanding and application of biometric technologies in forensic applications.

C.5 Target groups/end users

This COST Action will provide direct benefits to a wide and diverse group of potential beneficiaries, including researchers across hitherto distinct disciplines, national forensic science services, police forces, international crime agencies, private companies, policy makers and the legal profession. This will encompass *prevention* (driven by policy makers), *policing* (by the law enforcement agencies, implementing the results of policy), and *prosecution* (by the legal system, from an informed perspective on the underlying science). Engagement of all the relevant stakeholders from these groups in the preparation of this COST Action has already demonstrated the benefits of this integration and will, in the implementation of the Action.

The European Network of Forensic Science Institutes (ENFSI), will be the main platform of the Action end users and the principal dissemination environment. Several members of this Action are either members of the steering committees or chairmen of ENFSI expert working groups (such as the Forensic Speech and Audio Analysis WG, the Fingerprint WG and the Digital Imaging WG).

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

The overall task of this Action is to speculate on the potential convergence between biometrics and forensics in order to stimulate novel and creative solutions to crucial problems in real life investigations. In fact both biometrics and forensics are well-investigated disciplines, but the potential of their *joint* analysis has never been fully exploited. Therefore this Action will help to define the research lines for the biometrics community in order to provide new algorithmic and technological solutions to current forensic problems and at the same time to couple forensic and advanced signal/image/video understanding techniques to address novel and predicted digital threats.

Evidence collectable from different sources like video surveillance camera networks, mobile phones, telephone networks, social networks (Flickr, YouTube, Tweeter, Facebook, blogs, forums, Wikis, P2P/Torrent websites, news, media sharing, governmental or commercial websites) is becoming increasingly important for being able to infer various aspects about criminal activities. Bringing together researchers, industry, end-users, law-enforcing agencies, and citizens groups to share experiences and explore areas where additional research and development are needed, identify possible collaboration and consider the societal impact of such technologies represents one of the key tasks to be achieved in this Action. A careful and continuous ethical scrutiny is required in the field of emerging forensics biometrics, and greater collaboration among key stakeholders is needed to identify areas of ethical and social concern and test new solutions.

More in details, the scientific focus of this COST Action will be on the following broad areas which have been indentified at this stage as the most fertile areas of convergence between biometrics and forensics:

- Biometric evidence for forensic evaluation and investigation
- Audiovisual biometrics for forensics examination
- Soft biometrics for forensics examination
- Forensic behavioural biometrics
- Biometric analysis of crime scene traces and their forensic interpretation
- Combination of multimodal biometrics with other forensic evidence
- Ethical and societal implications of emerging forensics biometrics

Biometric evidence for forensic evaluation and investigation

Results of biometrics based case assessment and interpretation may be of pivotal importance at any stage of the course of justice, be it the very first police investigation or a court trial. In the police **investigative mode**, reasoning follows a process of generating likely explanations, testing these with new observations and eliminating or re-ranking the explanations. In the forensic **evaluative mode** for a court trial, an opinion of evidential weight, based upon case specific propositions (hypotheses) and clear conditioning information (framework of circumstances) should be provided for use as evidence in court.

The main objective of this task is to establish a robust methodology for forensic automatic biometric recognition based on statistical and probabilistic methods. Such a methodology should provide guidelines for the calculation of biometric evidence value and its strength and the evaluation of this strength under operating conditions of casework. We will define methodological recommendations for developing techniques and instruments in order to make the evidential measures objective, to make evaluation test results reliable, and then, accordingly, to develop a common system able to implement standard procedures and their validation. This theoretical approach and corresponding design methodology are intended to bridge the gap between forensic and biometric sciences.

This task incorporates a variety of aspects of the forensic casework process, from the collection of the evidence to the evaluation of the strength of evidence, and to provide legal and investigative branches of the judicial process, a unified framework which models the assumptions, conditions, and uncertainty implicit in the casework.

In this task a complete set of interpretation methods based on likelihood ratio approach will be defined to be used in the forensic biometrics domain independently of the baseline biometric recognition system. It should also define the integration procedure of these interpretation methods with the state-of-the-art automatic biometric recognition algorithms.

Audiovisual biometrics for forensics examination

Nowadays digital evidence rather than physical evidence is increasingly getting easier to acquire from the scene of crime or cyber-crime. In fact, the Internet, computers, video surveillance cameras, mobile phones, telephone networks, social networks are all examples of methods for generating, collecting and sharing information on a massive scale. Therefore, by exploiting biometric technologies it will be possible to capture identity information from "strong biometric data" left on the scene of a crime, like:

- facial imaging (face, ear, iris) which can be acquired from both single images and surveillance video recordings, etc.;
- voice recording acquired from video sequences, ambient microphones, phone call recordings;
- Audio-visual recording containing lip-motion and faces;
- gait information acquired from video sequences.

Among the aforementioned biometrics, face and iris, which are physical biometrics, possess a high degree of permanence and distinctiveness. On the contrary, being voice and gait behavioural biometrics, the identification accuracy they can provide for forensic applications is lower than physical biometrics. However, in many practical situations face and iris acquisitions are not ideal since they depend on the way of placing oneself in front of the acquisition camera, on potential occlusions, on the null degree of cooperation of the potential offender. These information must be complemented with what available to the investigator like possible information coming from other sources of evidence like voice recording, lip-motion, gait information, etc. Audio-visual speech is also useful to see if a recorded media is authentic, e.g. if lip-motion is in harmony with the speech. Therefore in this research task we will focus on the possible ways to complement information coming from different sources by combining biometric measurements obtained through different sensors for the purpose to identify an offender.

This is a challenging task because of the enormous amount of recorder data coming from visible and infrared camera sensor networks, microphones arrays, etc. that has to be scanned and that therefore needs developments in video and audio analytics which need to be properly designed for forensic applications. Moreover, being the scenario under analysis a non cooperative one, the information has to be acquired in a transparent way. This introduces another element of variability and reduced quality, which may result in a loss of recognition performance that, in the considered scenario is given by the False Non Match Rate, which therefore represents the critical performance design parameter. Interactive multimodal biometric authentication using quality and reliability measures will be studied as a solution to this problem.

In addiction, as non-cooperative biometrics, they express an enormous added value to forensic investigation and intelligence, especially if coupled to robust automated recognitions systems. Next future, audiovisual biometrics should be regarded as the most frequent starting point of forensic investigations, also capable to orient physical traces collection.

Soft biometrics for forensics examination

In this research task we take into account alternative sources of evidence, namely "soft biometrics" like:

- age, gender, ethnicity, height, weight, eye colour, hair style, etc.;
- moles, freckles, birthmarks, scars, marks, and tattoos.

Soft biometrics like age, gender, ethnicity, height, weight, eye colour, hair style, cannot be used to authenticate individuals since they lack of sufficient permanence and distinctiveness. Nevertheless, these characteristics can be used as ancillary information to support the decision process to either narrow down the field of search within the database or when only partial "strong biometrics" data are available. Moles, freckles, birthmarks, scars, marks, and tattoos possess higher discriminative capabilities than age, gender, ethnicity, etc. being permanent imprints on the body and they can therefore been used to assist the process of people identification in forensic applications or disaster recovery.

In this research task we will focus on the definition of new technologies to gather and exploit the aforementioned soft biometrics to assist the process of automatic people identification within different possible scenarios like fugitive tracking using a network of video surveillance cameras or criminal identification in law enforcement applications where evidence are available in digital format. Making the identification process, on the base of these soft biometrics, automatic would provide experts a valuable tool which could be used for different tasks like supplementing the decision made on the base of other biometrics (like face, iris, etc) to improve the identification accuracy, increasing the search speed in the database by performing hierarchical searches, enabling identification also when partial information coming from other biometrics are available because for example of face characteristics occlusion.

Forensic behavioural biometrics

From a forensic perspective, it is becoming increasingly important being able to infer various aspects about criminal activities. Either single user or crowd behavioural analysis is one these aspects. Given an audio visual or visual scene is there any unusual or abnormal event taking place in the scene? Are there any specific contexts or events that will change the behaviour of the scene dynamics by triggering other events without necessarily leading to unusual events? For instance, it is expected that when a train is near its departure time, that many individuals start running to catch it.

In this research task, we will focus on techniques such as text mining, web mining, and metrics to infer information flow. One of the major difficulties for this kind of analysis is the identification of that small portion of data that contains important information among a huge amount of it. Algorithms that could automatically detect unusual events within streaming or archival audio/video would significantly improve the analysis efficiency and save valuable human attention for only the most salient content. For example, algorithms for real time scene analysis, fight scene detection, various weapon detection, such as knifes, guns etc. The outcome of this research task is to associate Actions/events with a group, identifying the role of the various individuals leading up to the crime. In this framework special focus will be on real time analysis of the actions to detect a suspect behaviour in order to prevent crime.

Biometric analysis of crime scene traces and their forensic interpretation

This research task will focus on the acquisition and use of latent physical evidence, which has been left on the scene of a crime, for suspect identification. Specifically, our focus will be on:

- latent fingerprints and palmprints;
- written documents (signatures and handwriting analysis, etc.).

At the crime scene, fingerprints and palmprints can be found on many different surfaces and represent evidence physically left on the scene. Although fingerprint is being studied both in the forensic and in the biometric community for decades, the progresses made by the two communities have followed parallel and almost never convergent tracks. In this research task, the potential convergence is investigated by adopting high resolution optical non invasive measurement devices to obtain non destructive quality measurements from different surfaces for example for the purpose of determining the age of a latent fingerprint. In the forensic community this is still an open issue and of dramatic importance since the age estimation of fingerprints can be used to determine if the suspect was present before or after a crime took place. Moreover, the use of the whole spectrum of electromagnetic radiation should be used (from infrared to X-rays) to provide a non invasive scan of investigated surfaces to track potential biometrics, even in a covert mode, as latent finger and palm marks, allowing subsequent forensic analysis (e.g. contaminations, DNA, etc.). The same considerations can be applied to palmprints.

Novel means of visualizing fingerprints and palmprints will be addressed, particularly on metal surfaces that have been subject to extreme conditions, i.e. when a conventional treatment is unlikely to work. In this sense, extreme might mean elevated temperature, extreme cold, submersion in water, or washing of artefact. This Action will also investigate techniques that extend the range of treatments available for latent fingerprint visualization, all of which would extend the usefulness of an AFIS database in searching for offenders.

Written documents represent another source of physical evidence that is used by forensic experts and whose analysis can benefit from the studies conducted in the biometric field on both signature and handwriting analysis. The focus of this research task will be on the development of pattern recognition algorithms, which can complement and expedite experts' judgment in order to infer about the signature and writing style of an individual by taking into account the high inter-class variability of such biometrics. Beside the structural analysis of signatures and written text, for this latter, algorithmic solutions to perform an analysis at a semantic level, for extracting and representing the contextual-usage meaning of words by statistical computations applied to a large corpus of text, will be analyzed in this research task in order to infer about a user's identify.

Combination of multimodal biometrics with other forensic evidence

In this research task we will develop new techniques for gathering and fusing sources of data of varied nature. Fusion can be necessary because the same data is acquired from different acquisition devices or because different kind of data are acquired. As an example, a walking person can be acquired by different cameras in different locations: the need to fuse this information arises. On the other hand from the acquired video of a walking person different information can be acquired like his soft biometrics, gait, face, ear, voice, etc. This data needs to be properly represented using proper feature extrAction techniques and then fused. In the forensic community, little or no effort has been devoted to the multimodal integration and fusion of data from multiple sensory channels. Multimodal data fusion has been extensively studied by the biometrics community by means of different approaches. This COST Action will foster the application of fusion techniques of specific traits such as face, iris, fingerprint, gait, speech, soft biometrics, behavioural biometrics etc, to the forensic domain. This will resort in a multidisciplinary approach where techniques for effective decision-making based on fragmentary evidence, object detection and behaviour recognition in evidence data are concurring to provide a robust proof in agreement with the appropriate privacy/legal requirements and recommendations for policy making in this area will be provided. Understanding the influence of soft biometrics on criminal behaviour and criminality will be fused into the bigger picture of identifying criminality. This provides a natural link to aspects of social and legal acceptance of new and emerging technologies, which will be significant in their implementation and which are the focus of WG6

Ethical and societal implications of emerging forensic biometrics

It is of crucial importance for law enforcement practices to accomplish with key democratic principles and fundamental human rights. In this research task, we will anticipate the major reasons for ethical and societal concerns surrounding new and emerging forensic biometrics and provide early warnings. We will review existing policies, propose regulations, develop guidelines, and formulate policy options in three main areas

- Impact on Fundamental Rights: according to the *Strategy for the effective implementation of the Charter of Fundamental Rights by the European Union* (COM(2010) 573 final, 'the Charter Strategy') adopted by the Commission on 19 October 2010, all EU policies should be assessed against their impact on fundamental rights. This holds true in particular for RTD policies and technologies concerning justice and law enforcement. We will identify fundamental rights liable to be affected by new forensic biometrics, the degree of interference with the right(s) in question and the necessity and proportionality of the interference in terms of societal benefits and policy options.
- Impact on Privacy and Data Protection: the likely impact of new and emerging biometrics on privacy and data protection will be assessed and specific guidance will be issued, in particular we will explore the possibility to adopt a "privacy by design" approach to forensic biometrics. We will also address relevant policy issues concerning international biometric data sharing for forensic purposes and the establishment of crossborder biometric forensic databanks.
- Impact on vulnerable and disadvantaged groups: the risk that the implementation of new forensic biometrics may produce discrimination against ethnical and religious minorities, low income or geographically dispersed populations, children and minors, persons with disabilities and ageing population, will be carefully assessed and specific policy options aiming to minimize such a risk will be formulated.

In order to fully implement this task, the interaction with other members of this COST Action and cooperation in different activities of other Working Groups will be of paramount importance. This will result in increasing the understanding of non-technical challenges of emerging forensics biometrics among the international scientific community and in strengthening the COST network.

D.2 Scientific work plan methods and means

The objectives of the Action will be reached using both a top-down approach relying on existing literature and publications on one hand, and a bottom-up approach emerging from case studies suggested by the end users involved at large, both from inside or from outside, in the Action on the other hand. A list of relevant issues has been agreed upon, including aspects as biometric evidence for forensic evaluation and investigation, audiovisual biometrics for forensics examination, soft biometrics for forensics examination, forensic behavioural biometrics, biometric analysis of crime scene traces and their forensic interpretation, and combination of multimodal biometrics with other forensic evidence. These issues will be tackled by working groups (WGs) whose members have expertise in the specific area to which the WG is dedicated. However, next to the core of each WG, members of other WGs will join WG's to which they don't belong to promote scientific collaborations, the exchange of knowledge, human resources and expertise. This approach will ensure cross-referencing between the different WGs and a multidisciplinary approach to each topic. To achieve this goal it is of paramount importance for this Action to engage with stakeholders in the biometric community as well as with criminal police departments, judges, lawyers, and professionals belonging to the forensic community either from within the consortium or outside. This strong envisaged bidirectional interaction between the two communities will lead to findings that can be transferable from the stakeholders' work to both the general public and to a wider biometric and forensics community.

This goal will be reached by this Action by producing, as a result of the expected strong interaction, scientific papers both presented at international conferences and published in International journals, presentations, recommendations, best practices, legal, privacy, and ethics guidelines as well as position papers and white papers that will disseminate the findings in specific WGs to the interested community. This will raise public awareness about the convergence between biometrics and forensics, will point out pitfalls and deficiencies, and will facilitate further developments. Specifically each WG, with the support of key players from other WGs:

- will identify interesting case studies enlightened by the stakeholders,
- will perform a review on the exiting literature on the issue,

- will define best practices to apply to the selected case studies in order to make what collected usable in a court of law,

- will design methods for capturing and analyzing data from multiple sources,

- will develop tools that capture the important legal and privacy aspects, and their congruity to existing best practices,
- will verify that the approached used for acquiring, analyzing, and storing the data satisfy legal, privacy and ethical requirements,
- will evaluate pilot studies and identify most important and valuable core variables.

A joint harmonization among the WGs will take place once the core groups have been established and work started.

E. ORGANISATION

E.1 Coordination and organisation

The Management Committee (MC) will elect an Action Chairperson and a Vice Chairperson. The MC will meet at least twice a year in order to monitor and inform the progress of this Action, and develop liaisons with other complementary COST Actions.

The topics addressed by this Action will be assigned to the WGs defined in section E.2. Each WG will be represented by a coordinator and vice coordinator elected by the MC.

The WG coordinator will lead the networking of WG members and report regularly to the MC. WGs will work in parallel on predefined timetable of sub-phases which can be summarised as follows: (1) State-of-the-art investigation (2) Innovation proposal (3) Validation.

Activity dissemination will adopt a range of tools.

- A Website and social networks (LinkedIn, etc) will facilitate information sharing within the Action and the dissemination to the outside world.

- Scientific papers in International Journals, communication to conferences, white papers and recommendations will be given. Collaborative book proposals will be developed.
- STSMs will be regularly organized and monitored in order to disseminate knowledge across Institutions. An ad-hoc STSM Committee will be established to ensure the effectiveness of the proposed exchange visits.
- An annual thematic Training School will be organized bringing together lecturers and participants from the biometric and forensic communities.
- Tutorials, seminars and meetings, also co-located with selected scientific and industry conferences (IEEE WIFS, ACM MM&SEC, ENFSI, etc.) will be organized.
- A thematic annual international workshop open to academia, industry, law enforcement agencies, forensic experts, lawyers, data protection and ethics policy makers.

Upon approval of this Action, a specific website will be created with the aim to share all relevant information and events organized by the Action. The website will be managed and regularly updated. In order to ensure that the website content is properly updated, all MC members will be regularly requested from the webmaster to provide additional content to be added to the website. Moreover, the website update will be an item included in all MC meetings. The website will contain relevant information for each Working Group. Each WG chair will be also responsible to provide a regular update (at least every three months) on the WG activities and outcomes to be included in the website.

Following the election of a chairperson and a vice-chairperson, the Management Committee (MC) will invite nominations and elect a coordinator for each working group (WG). The Management Committee will normally have two meetings per year.

Members of the Management Committee should be involved in research and/or development work related to at least one of the main areas of the Action activities. They will attend the Management Committee meetings regularly and make contributions to the objectives of the Action. They will also act as the Action liaison officers in their own countries. When required, members will collaborate in groups formed to address specific issues.

This Action will capitalize on the experience gained by some of the members over the last 10 years in the organization of a very successful summer school on biometrics, which is the leading international educational event in the field. In the last two years this summer school has been focused on biometrics and forensics showing the great potential in harmonizing these topics as well as the underlying communities. For every edition about 18 lecturers and 40-50 participants have been involved together in an intensive week of study and lectures providing the optimal setting for cross-fertilization and fostering novel ideas. It is the intention of this Action to further develop and enhance this successful instrument.

Technical visits and workshops will be used for rapid exchange and dissemination of information as follows. The Management Committee will, as driven by technical needs, arrange laboratory visits and short-term staff exchange between participating institutions, and also technical visits to laboratories outside the Action.

Workshops will be organised and used as the main form of disseminating the Action's findings and outcomes. They will be planned according to be the important milestones and are expected to provide useful platforms for the evaluation of this Action progress. Significantly, they will contribute to over-the-horizon scanning in anticipation of future needs and opportunities.

Research papers describing the results of the Action activities will be presented at European and International conferences and in high-impact journals. A book presenting the major findings, achievements and recommendations of this Action will also be published.

E.2 Working Groups

This COST Action consists of six working groups (WGs), each being responsible for one of the areas described in Section D:

WG1: Biometric evidence for forensic evaluation and investigation
WG2: Audiovisual biometrics for multimedia forensics
WG3: Forensic behavioural and soft biometrics
WG4: Biometric analysis of forensic traces and their interpretation
WG5: Multimodal biometric evidence and its combination with other forensic evidence
WG6: Ethical and societal implications of emerging forensic biometrics

Their organisational structure is as follows:

WG1: Biometric evidence for forensic evaluation and investigation

The research programme of this working group is arranged according to the items crosscutting the biometric modalities. Those items are:

- Creation of a common interpretation methodology for automatic biometric recognition in forensic investigative and evaluative modes within the framework of the support to the criminal justice system.

- Building universal methodological support based statistical/probabilistic methods and likelihood ratio approach for automatic biometric recognition, corresponding to challenges found in real casework and modern computer and communication networks.

- Adaptation of the state-of-the-art automatic biometric recognition algorithms to the quantitative estimation of biometric evidence.

- Quality reporting and courtroom presentation of the forensic biometrics based examination in a manner which is understood by responsible investigative, prosecutorial and judicial target groups.

WG2: Audiovisual biometrics for multimedia forensics

The main items are:

- Development of advanced signal, image and video processing, recognition and understanding techniques to address biometric evidence extrAction from the audiovisual recordings of the scene of crime or being in relation to cyber-crime.

- Evaluation of the quality and usability of evidential audiovisual material collected from the variety of multimedia platforms (e.g., the Internet, computers, video surveillance cameras, mobile phones) to be exploited by the forensic biometrics examination.
- Development of statistical and probabilistic methods for automatic interpretation of biometric evidence extracted from audiovisual multimedia data given circumstances of the case (acquisition and environmental conditions, data processing and operator interaction).
- Facial imaging (e.g., face, iris, ear, periocular regions) in different acquisition, environmental and media conditions and automatic recognition of facial visual patterns in mismatched recording conditions (e.g., photo images and surveillance video recordings).
- Automatic speaker recognition with cooperative and non-cooperative suspects in mismatched recording conditions (e.g., audio from video sequences and phone call recordings).
- Automatic gait recognition at-a-distance scenario from video sequences in different real-world recording conditions.
- Combination of audiovisual evidential biometric measurements obtained from different sources, using the quality and reliability measures of combined audiovisual biometric modalities.

WG3: Forensic behavioural and soft biometrics

The main items are:

- Development of automatic methods for recognition of non-cooperative individuals at a distance from their style of action/actions using video surveillance systems.
- Modeling individual human's behaviour capable of predicting future actions based on a given situation, specific behaviour, which was exhibited during the criminal act and environmental factors.
- Automatic extraction of soft biometric features (e.g., gender, ethnicity, age, height, weight, eye color, moles, freckles, birthmarks) in a nonintrusive manner in order to assist of people recognition in forensic applications (e.g., identification of disaster victims).
- Combination of behavioural and soft biometric features in fusion schemes with primary biometric characteristics in order to improve the overall accuracy of the biometric recognition and strengthen the biometric evidence.

WG4: Biometric analysis of forensic traces and their interpretation

The main items are:

- Assessment of new generation of contactless sensors to acquire evidence from crime scenes (fingermarks and fingerprints).
- Development of advanced image processing and recognition techniques to gather biometric evidence from fingerprints, palmprints or other portions of friction ridge skin.
- Development of statistical and probabilistic methods for automatic interpretation of fingerprint/mark evidence.
- Evaluation of the quality of papillary marks left on crime scene.
- Development of automatic systems operating in "lights out" mode to process prints and marks in different real-world recording conditions.
- Extension of such methods to earprints/marks, barefoot impressions and lip-prints left on scenes or related objects.
- Development of dedicated automatic recognition systems in relation to the forensic assessment of handwriting and signatures both for an investigative usage and the production of corroborative evidence.

WG5: Multimodal biometric evidence and its combination with other forensic evidence

The main items are:

- Universal combination models of multiple modalities and corresponding evidence selected among forensic traces, audiovisual, behavioural and soft biometrics, using the quality and reliability measures of these modalities.
- Design methodologies for the acquisition and maintenance of large-scale operational (multimodal) databases of identities and biometric data for forensic case assessment and interpretation, forensic intelligence and forensic ID management.
- Development of interoperability methodologies and exchange protocols of data of large-scale operational (multimodal) databases of identities and biometric data for forensic case assessment and interpretation, forensic intelligence and forensic ID management.

- Assessment of multimodal biometric recognition systems with respect to real-life recording conditions, as well as forgery and spoofing, using fit-for-purpose forensic efficiency measures.
- Comparison of the inference of identity of source by classical examination of forensic experts with that of automated forensic multimodal biometrics systems.
- Combination of auxiliary information (e.g., scars, tattoos, clothing, footwear or glove marks) and other forensic evidence (e.g., modus operandi, locations) with multimodal biometric evidence.

WG6: Ethical and societal implications of emerging forensic biometrics

The main items are:

- Anticipation of the major reasons for ethical and societal concerns surrounding new and emerging forensic biometrics and provision of early warnings in this domain.
- Identification of fundamental rights liable to be affected by new forensic biometrics, the degree of interference with the right(s) in question and the necessity and proportionality of the interference in terms of societal benefits.
- Assessment of the impact of new and emerging forensic biometrics on privacy and data protection, including international biometric data sharing and cross-border biometric forensic databanks.
- Assessment of the risk of discrimination against ethnical and religious minorities, low income or geographically dispersed populations, children and minors, as well as persons with disabilities and ageing population in the applications of forensic biometrics.
- Review of existing policies, proposition of regulations, development of guidelines, and formulation of policy options in three main areas of the impact of forensic biometrics on: fundamental rights, privacy and data protection, as well as vulnerable and disadvantaged groups.

E.3 Liaison and interaction with other research programmes

Working liaison with other COST Actions will, in general, be achieved through consultation with the corresponding COST Domain Committees. The Action will particularly establish effective collaboration with all COST Actions whose activities are complementary to this programme of work.

An active cooperation with other EU and National projects has been already sought. Members of this Action are also within the consortia of the most relevant projects in the most closely related scientific fields. This is already envisaged with the EU Marie Curie BBfor2 project, on biometrics and forensics, project TabulaRasa on anti-spoofing and impersonation techniques, the HIDE and RISE projects involved with the definition of policies for privacy in biometrics.

In addition, this Action will actively seek to liaise with other projects in the biometrics and forensics fields and, in particular, those in the EU FP7/FP8 programme. This will be achieved by inviting people from the consortia to participate to thematic workshop and WG meetings. This Action will be a stepping stone to identification of transnational goals of mutual interest: these needs and opportunities will naturally define future FP7/FP8 projects. Moreover an active cooperation will be searched by organizing common workshops and related events. Experts from other consortia will be also invited to give lectures at the annual Action training schools.

E.4 Gender balance and involvement of early-stage researchers

This COST Action will respect an appropriate gender balance in all its activities and the Management Committee will place this as a standard item on all its MC agendas. This Action will also be committed to considerably involve early-stage researchers. This item will also be placed as a standard item on all MC agendas.

Proper involvement of early-stage researchers is foreseen through the organization of a yearly training school (summer school) which will provide a forum for exchange of ideas and communication with the major experts in both the biometrics and forensics field. The training schools will particularly favour ESR and the appropriate gender balance.

F. TIMETABLE

The duration of this Action is 4 years.

The Action is divided into three distinct phases. Table 1 gives the duration of each phase together with a description of the activities during individual phases.

Table 1. Timetable of the Action

Activity	*Duration*
Election of chair, vice-chair, working group coordinators, STSM committee members and initial planning, organisation of the first Training School (given the short time frame and in order to ensure the success of the first training school to be held in summer 2012, the organisation has been already started from the members of this Action)	4 months
Phase 1 **Innovative networking** Coordinated networking of scientific activities in the areas of biometrics and forensics chosen by Management Committee of the Action from WG1-WG6 items for Phase 1. **Inter-disciplinary networking** • Organising the first Action Workshop. • Organising the first and second Training School. • Fostering and activation of inter-partner STSM visits. • Creation liaisons with other COST Actions. • Establishing links with forensic and biometric organisations, national and international research projects and other international networks in the domain of interest. • Setting up the Action web site.	16 months

Phase 2 **Innovative networking** • Coordinated networking of scientific activities in the areas of biometrics and forensics chosen by Management Committee of the Action from WG1-WG6 items for Phase 2. **Inter-disciplinary networking** • Organising the second Action Workshop. • Organising the third Training School. • Monitoring and arranging networking inter-partner STSM visits. • Organising Cross-Action and inter-projects thematic meeting. • Reviewing external links. • Presenting papers at conference special sessions. • Updating the Action web site.	12 months
Phase 3 **Innovative networking** Coordinated networking of scientific activities in the areas of biometrics and forensics chosen by Management Committee of the Action from WG1-WG6 items for Phase 3. **Inter-disciplinary networking** • Organising the final Action Workshop. • Organising the fourth Training School. • Monitoring and arranging networking inter-partner STSM visits. • Organising Cross-Action and inter-projects thematic workshop. • Reviewing external links. • Presenting papers at conference special sessions. • Updating the Action web site.	16 months

The Action progress will be reviewed during the second, fifth and seventh meetings. The type and extent of activities within individual phases may be readjusted in the light of the progress achieved.

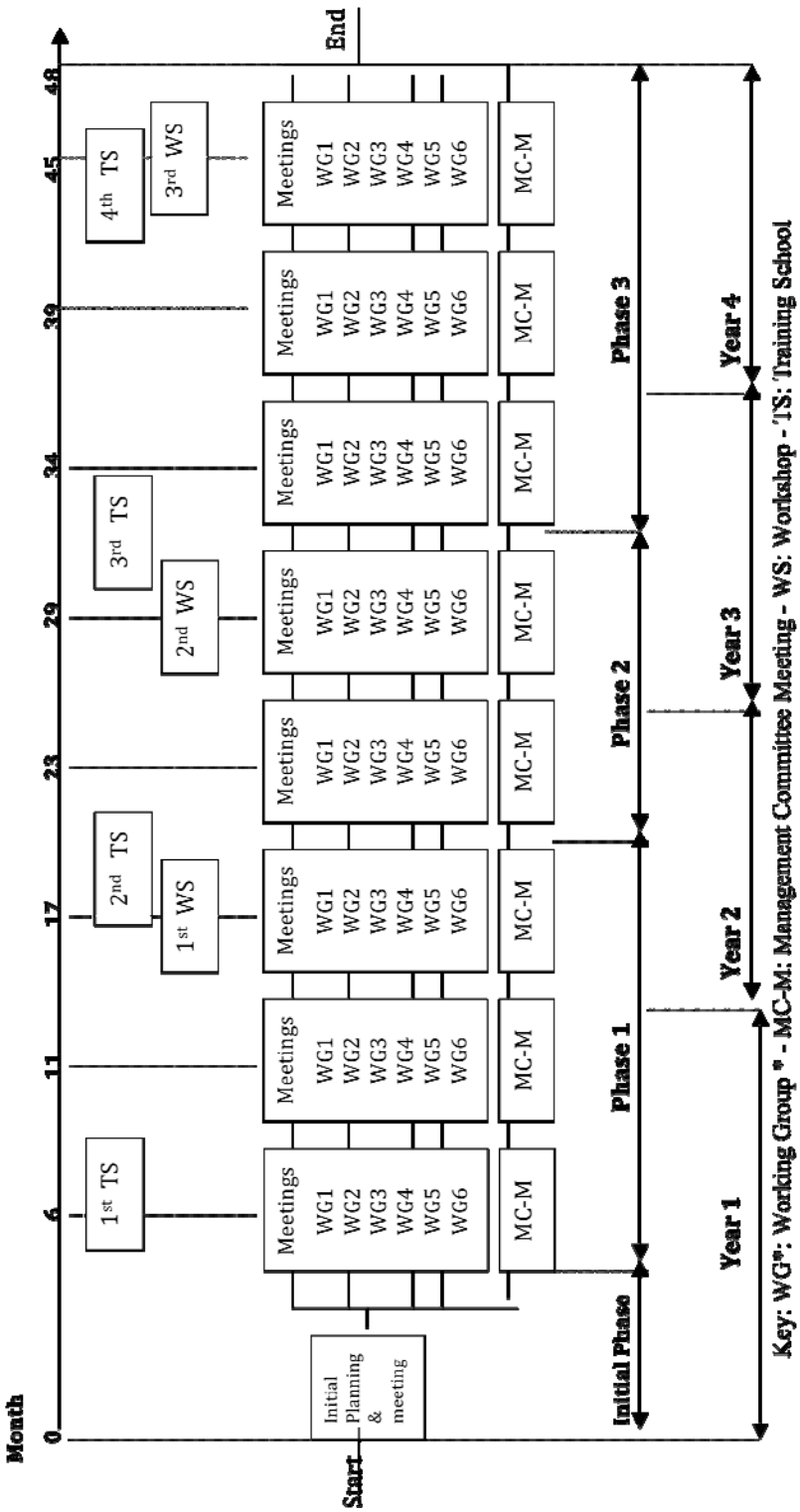

Figure 1. Timetable for the Action.

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: CH, CY, DE, DK, EL, ES, FI, FR, IE, IT, LV, NL, PT, SE, SI, TR, UK. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 68 Million € for the total duration of the Action. This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

H. DISSEMINATION PLAN

H.1 Who?

The dissemination of information and findings will be planned and managed by the Management Committee or, by a special working group formed for this purpose. However, the plan for this purpose will, in addition to satisfying the general dissemination requirements, involve:

- identifying appropriate target recipients, and
- implementing effective dissemination methods for these.

The abovementioned recipients include all those who may directly or indirectly benefit from the outcomes of the Action activities. Examples of these are:

- The European Network of Forensic Science Institutes (ENFSI), will be the main platform of the Action end users and the principal dissemination environment. Several members of this Action are either members of the steering committees or chairmen of ENFSI expert working groups (such as the Forensic Speech and Audio Analysis WG, the Fingerprint WG and the Digital Imaging WG).
- Potential end-users such as governmental, financial institutions and other service providers in the public and private domains,
- organisations concerned specifically with the security of information and services such as regulators, security advisers and law enforcement agencies,
- research groups, consortia and organisations working (in collaboration with the potential end-users or otherwise) in areas related to the technical contents of the activities undertaken, or the applications considered, by the Action.

Given the large community subtended to this Action, several groups are expected to benefit of its outcomes. The target groups for dissemination are expected to be the following:

- Researchers in the field of biometrics and forensics, as well as from related disciplines such as machine learning, computer vision, and signal processing.
- PhDs and ESRs working in the field of forensics and biometrics.
- EU projects in security and ICT, investigating the exploitation of biometric and related technologies to safeguard the public.
- Standardization Bodies in forensics applications of biometrics.
- Industries in the security market and providing services for police organizations as well as training investigation personnel.
- EU and National level policy makers in the field of security.
- National and pan-European police forces and forensics labs.
- National forensics institutes.
- General public

H.2 What?

The actual dissemination process will include all the elements known to be effective such as workshops, reports, conference papers and web sites. These will collectively form the basis for the general dissemination of the Action outcomes for the benefit of all. However, in order to fully satisfy the Action objectives, special efforts will be made to reach an appropriate subset of the recipients stated above consisting of areas and organisations identified as the main target recipients that may benefit from the Action activities and findings more directly. As indicated earlier, the exact approach for this purpose will be discussed and decided by the MC, and updated in the light of the results of the regular evaluations of the Action. However, the approach is expected to include the provision of additional material (based on the Action outputs) in various forms such as special reports and papers, application notes, assessment methods, and design considerations and tools.

These can then be disseminated through appropriate channels to different categories of target recipients. Examples of these are direct/indirect links, special sessions at conferences and the Action workshops, relevant seminars and the Action web site. Past experience has shown that the above combined approach maximises the dissemination effectiveness by ensuring that each category of the target recipients is exposed to the right type of information.

- Events: thematic conferences and workshops, special sessions in main conferences related to forensics and pattern recognition; Joint conferences involving biometrics and forensics experts;
- Posting of information on the Action web server;
- Publications: technical
- Publications: for the general audience
- Annual (summer) training school on biometrics and forensics related themes.

As it was in the past with several biometric-related technologies, such as the AFIS systems, a strong impact in the standardization is also expected with regards to emerging forensic modalities such as 2D and 3D face recognition, palmprint recognition and the recognition of skin details such as scars and tattoos.

As biometric technology matures, there will be an increasing interaction among forensic cases, biometrics technology, applications and education. For the widespread use of the biometrics into forensics to materialise, it is not only necessary to undertake systematic studies of the fundamental research issues underlying the design and evaluation of systems to automatically process forensic traces, but also invest in educational process that targets public acceptability issues. The results of the Action will be incorporated in existing and future joint biometrics- and forensics-related educational activities at participating academic institutions.

H.3 How?

Dissemination will take place at several levels. First of all in the scientific community through the publication of technical papers and the organization of thematic conferences and workshops. Further and beyond this we plan to disseminate the results of the Action at a wider and broader level by organizing seminars in universities, forensics institutes, police organizations.

Moreover, an yearly international training school will be organized to facilitate the training and dissemination within European Phd students and ESRs.

Thematic conferences are also planned in conjunction with projects such as HIDE to involve policy makers and police organizations into the outcomes of the Action. Particularly making people well aware of the great potential of the application of biometric technologies in forensic applications.

In order to ensure that the Action web site will serve the dissemination purposes effectively as well as facilitating communication, it will be designed to include the following information:

- A list of the official members and all other participants, giving their names, organisations, postal and e-mail addresses as well as telephone and fax numbers. In order to further facilitate communication, a group e-mail address will also be issued.
- Publication of the structure and activities of the Action.
- Publication of previous and forthcoming events, including MC meetings and workshops.
- Dissemination of appropriate technical reports and experimental results at thematic conferences and workshops.
- Special reports and application notes.
- Publication of minutes of MC meetings on a public access repository.
- Publication of the proceedings of the workshops run by the Action.
- Links to other appropriate web sites; for example other organisations, COST Actions and European areas involved in a related field.
- Thematic seminars and meetings held in conjunction with major public events, such as the annual EU ICT and/or Security conference and the ENFSI conferences.

In addition, a secure FTP site will be set up to hold technical information and databases which are to be used only by members of the Action. In due course, an additional web site will be set up to be used for the purpose of demonstration and testing some applications.