Proposal full title: A framework for interpretation and evaluation of measurements within forensic science

Proposal acronym: INTERVAL

Type of funding scheme: Coordination and support actions (Coordinating)

Work programme topics addressed:
SEC-2011.1.4-3 Advanced forensic framework

Name of the coordinating person:
Anders Nordgaard

List of participants:

Participant no.	**Participant organisation name**	**Country**
1 (Coordinator)	Statens Kriminaltekniska Laboratorium	Sweden
2	University of Edinburgh	United Kingdom
3	Netherlands Forensic Institute	Netherlands
4	Instytut Ekspertyz S•dowych	Poland
5	Lancaster University	United Kingdom
6	Forensic Science Service Ltd	United Kingdom
7	University of Glasgow	United Kingdom
8	Universidad Autonoma de Madrid	Spain
9	Guardia Civil Espanola	Spain
10	Université de Lausanne	Switzerland
11	Università Ca'Foscari Venezia	Italy
12	Bundeskriminalamt	Germany
13	Universitetet for Miljø og Biovitenskap	Norway
14	Keskusrikospoliisi	Finland
15	Universidad de Castilla-La Mancha	Spain

1. Scientific and/or technical quality, relevant to the topics addressed by the call

1.1 Concept and objectives

The field of forensic science is rapidly developing. DNA is probably the most prominent example of an area in which new technologies and equipment are being used, but also other forensic disciplines show fast progress. This rapid development is valuable and important. However, the focus has been on new technology. The justice system can only make full use of this if the evidential strength of the results can be derived reliably. This is a weak link in the chain of the administration of justice for many areas of expertise. In addition, current knowledge is not spread evenly across Europe. This proposal aims at strengthening this link and disseminating knowledge across Europe.

Procedures related to improving the assessment of evidential strength and its reliability require probabilistic and statistical reasoning. Such reasoning is currently not so advanced as to be able to provide an accurate evaluation and interpretation of the evidence in many areas. Improved methods are necessary in order to deal with all sorts of uncertainties that are inevitably associated with forensic scientific evidence and hence obtain best value from new technological developments.

The use of methods for the quantitative evaluation (or strength) of evidence is increasing at forensic laboratories across Europe. The method receiving the most attention from researchers and with the best theoretical foundations is that of likelihood ratios. A likelihood ratio evaluates the evidence by a comparison of the probability of the evidence assuming the prosecution proposition is true and the probability of the evidence assuming the defence proposition is true. (If necessary, the defence proposition is simply the negation of the prosecution proposition.) There is a theoretical framework for the calculation of evidentiary strength with the use of likelihood ratios that is able to combine subjective and objective evaluations in one overall evaluation. However, the use of, and interpretation from, the outcomes of this framework vary considerably between different laboratories and different countries.

For instance, in DNA analysis it very often occurs that mixtures of DNA from two or more people are observed in the same sample. Furthermore, the DNA may be degraded so that only part of the profile can be made visible. There may be a single suspect that matches part of this mixture profile. The ways that the different forensic laboratories across Europe report the evidential strength of this common situation varies widely. Some may just report that they cannot exclude that the sample contains DNA from the suspect. Others may use elaborate statistical models and report that the probability of obtaining this DNA profile is, e.g., 350 million times more likely if the sample contains DNA from the suspect than if it does not contain DNA from the suspect (the LR is 350 million). Thus while the technique of producing DNA samples is more or less standard, the way to interpret and report the evidential value of this to the court varies tremendously. The situation in areas other than DNA is similar or even worse. This is partly due to the fact that the statistical models needed for evidence evaluation for the specific question are not always available and need to be developed, and partly due to the fact that current knowledge is concentrated in a few institutes and needs to be disseminated.

For different pieces of evidence, a statistical approach to their combination provides an efficient procedure to increase the overall value of the evidence. However, the approach may often be treated erroneously, for example by treating each piece of evidence as independent of all other pieces. Instead of taking into account circumstantial information in the particular case, the different pieces of evidence are evaluated with propositions about the source of the evidence, found at the crime scene and in association with the suspect, that only consider its similarity and rarity, so-called source propositions. The results for the different pieces of evidence are then reported separately with the intention that the fact-finders should then combine the effects of the separate items. Knowledge as to how this may best be done cannot be expected to be found among jurors, judges, prosecutors or lawyers, since the combination involves particular consideration of sources of variation from different stages of a criminal activity. Also, there has to be consideration of the circumstantial information, for example about the activity that might explain how the evidence may have been transferred, retained

and have persisted, so-called activity propositions. It is the aim of this proposal to provide a framework on which work on further research, development and dissemination of these ideas may be built.

The theoretical framework for evidence evaluation is by necessity to a great extent statistical in its nature. There is a broad spectrum of literature on this subject ranging from general textbooks to specific books or papers on particular classes of evidence types. Nevertheless, the general forensic scientist is not a statistician by training and the translation from statistical text to daily case-work in the laboratory is complicated. Several laboratories have established standard procedures for how to handle certain cases, but it is seldom that such procedures provide an adequate description of the statistical issues that come to hand.

An important aspect for the construction of the framework is the role of databases. DNA, with its natural conditioning on the existence of a reliable database, provides the starting point from which forensic scientists search for the possibility of compiling similar databases for other types of evidence. For some of these types, e.g. glass and gunshot residues, considerable progress has been made. For other types of evidence the compilation of a database is a more involved process. For example, with footwear marks, time-dependency must be taken into account. Some databases are such that an objective numerical baseline for the evidentiary strength based typically on features created in the manufacture of the evidential object may be derived while features acquired individually by an object after manufacture cannot be objectively evaluated. However, the likelihood ratio is able to evaluate the evidence in the absence of databases, taking account of subjectivity in a robust and rigorous manner, and to provide a more rigorous analysis than is provided by a summary as to the possible source of the evidence or to the consistency of the evidence with respect to some proposition.

The objective of the current proposal is to develop a framework to enable practical implementation of the "state of the art" concerning the statistical evaluation and interpretation of forensic evidence in legal processes throughout European member states and associated states. The framework will be concerned not only with evaluation, interpretation and presentation in court, the trial stage, but also with the investigative stage of a crime. This framework will comprise current knowledge about, and implemented routines for best practises, methodologies and technological standards, and in addition what future development of theoretical models and practically implemented methods should be pursued.

1.2 Contribution to the co-ordination of high quality research

The member institutes of the proposed consortium are the most supportive of, and house the most outstanding researchers, in forensic statistics in Europe. There is considerable breadth of expertise in the network, ranging from academic statisticians, forensic scientists and lawyers, to practising statisticians and forensic scientists in forensic science institutes and police investigators (and include an external (non-ENFSI) adviser of the R&D committee of the European Academy of Forensic Sciences, the research wing of ENFSI (the European Network of Forensic Science Institutes). Much of the current knowledge and implemented routines for evidence evaluation and interpretation has been developed within these institutes and the named persons are to a great extent leaders of the continuing development of models and methods. The proposed coordination action will enable a compilation of these models, methods and routines into a coherent framework and further enable a fast dissemination of this framework to researchers, practitioners and decision makers within forensic science laboratories and institutes, police authorities and courts in Europe and beyond.

There is a link between this proposal and the proposal submitted via ENFSI 'Development and implementation of an ENFSI standard for reporting evaluative forensic evidence', the so-called Monopoly project in that there are several partners in common between the two bids: Professor Colin Aitken (UEDIN, 2), Professor Franco Taroni (UNIL, 10), Dr Roberto Puch-Solis (FSS, 6) and Dr.

Grzegorz Zadora (IFR, 4). The link will strengthen the work of both bids. They are complementary bids but both are entirely self-contained.

The Monopoly project is to propose a standard for the interpretation and reporting of evaluative evidence that can be adopted as an ENFSI standard with an application across forensic science specialist areas, to identify the challenges associated with its implementations and to provide recommendations to overcome these challenges, to put in place the necessary conditions for the implementation of the standard through the provision of adequate training to key members of staff and to identify any further outstanding implementation challenges.

The objective of this proposal is to provide a framework for the future research and development of theoretical models for the interpretation and evaluation of forensic scientific evidence and for the practical implementation of models that arise from this process. An initial stage in this process will be a framework to enable the practical implementation of the current research that concerns the evaluation, interpretation and presentation of forensic scientific evidence in legal processes. This initial framework will comprise current knowledge about, and implemented routines for, best practices, methodologies and technological standards and will provide the foundation for the final framework relating to future research and development.

The Monopoly project is concerned with standards for interpretation and reporting. The standard will be developed in consultation with the Quality and Competence Committee and working groups of ENFSI and will be concerned with quality assurance. The project will help ensure high standards through the provision of help for ENFSI staff to access certified education and training on issues on interpretation.

The work described in this proposal on the initial framework on current knowledge will inform the Monopoly project as that project develops its standard for interpretation and reporting. In turn, as the Monopoly project identifies the implementation challenges these will enhance this proposal as it builds the framework for future research and development. The partners in common between the two bids will ensure solutions and ideas arising in either project will be able to be disseminated rapidly to the other project. This will ensure a beneficial cross-fertilisation of ideas and a synergy such that both projects will together provide greater beneficial outcomes than would have been the sum of both working independently of each other.

The 2009 report 'Strengthening Forensic Science in the United States: A Path Forward' from the USA National Academy of Sciences (NAS) has identified as important for the administration of justice many of the issues that will be addressed by this proposal. This proposal will identify the areas in which scientific studies should be conducted and, in particular, those areas for which there is the greatest need and for which the greatest benefits to the administration of justice may be obtained. The framework will clarify the questions, and the liaison with Monopoly with its identification of implementation challenges will be important here.

The framework will consider questions raised by the NAS report concerning (1) the extent to which a particular forensic discipline is founded on a reliable scientific methodology that gives it the capacity to analyze evidence and report findings accurately and (2) the extent to which practitioners in a particular forensic discipline rely on human interpretation that could be tainted by error, the threat of bias, or the absence of sound operational procedures and robust performance standards. The Monopoly bid is of relevance here; implementation challenges include those on human interpretation listed above in (2).

The NAS report also calls for greater support for research in forensic science. Identification of the important areas of research by the project will provide evidence that will strengthen the case for funds to be made available for such research, including fundamental basic scientific questions. The project will also consider the hindrance to advancement caused by the disaggregation of current enterprise in forensic science as identified by the NAS report. The partners are well used to dealing with many

forensic disciplines. It is one of the strengths of statistics that it is able to distil the important characteristics of a problem, to determine the factors common to many apparently disparate areas and to provide solutions common to all of these areas. The partners are experts in forensic statistics and can combine their expertise in statistics with their knowledge of forensic science to propose a fundamental framework to guide future research and development.

1.3 Quality and effectiveness of the co-ordination mechanisms, and associated work plan

1.3.1 Work plan: Overall strategy

The overall strategy of the work plan is "from diversity to coherence". Most of the suggested work packages take their standpoints from the current status and in particular work packages 1 and 2 will serve as the natural base for the outcomes of the other work packages. Successive integration of the outcomes will finally lead to a comprehensive framework, where today's diverse methods of evaluation and interpretation are replaced by a standardised coherent system. The skeleton of the framework end-product will be established at the start of the project and will be successively filled with information from the different work packages.

For each work package suggested there will be a selection of evidence types to focus on. The selection will however be such that results can be used in the whole range of evidence types.

Each participant will carry out most of the work at their respective institutes, with organised exchange of personnel between institutes within the same work package. Successive coordination of outcomes will be done at general project meetings, where two meetings per year are planned. These meetings will partly be co-scheduled with the annual FORSTAT workshops on statistics in forensic science for members of ENFSI (to which the project is connected through the associated research group from which the consortium was formed – see 2.2.3 and the biographical note for Ivo Alberink, NFI, 3), but otherwise move amongst the other participants in order to enhance the knowledge building of the pan-European forensic science perspective.

The strategy of the dissemination will also steer the development of deliverables within the work packages. Some deliverables need to be traditional reports to ease the communication of the outcomes to future researchers and developers, but some deliverables and in particular the final deliverable will take the forms of live products (web sites) that will allow for end-user interaction. Review papers will be prepared and submitted for publication in peer-reviewed journals as appropriate.

1.3.2 Timing of different work packages and their components

Figure 1.3a shows the timing of the different work packages and their deliverables.

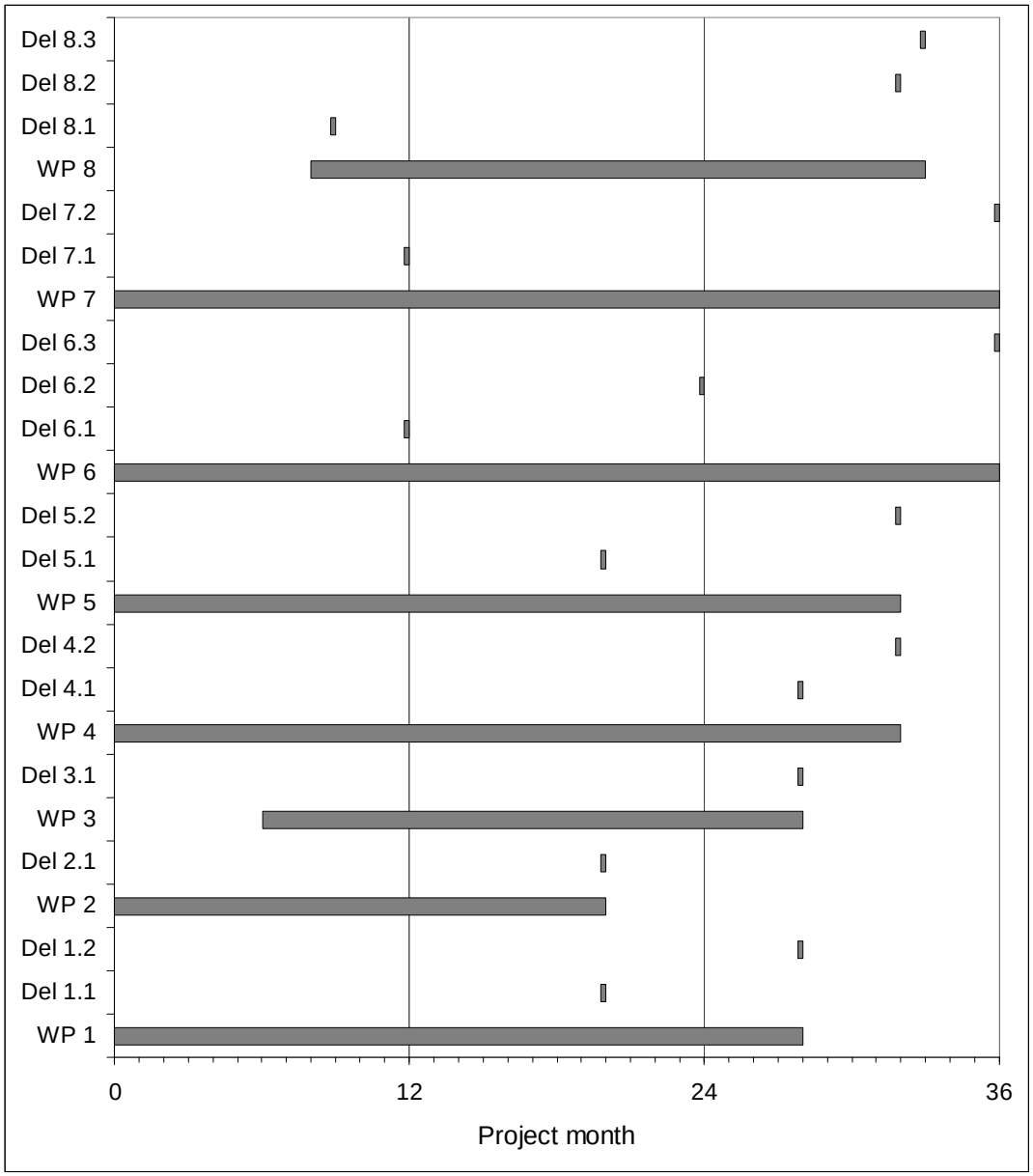

Figure 1.3a Timing of different work packages and their deliverables

1.3.3 Detailed work description

1.3.3.1 Work package list

A total of 8 Work packages are proposed as presented in Table 1.3a.

Table 1.3 a: Work packages

Work package No	Work package title	Type of activity	Lead participant No	Lead participant short name	Person-months	Start month	End month
WP 1	Collection of methods and identification of potential standards	COORD	3	NFI	18.98	1	28
WP 2	Case assessment and interpretation	COORD	10	UNIL	5.68	1	20
WP 3	Case studies	COORD	4	IFR	9.84	7	28
WP 4	Training and communication	COORD	2	UEDIN	12.82	1	32
WP 5	Technological standards	COORD	5	ULANC	8.8	1	32
WP 6	Administration, scientific coordination and assessment	MGT	1	SKL	5.28	1	36
WP 7	Framework building	COORD	6	FSS	8.21	1	36
WP 8	Dissemination	OTHER	1	SKL	11.29	9	36
				TOTAL	80.90		

1.3.3.2 Deliverables list

A total of 16 Deliverables are proposed as presented in Table 1.3b.

Table 1.3 b: List of deliverables

Del no.	Deliverable name	WP no.	Nature	Dissemi-nation level	Delivery Date
6.1	Progress report 1	6	R	CO	12
7.1	Web-site, first edition	7	O	PU	12
8.1	Conference session EAFS 2012	8	D	PU	9[1]
1.1	Current methodologies for evidential interpretation and statistical practice	1	R	PU	20
2.1	Case assessment and interpretation	2	R	PU	20
5.1	Recommendations for software use	5	O	PU	20
6.2	Progress report 2	6	R	CO	24
1.2	Standards for evidential interpretation and statistical practice	1	R	PU	28
3.1	Case studies	3	R	PU	28
4.1	Communication and Interpretation of forensic evidence in European courts	4	R	PU	28
4.2	Guidelines for training	4	O	PU	32
8.2	Conference session ICFIS9	8	D	PU	32[2]
5.2	Platform for downloading open source software with instructions	6	O	PU	32
7.2	Framework for interpretation and evaluation of measurements within forensic science	7	O	PU	36
8.3	Final workshop	8	O	PU	33
6.4	Final report	6	R	PU	36

[1] September 2012 (Month 9 if project starts in January 2012)
[2] August 2014 (Month 32 if project starts in January 2012)

1.3.3.3 List of milestones

For this project three milestones are proposed as presented in Table 1.3c. The inventory and identified needs for standardisation as well as the review of case assessment and interpretation and the recommendations for software use will constitute the first milestone. The second milestone is reached when the inventory, the means of standardisation and the recommendations for software use have been integrated with case studies, guidelines for training, a platform for software and rules for evidence and European collaboration. The third milestone is reached when the coherent European strategy has been disseminated at international conferences and at the final workshop and the framework is launched.

Table 1.3 c: List of milestones

Milestone Number	Milestone Name	Work package(s) Involved	Expected date	Means of verification
1	Inventory of current praxis and theory	WP 1, WP2, WP 5, WP 6, WP 8	20	Deliverables 1.1, 2.1, 5.1 , 7.1 and 8.1
2	A coherent European strategy for the investigation, analysis, evaluation and interpretation of physical evidence	WP 1, WP 2, WP 3, WP 4, WP 5, WP 6, WP 7, WP 8	32	Deliverables 1.2 3.1, 4.1, 4.2, 5.2 and 8.2
3	A framework for interpretation and evaluation of measurements within forensic science	WP 7 and WP 8	36	Deliverables 8.3 and 7.2

1.3.1.4 Description of the work packages

Below are the detailed descriptions of Work packages 1-8. Each description (besides the first one) starts on a new page.

Table 1.3 d: Work package description

Work package number	1	**Start date:**		1
Work package title	Collection of methods and identification of potential standards			
Activity type	COORD			
Participant number	1	2	3	4	5
Participant short name	SKL	UEDIN	NFI	IFR	ULANC
Person-months per participant	2	0.5	6.4	0.5	1
Participant number	6	7	8	9	10
Participant short name	FSS	UGLAS	UAM	GUCI	UNIL
Person-months per participant	1	0.4	1.5	0.5	1.24
Participant number	11	12	13	14	15
Participant short name	UNIVE	BKA	UMB	NBI	UCLM
Person-months per participant	0.74	0.6	1	1	0.6

Objectives

(i) To identify current practises prevalent at forensic laboratories of collecting, measuring, analysing, and interpreting scientific forensic evidence; and
(ii) To identify potential standards for the treatment of forensic measurements.

Description of work

The work package will take its standpoint from the methodologies covered by the working groups of the European Network of Forensic Science Institutes (ENFSI). Each working group reflects the ambitions to form standards within the area covered. However, no work has so far been carried out to identify potential standards that go beyond the group structure.
It is expected that the areas covered by the ENFSI groups will constitute the core, but also help to identify important areas that do not fit into this working group structure and thus are left out of current standardisation work.

The work package is naturally divided into a number of sub-tasks that will be carried out separately from or integrated with each other. For each sub-task a number of participants varying between 1 and 15 are active:

1) Identifying how samples are taken and investigate sampling plans for consignments brought to the forensic laboratory. Active participants: UEDIN, NFI, SKL and ULANC.
2) Collecting and investigating methods of reporting the uncertainty of estimates (of e.g. post-mortem interval, proportion of a consignment that is illicit, quantity of illicit drug in a consignment). Active participants: NFI, UEDIN and ULANC.
3) Surveying the degree of probabilistic reasoning and decision making under uncertainty in forensic casework. Active participants: All
4) Investigating efficient numerical calculation of evidential strength (i.e. likelihood ratios). Active participants: UNIVE and UNIL
5) Identifying how and to what extent interpretation of evidential strength in a hierarchy of propositions (levels of source, activity and offense) is used. Active participants: UNIL, UNIVE, SKL, NFI
6) Surveying currently used reference databases: guidelines for criteria for inclusion, collection,

retention and maintenance; investigating their roles in evidence evaluation and interpretation. Active participants: SKL, NBI, IFR, FSS, GUCI, UNIL, BKA, NBI

7) Surveying available methods for the assessment of the quality of methods for calculation of evidentiary strength (i.e., likelihood ratios): UAM, IFR, UEDIN.

8) Surveying the use of Bayesian belief networks for

- o the connection of activity and source level propositions
- o case pre-assessment
- o combining evidence, for example DNA and fingerprints

Active participants: UNIL, UNIVE, NFI, FSS, IFR

9) Surveying best practices and methodologies in a world-wide perspective where in particular experience from professional work in United States and Australia/New Zealand will be collected. Active participants: SKL, UEDIN, UGLAS, FSS, NFI, GUCI, UMB

Deliverables

Deliverable 1.1

Title: Current methodologies for evidential interpretation and statistical practice.

Brief description: A comprehensive report defining the current practises used, identified relationships and inter-dependencies and suggesting steps of research and development to reach the implementation of best practices and methodologies. (A review paper will also be prepared for submission to an appropriate forensic science journal.)

Month of delivery: 20

Deliverable 1.2

Title: Standards for evidential interpretation and statistical practice

Brief description: A collection of all identified methodologies for which standards for evidential interpretation and statistical practice can be applied, including the grouping of methodologies for which a unified standard can be applied, no matter the forensic area.

Month of delivery: 28

Work package number	2	**Start date:**				1
Work package title	Case assessment and interpretation					
Activity type	COORD					
Participant number	2	8	9	10	11	13
Participant short name	UEDIN	UAM	GUCI	UNIL	UNIVE	UMB
Person-months per participant	0.45	1.5	0.5	1.24	1.49	0.5

Objectives

To review the case assessment and interpretation framework in forensic science and make recommendations.

Description of work

This work package will to some extent use results from work package 1 and also liaise with other FP7 projects within the forensic area of the Security Theme (e.g. ODYSSEY) and also the ENFSI Monopoly project on development and implementation of an ENFSI standard for reporting evaluative forensic evidence. The work package will review the framework for case assessment and interpretation (CAI) along with a comprehensive SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis with which forecasts for implementation in different European countries can be made.

CAI provides the means to define the requirements of the investigators, to assess how forensic science can help, to develop and agree an examination strategy for the evidence and then to carry out the examination. The use of the techniques of pre-assessment helps decide which items of evidence will address the issues efficiently and effectively; its use also eases the interpretation of results. The requirement of the investigator is defined according to the case circumstances (timings, allegations, offence), the uncertainties (with what factors is help required), the strength of evidence required, whether it is for charging or for prosecution and the deadlines.
A table of likelihood ratios and associated conditional probabilities enables a prediction to be made of the value of, and the probability of, obtaining evidence for each type of evidence and for each item, if (a) the suspect was truly guilty and (b) the suspect was truly innocent.

If proposition (a) were really true then it is possible to determine the probabilities of likelihood ratios of various values using subjective probabilities. If proposition (b) were really true, it is also possible to determine the probabilities of likelihood ratios of various values using subjective probabilities. These results can then be used to help determine a useful strategy. For example, they may show that there is a reasonably high probability that the evidence will provide support for either proposition but that the support will most likely only be moderate.

Deliverables

Deliverable 2.1

Title: Case assessment and interpretation

Brief description: A comprehensive report describing the reviewed framework, a SWOT analysis and its ramifications for forecasting future implementation. This report will contain recommendations to The European Union for consideration for further submission to the board of the European Network of Forensic Science Institutes (ENFSI).

Month of delivery: 20

Work package number	3	**Start date:**			6
Work package title	Case studies				
Activity type	COORD				
Participant number	1	3	4	6	8
Participant short name	SKL	NFI	IFR	FSS	UAM
Person-months per participant	0.5	0.5	3	1	1.5
Participant number	10	12	13	14	
Participant short name	UNIL	BKA	UMB	NBI	
Person-months per participant	1.24	0.6	0.5	1	

Objectives

To produce case studies to go along with the final framework

Description of work

In this work package case studies will be produced within different areas of evidence evaluation (e.g. DNA, chemistry, forensic speaker recognition and biometrics, visual inspection, data mining) as have been identified in WP 1 and with application of the framework reviewed in WP 2. There will be liaison with the ENFSI Monopoly project with partners IFR and UNIL in common.

Each case will be delivered in such a format that it should be possible to access it from the final framework (Del. 7.2) and as such it will comprise a background description, a theoretical framework, a reference system for materials and methods, software implementation and methods for the use and final communication of the results.

These case studies should serve as "examples" for end-users, mainly at forensic laboratories and will cover those areas of evidence evaluation in which forensic laboratories in all European countries are active. Thus, more specialised topics where only a fewer number of laboratories are involved will be left out.

Deliverables

Deliverable 3.1

Title: Case studies

Brief description: A comprehensive report describing in detail the selected case studies, including flow-schemes of the work from laboratory to court. This report will be made available to all ENFSI working groups.

Month of delivery: 28

Work package number	4	**Start date:**			1
Work package title	Training and communication				
Activity type	COORD				
Participant number	1	2	3	4	6
Participant short name	SKL	UEDIN	NFI	IFR	FSS
Person-months per participant	0.5	3.38	1	2	1
Participant number	9	10	13	15	
Participant short name	GUCI	UNIL	UMB	UCLM	
Person-months per participant	1	1.24	0.5	2.2	

Objectives

(i) To identify the current status of training of forensic scientists in Europe in evaluation and interpretation and define standards
(ii) To establish guidelines for training in statistical methods and probabilistic reasoning with respect to the recommended standards
(iii) To investigate the communication of probabilistic aspects of forensic evidence to commissioners and in court.
(iv) To survey the market fragmentation in the forensic services field and recommend solutions.

Description of work

This work package consists of the establishment of guidelines for the training of beginners as well as experienced forensic analysts and jurists with respect to the recommended standards. Results from work packages 1, 2, 3 and 5 will be used and the guidelines will further be in compliance with the established and ENFSI-supported FORSTAT Workshop and will take account of the considerable experience already existing within the consortium. Experiences of the e-learning course on 'Statistics and the evaluation of evidence' at UNIL, an 18-month course that provides 15 University transferable credits, will be valuable input. The training in this WP will be focused on examples from real cases. The lead participant in this WP is a consultant for the UNIL e-learning course and has been involved in workshops on the logic and interpretation of evidence sponsored by the UK Forensic Science Society and the Royal Statistical Society and the experience gained from these will also provide valuable input. There will be liaison with the ENFSI Monopoly project for which UEDIN, UNIL and IFR are common partners.

Recommendations will also be made for the communication of probabilistic aspects of forensic evidence (for instance, evidential force and the effect of sources of uncertainty) to jurists such as police investigators, judges, prosecutors and defence attorneys.

The Law contribution (UEDIN (2), Schafer; UCLM (15), Gascón) will be across all work packages implicitly but the explicit description is given here.

Legal experts (UEDIN(2) – Schafer; UCLM (15) (Gascón) with direct expertise in four of the main European legal families – Romanist (Spain), Germanic (Germany), common law (England) and mixed (Scotland) – will advise at all stages of the project, and across the work packages, regarding whether any of the methods and approaches chosen is likely to be in conflict with specific legal regulations, or practices otherwise embedded in the justice process of the member states. In order to gain the greatest possible benefits from the scientific results that this project aims to achieve, cognisance has to be taken of the fact that forensic science takes place "in the shadow of the trial". This means, first, that not everything that is scientifically desirable in the fact-finding process is also necessarily legally permitted, and, second, that modes of communication of scientific results have to be found that are meaningful for lawyers operating in a variety of (European) jurisdictions and their respective legal traditions.

There are two possible scenarios where sound scientific results can fail to have an impact in legal practice: (a) legal regulations prevent its use; (b) lawyers fail to understand the benefits of the approach, due to a mismatch of scientific and legal concepts.

In a multi-jurisdiction context, these difficulties potentially multiply, and can cause real obstacles when, for instance, requests for evidence are made within the framework either of the European Arrest Warrant or of other agreements for judicial assistance. To address these issues, this project incorporates different approaches from current comparative legal methodology. Addressing scenario (a), this will ensure that results are formulated in a vocabulary that is neutral vis-a-vis the different legal terminology used in national jurisdictions. For this, a series of case scenarios will be developed that are based on archetypical problems such as whether to prosecute or not, whether to allow or suppress evidence and whether or not to supply evidence when requested from abroad. This will result in a diagnostic tool to identify possible legal obstacles in the use of the statistical methods developed in the other parts of the project. Secondly, there will be a look beyond "law in books" to "law in action", through a survey-based approach that will gauge how confident lawyers in different jurisdictions feel about handling statistical evidence. This will enable us to compare subjective perceptions of problems with real legal obstacles.

The methodology used will be similar to that employed in the EU funded AEEC project on the Admissibility of Electronic Evidence in Court. Rated as "Excellent" upon completion by the EU, the project (in which Schafer (UEDIN(2)) was involved as PI) analysed the legal issues raised by the use of digital evidence across Europe, combining quantitative studies of attitudes of lawyers with qualitative analysis of the relevant legislation by our experts. This highly successful methodology will be employed to ensure that the results are not only compatible with "hard" legal rules on admissibility, but also with "soft", culturally mediated differences in the way in which evidence is handled, presented and assessed in different jurisdictions. Using a theoretical framework based on the interaction between the system of "law" and the system of "science", a methodologically rigorous comparative legal study will produce
(a) a map of the legal obstacles that the use of statistical evidence can face across Europe, (b) recommendations for law reform where these obstacles can be seen as arbitrary, counterproductive and/or in danger of segmenting the market on forensic services provisions in Europe and (c) a training programme suitable for lawyers, judges and prosecutors similar to the "Certificate in Digital Evidence" whose development was funded by the EU in the AEEC project

Inputs will be taken from the experience of the members of the consortium on this project, but also from experienced practitioners and research users across Europe. This will include practical experience regarding expert testimony in court and also draw on psychological research on the apprehension of numerical likelihood ratios among judges, juries and police officers with typically little or no background in probability theory.

The recommendations will take into account different jurisdictional systems among European countries and be conformed to these. The work of the Royal Statistical Society's working group on statistics and the law (a group whose chairman is part of this bid (Aitken, UEDIN) and whose membership includes a judge, a barrister, an advocate, other lawyers, as well as forensic scientists and statisticians) will also be relevant; this work includes the production of a series of reports, supported by a grant from the Nuffield Foundation, on various aspects of probabilistic reasoning in the law, including DNA profiling, case assessment and interpretation, and Bayesian belief networks. The first of these reports was published in November 2010.

The further issue of combining different evidence in one particular case will be studied through real cases, such as those developed in WP3.

The recommendations will reflect questions like "Which ways work?", "Which ways do not work?", "How may errors of thinking be avoided?"

Work will include the development, conduct and analysis of two Web-based surveys, one, addressed to forensic scientists, will gather information about market fragmentation in the forensic services field and one, addressed to jurists, will investigate the practice of reasoning with statistics in the criminal justice system, informed by comparative legal methodology.

Deliverables

Deliverable 4.1

Title: Communication and Interpretation of forensic evidence in European courts

Brief description: A comprehensive report describing the current status of interpretation at European courts. Recommendations for the communication of probabilistic aspects of forensic evidence conformed to different jurisdictional systems and considering current European collaboration in forensic services and analysis will be compiled. A review paper will be prepared for an appropriate peer-reviewed journal.

Month of delivery: 28

Deliverable 4.2

Title: Guidelines for training

Brief description: A framework for teaching materials for non–scientists (judges, prosecutors) from which teaching materials may be developed. Comprehensive guidelines comprising suggested packages of lectures and scenario-driven exercises including the use of designated software.

Month of delivery: 32

Work package number	5	**Start date:**			1
Work package title	Technological standards				
Activity type	COORD				
Participant number	4	5	7	8	13
Participant short name	IFR	ULANC	UGLAS	UAM	UMB
Person-months per participant	1.5	3	1.8	2	0.5

Objectives

To produce

(i) Recommendations and guidelines for the use of open source software for the European forensic science community.
(ii) An open repository of software for use by the European forensic science community.

Description of work

The package will have two stages to correspond to the two objectives above, the provision of recommendations and guidelines and the provision of open repository software. Together, the stages will serve to provide a repository of existing forensic software by providing, and coordinating, the low level building blocks which are employed in user-level applications, with recommendations and guidelines on use.

Low-level numerical libraries of applications that are independent of their platform can be collated for each of the main environments favoured by forensic scientists in their respective institutions. For example, there is a collection of existing functions, written in the low level language C, to calculate continuous likelihood ratios for multivariate data. Developers of forensic software will benefit considerably from access to these functions. More specific implementations of the core functionality can be formed into a series of user level packages for existing mathematical languages such as Matlab and R. Moreover software for the application of Bayesian Belief Networks will also be catalogued. The result will be useful toolbox of applications for daily casework at the institutions of forensic practitioners.

The repositories will be made available to all ENFSI laboratories. Hence, many European forensic scientists will have the opportunity to gain access to software which meets the then current validated standards, for many of the implementations that may be employed.

Deliverables

Deliverable 5.1

Title: Recommendations for software use

Brief description: Repository of on-line recommendations with links to recommended software platforms, and short examples of their use.

Month of delivery: 20

Deliverable 5.2

Title: Platform for downloading open source software with instructions

Brief description: A web-based platform with detailed instructions for downloading, installing and launching open-source software and with brief manuals for each software package built on case studies developed within work package 3.

Month of delivery: 32

Work package number	6	**Start date:**				1	
Work package title	Administration, scientific coordination and assessment						
Activity type	MGT						
Participant number	1	2					
Participant short name	SKL	UEDIN					
Person-months per participant	3	2.28					

Objectives

To manage the project

Description of work

Management of the project comprising the organisation of planned events, financial management, surveillance of work packages activities and deliverables and communication with EC project officers.

Organisation of dissemination activities and establishment of platforms for sustainable future reference to project outcomes.

Conduct of self-assessment procedures for the processes and outcomes of work packages 1-5, 7 and 8.

Deliverables

Deliverable 6.1

Title: Progress report 1

Brief description: Outcomes and project status after first project year

Month of delivery: 12

Deliverable 6.2

Title: Progress report 2

Brief description: Outcomes and project status after second project year

Month of delivery: 24

Deliverable 6.3

Title: Final report

Brief description: Final outcomes of the project

Month of delivery: 36

Work package number	7	**Start date:**		1	
Work package title	Framework building				
Activity type	COORD				
Participant number	1	2	3	4	5
Participant short name	SKL	UEDIN	NFI	IFR	ULANC
Person-months per participant	0.5	0.42	0.2	0.5	1
Participant number	6	7	8	9	10
Participant short name	FSS	UGLAS	UAM	GUCI	UNIL
Person-months per participant	2	0.6	0.5	0.5	0.2
Participant number	11	12	13	14	
Participant short name	UNIVE	BKA	UMB	NBI	
Person-months per participant	0.19	0.6	0.5	0.5	

Objectives

To coordinate the outcomes of all other work packages into a coherent framework

Description of work

Coordination of the outcomes of work packages 1-5 into one comprehensive framework for the interpretation and evaluation of measurements within forensic evidence. The framework will be structured in a live web site with links to theoretical models, practical implementations with recommendations, software downloads and benchmarking case studies, and along which also identified needs for future research and development are clearly exposed.

Deliverables

Deliverable 7.1

Title: Web-site, first edition

Brief description: The skeleton of the final framework

Month of delivery: 12

Deliverable 7.2

Title: Framework for interpretation and evaluation of measurements within forensic science

Brief description: Web site with the suggested framework.

Month of delivery: 36

Work package number	8	**Start date:**			9
Work package title	Dissemination				
Activity type	COORD				
Participant number	1	2	3	4	5
Participant short name	SKL	UEDIN	NFI	IFR	ULANC
Person-months per participant	1.5	0.4	1	0.5	1
Participant number	6	7	8	9	10
Participant short name	FSS	UGLAS	UAM	GUCI	UNIL
Person-months per participant	1	0.8	1	0.5	0.2
Participant number	11	12	13	14	15
Participant short name	UNIVE	BKA	UMB	NBI	UCLM
Person-months per participant	0.19	0.6	1	1	0.6

Objectives

To establish measures for dissemination of the project outcomes

Description of work

Designed dissemination of successive and final outcomes at international and national conferences, ENFSI Working Group meetings and at a final project-specific workshop. The designed dissemination will be in terms of demonstrations, methodological presentations and workshop participant activities. There will also be the preparation and submission of papers for publication in appropriate peer-reviewed journals. Participant 2 is an external advisor to the Research and Development Committee of the European Academy of Forensic Sciences and will enable dissemination through that committee to the members of the European Network of Forensic Science Institutes. There will also be liaison with the Monopoly proposal for which UEDIN, IFR and UNIL are members in common.

Deliverables

Deliverable 8.1

Title: Conference session EAFS 2012

Brief description: A designed session with project outcomes and inputs at the triennial meeting of The European Academy of Forensic Science to be held in The Hague, Netherlands in September 2012.

Month of delivery: 9

Deliverable 8.2

Title: Conference session ICFIS9

Brief description: A designed session with project outcomes at the 9th International Conference on Forensic Inference and Statistics scheduled to be held in Europe in 2014.

Month of delivery: 32

Deliverable 8.3

Title: Final workshop

Brief description: A project-specific workshop to be held in Edinburgh, UK in August or September

2014. *Month of delivery:* 32 or 33

1.3.1.5 Summary of staff effort

The summary of the staff effort is found in Table 1.3e. The number of person-months for the leading participants of the work packages are highlighted in bold.

Table 1.3 e: Summary of staff effort

Participant no./short name	**WP1**	**WP2**	**WP3**	**WP4**	**WP5**	**WP6**	**WP7**	**WP8**	**Total person months**
1/SKL	2		0.5	0.5		**3**	0.5	**1.5**	8
2/UEDIN	0.5	0.45		**3.38**		2.28	0.42	0.4	7.43
3/NFI	**6.4**		0.5	1			0.2	1	9.1
4/IFR	0.5		**3**	2	1.5		0.5	0.5	8
5/ULANC	1				**3**		1	1	6
6/FSS	1		1	1			**2**	1	6
7/UGLAS	0.4				1.8		0.6	0.8	3.6
8/UAM	1.5	1.5	1.5		2		0.5	1	8
9/GUCI	0.5	0.5		1			0.5	0.5	3
10/UNIL	1.24	**1.24**	1.24	1.24			0.2	0.2	5.36
11/UNIVE	0.74	1.49					0.19	0.19	2.61
12/BKA	0.6		0.6				0.6	0.6	2.4
13/UMB	1	0.5	0.5	0.5	0.5		0.5	1	4.5
14/NBI	1		1				0.5	1	3.5
15/UCLM	0.6			2.2				0.6	3.4

1.3.4 Interdependencies of the project components

Figure 1.3b (next page) shows the interdependencies of the project components.

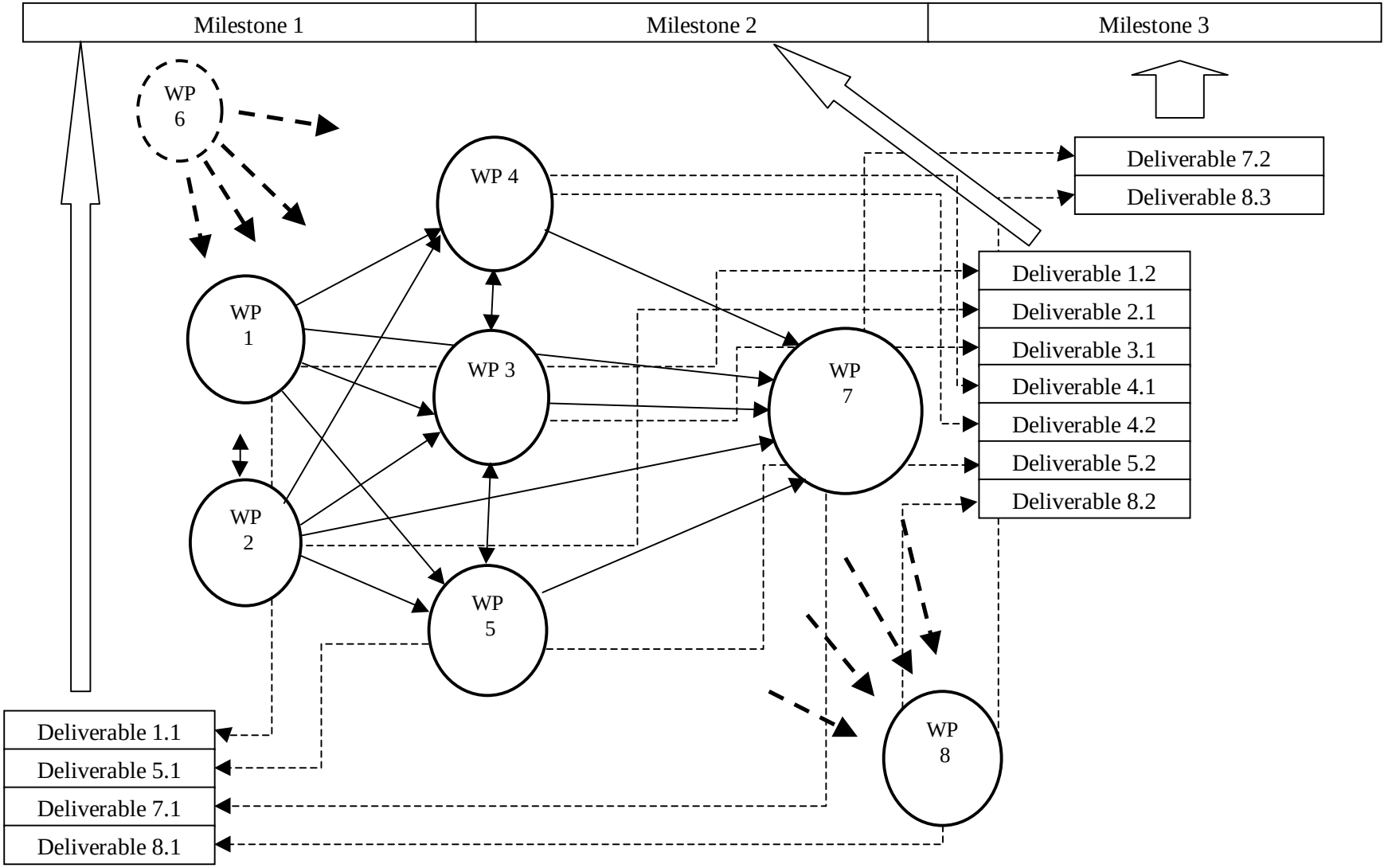

Figure 1.3b Interdependencies between project components

1.3.5 Risks and associated contingency plans

Identified risks of this project are

1. There is always a risk that one ore more participants will be disabled to fulfil the project or parts of it due to
    - personal reasons (such as unforeseen injury or illness)
    - force majeure (such as strikes)
    - unforeseen re-organisation within an institute
2. Two of the deliverables are to be launched at the conferences EAFS 2012 and ICFIS9 and there is a small risk that one or both of these might be cancelled.
3. The progress of this project depends on the willingness among European and overseas authorities, laboratories and institutes to cooperate in providing information about the current status of procedures and activities. There is a small risk that some of these bodies will not provide such cooperation.
4. The outcomes of this project will be in English only, but for several end-users translation to the national language where the end-user resides will be necessary for efficient use of the framework. There is always a risk that important issues will be lost in such translations.

The contingency plan for mitigating the consequences of a participant withdrawn from the project is the following:

Participant withdrawn	**Mitigation**
1. SKL	UEDIN will take over the coordination of the project and the leading position of WP 6. NFI will take over the leading position of WP 8
2. UEDIN	UNIL will take over the leading position of WP 4 and amendments of WP4 will be needed.
3. NFI	Amendments to all work packages, where NFI is involved will be made. FSS will take over the leading position of WP 1
4. IFR	Amendments to all work packages, where IFR is involved will be made. NFI will take over the leading position of WP 2
5. ULANC	Amendments to all work packages, where ULANC is involved will be made. UAM will take over the leading position of WP 5
6. FSS	Amendments to all work packages, where FSS is involved will be made. ULANC will take over the leading position of WP 7
7. UGLAS	Amendments to all work packages, where UGLAS is involved will be made.
8. UAM	Amendments to all work packages, where UAM is involved will be made.
9. GUCI	Amendments to all work packages, where GUCI is involved will be made.
10. UNIL	Amendments to all work packages, where UNIL is involved will be made. UEDIN will take over the leading position of WP 3.
11. UNIVE	Amendments to all work packages, where UNIVE is involved will be made.
12. BKA	Amendments to all work packages, where BKA is involved will be made.
13. UMB	Amendments to all work packages, where UMB is involved will be made.
14. NBI	Amendments to all work packages, where NBI is involved will be made.
15. UCLM	Amendments to all work packages, where UCLM is involved will be made.

The contingency plan for mitigating the consequences of cancelling either of the two conferences EAFS 2012 and ICFIS9 is to launch respective deliverables at the closest international conference aiming at forensic science following the scheduled date of the cancelled conference. In addition measures will be taken to disseminate the deliverable at the ENFSI working groups meetings nearest in time.

European institutes that are not members of the consortium and institutes in other countries world-wide who are contacted with requests for information or with offers of dissemination may decline to help. Substitute institutes will be identified as replacements.

Translation of the outcomes to other languages than English can be supported by the consortium regarding the languages German, French, Spanish, Italian, Dutch, Polish, Swedish, Norwegian and Finnish, but is not part of the budget of this project.

2. Implementation

2.1 Management structure and procedures

The fixed communication points of this project will consist of two general project meetings per project year, two international scientific conferences and one final workshop. The management structure will take its standpoint from these points.

The suggested work packages of the project are different from each other both in person month efforts and in number of participants, with some exceptions. Generally, the project is framed with work packages 1 and 8 in which all participants are included. Following the PERT diagram in figure 1.3.1 work packages 1 and 2 will define the state of today (theoretical – WP2 and practical – WP1) and the work carried out within work packages 3, 4 and 5 will be based on this state, and coordinated to the general framework in work package 7.

The project will start with a general meeting with the objective to define and divide the sub-tasks of work package 1 among the participants, and even in more detail among the people from the different institutes. The sub-tasks will thus define sub-groups with missions to be carried out to the second general meeting to be held within 6 months from the first. That meeting and the following two will serve as communication points for following-up of previous sub-tasks and defining new sub-tasks. At the fourth general meeting (i.e. after 18 months) work package 1 will be summarised and the structure of Deliverable 1.1 will be defined. The coordination of the activities is made within work package 6, but the work will otherwise be lead and conducted by participant 3, NFI.

The first general meeting will also be the starting point of work packages 4 and 5, each with a specified leading participant but comprising fewer participants. For each of these, activities will be defined and scheduled at this first general meeting and together with the coordinator follow-up reports and final summaries will be provisionally scheduled for the project meetings applicable to each of these work packages.

Work package 7 will be initialized at the first general meeting by establishment of a skeleton for the framework that will be released upon the third general meeting.

Work packages 3 have a later start month and will undergo analogous procedures as those described in the previous paragraph at the second general meeting (six months into the project).

Work package 8 is of another kind and will be considered within all other work packages and at general meetings prior to the activities (deliverables) proposed.

Work package 6 comprises three deliverables. The first two are yearly progress reports. The contents of these three will be based on the follow-up reports and summaries made at general meetings held since either the start months (progress report 1) or since the last progress report. The third deliverable, the final report, will summarise the whole project and will thus not be completed until after the last general meeting and the final workshop.

Work package 6 will coordinate communications amongst participants and administer the financial coordination according to the FP7 rules for coordination and support actions. WP 6 will also coordinate the production and distribution of written material and other products produced and published within the project. To carry out these tasks administrative resources at participants 1 and 2 will be used to which parts of the funding will be allocated.

The decision-making mechanisms will be defined to a large extent by the participants of each work package, one participant of whom will be placed in the leadership position. Decisions that need to be made between general meetings will be made within the sub-groups constituted to solve the tasks

defined. At the general meetings, those decisions shall be reviewed and in case consensus has not been reached between the work package participants, the consortium will agree on the decision to be made. When consensus cannot be reached within the consortium, the project coordinator will make the decision.

Each work package can and will define their own method of working and of communication. Within the budget limits there may be an exchange of personnel between the institutes; such decisions shall be made at general meetings as those budget items are not broken down for single work packages.

At each general meeting at least one person from each participating institute should be present. The same rule applies to the activities of work package 8 (the two scientific conferences and the final workshop). This personal representation is necessary for the follow-through of the project, as other means of communications are not sufficient for the objectives of these meetings. There will also be a secretary from UEDIN partly because the language of communication is English, but also because the meetings and dissemination administration is to be handled by UEDIN.

The connection between the project and the established yearly FORSTAT workshops will be used to simplify the organisation of general meetings. Thus, where applicable, some general meetings will be held in conjunction with FORSTAT workshops. These are held alternately at The University of Edinburgh (scheduled for 2012 and 2014) and at The Institute of Forensic Research in Krakow (scheduled for 2011 and 2013), both of whom are also participants of the project. The remainder of the general meetings will be rotated among the other participants with the objective to increase the knowledge within the consortium of the knowledge of the routines and daily work associated with forensic science in a pan-European perspective.

2.2 Individual participants

2.2.1 Participant 1 (coordinator): *Statens Kriminaltekniska Laboratorium (SKL)*

Statens Kriminaltekniska Laboratorium (The Swedish National Laboratory of Forensic Science, SKL) is a state funded independent laboratory under the Swedish National Police Board. As such, SKL is the expert body of the national police organisation and is in close collaboration with a number of police authorities.
The employees of SKL are not police officers but specialists in their respective fields. Most employees have an academic decree supplemented with an extensive internal training programme.
The majority of the forensic investigations at SKL are carried out on behalf of the judicial system, i.e. the police, prosecutors and courts of law, in matters relating to a criminal act. SKL also undertakes assignments or investigations on behalf of individual clients.

The main function of SKL is to act as an impartial expert body in investigations of criminal matters on behalf of the judicial system. This requires state of the art analytical and exploratory equipment and a highly trained workforce with the necessary competence to carry out forensic investigations and evaluations and apply the results in a judicial context. SKL is accredited according to ISO/IEC 17025 for the majority of its operations.
The SKL competence assurance system CDA (Competence, Development and Authority) ensures that all personnel have the right competence for their tasks.
SKL also conducts research and development and works with information, training, support and service in all aspects of forensic science. The work carried out within ENFSI (European Network of Forensic Science Institutes) has positioned SKL at the international forefront.

Anders Nordgaard, PhD, the lead scientist and coordinator of the project, works part time (80%) at the laboratory and part time as Associate Professor in Statistics at Linköping University, Linköping, Sweden. His role in the laboratory is to be scientific specialist in statistics applicable to all fields of forensic science in which the laboratory is involved, and in particular issues of evidence evaluation and interpretation. Nordgaard's scientific experience within the forensic field covers topics as drugs sampling, DNA profile quality, digital camera identification, construction of scales for the strength of evidence. He has also given courses in evidence evaluation within a designed study program of Forensic Science and a PhD course in Bayesian networks at Linköping University; and courses in Forensic Statistics for the laboratory staff. Nordgaard has also experience in environmental statistics and was assistant coordinator of the EC-funded project IMPACT, 2000-2002 within FP5.
Recent or current relevant publications are "Nordgaard A., Höglund T. Assessment of Approximate Likelihood Ratios from Continuous Distributions: A Case Study of Digital Camera Identification. *J.For.Sci* (to appear, May 2011), "Hedman J., Ansell R. & Nordgaard A. (2010) A ranking index for quality assessment of forensic DNA profiles. *BMC Res Notes 2010, 3:290 "*, "Hedman, J., Nordgaard, A., Rasmusson, B., Ansell, R. & Rådström, P. (2009) Improved forensic DNA analysis through the use of alternative DNA polymerases and statistical modelling of DNA profiles. *BioTechniques* 47: 5" and "Nordgaard, A. (2006) Quantifying experience in sample size determination for drug analysis of seized drugs. *Law, Probability and Risk* 4: 217-225"

2.2.2 **Participant 2:** *University of Edinburgh (UEDIN)*

The University of Edinburgh is a major international research university. It is the lead institution of the Joseph Bell Centre for Forensic Statistics and Legal Reasoning. Colin Aitken and Burkhard Schafer are co-Directors. David Lucy (ULANC, 5) and Tereza Neocleous (UGLAS, 7) have both been RAs in the Centre; Grzegorz Zadora (IFR, 4), Franco Taroni (UNIL, 10) and Daniel Ramos (UAM, 8) have all been visitors.

Colin Aitken is Professor of Forensic Statistics at The University of Edinburgh. He is a Fellow of the Royal Statistical Society (RSS), a Fellow of the Forensic Science Society and a Chartered Statistician. He has a long-standing research interest in the interface of statistics, law and forensic science, has published many papers on the subject, in statistical, legal and forensic scientific journals (including with several of the other participants) and has been consulted as an expert in many criminal cases. He is a co-author of three books in this area, all include other participants in the proposal as co-authors. He has been awarded over £1.3M in research funding in this area over the last ten years, six of these projects were in collaboration with Burkhard Schafer. Current grants include one from the Nuffield Foundation on 'Communicating and interpreting statistical evidence in the administration of criminal justice', an EPSRC CASE studentship to investigate the 'Establishment of frameworks for the evaluation of evidence relating to traces of drugs' and the ENFSI Monopoly project. He is Chairman of the RSS' working group on Statistics and the Law, an external adviser to the European Academy of Forensic Sciences (EAFS) committee on research and development, co-chairman (with Grzegorz Zadora, IFR, 4) of FORSTAT, a member of the US NIJ/NIST working group on 'Human Factors in Latent Print Analysis', a member of the UK Forensic Science Regulator's Specialist Advisory Group on Evidence Assessment Quality Standards, and a member of the Scottish Institute for Policing Research's (SIPR) Evidence and Investigation group. He was the Chief and Founding Editor of the journal *Law, Probability and Risk* (2002-2009) and remains an Editor. He is an external consultant on the e-learning course on statistics and the evaluation of evidence at the University of Lausanne.

Burkhard Schafer is Professor of Computational Legal Theory at the School of Law of the University of Edinburgh and co-Director of its AHRC Centre in IT and IP Law. His main field of interest is the interaction between law, science and computer technology, especially computer linguistics. How can law, understood as a system, communicate with systems external to it, be it the law of other countries (comparative law and its methodology) or science (evidence, proof and trial process)? His work helps to develop mathematically sound methods to evaluate scientific evidence, develop computer models which embody these techniques, and provide assistance to police and lawyers to interpret and apply scientific evidence. A special interest here is the development of computer systems that help law enforcement agencies to co-operate more efficiently across jurisdictions. This research is linked to his wider interest in comparative law and its methodology, the idea of a "Chomsky turn in comparative law", and the project of a "computational legal theory". He has published more than 50 papers in the field of law, computer science and logic, with emphases on the evidential and procedural aspects of computer technology; and on the methodological and practical challenges of harmonising regulation of technology in the EU. His work has been translated into several languages including Italian, Lithuanian and Spanish He was PI or Co-PI on thirteen externally funded projects, including the EU FP5 FF POIROT project and two EPSRC "Think Crime" projects. He is, amongst other positions, a member of the Executive of SIPR, the Scottish Network for Excellence in Cybercrime and Cybersecurity, the International Association of AI and Law and the German Society for Informatics.

2.2.3 Participant 3: *Netherlands Forensic Institute (NFI)*

The Netherlands Forensic Institute (NFI) is an agency of the Ministry of Justice. The institute has three key roles: (1) Performing examinations in criminal cases (2) Conducting research & development (3) Being a centre of knowledge and expertise. It is dedicated to research and development in order to be able to deliver state-of-the-art technology and science. With over thirty forensic disciplines, the NFI is the only institute in the Netherlands to offer such an extensive range of high-tech forensic services. The NFI provides services to clients within the criminal justice chain, such as the Public Prosecution Service and the police. A lawyer in a criminal case may also ask the examining magistrate or the public prosecutor handling the case to have the NFI conduct an examination. In addition, the NFI provides services to other persons or authorities, such as the International Criminal Tribunal for the former Yugoslavia, the Immigration and Naturalisation Service, foreign police or justice authorities, or to special investigative services such as the General Intelligence and Security Service (AIVD) and the Fiscal Information and Investigation Service (FIOD).

Annabel Bolck received her doctorate in chemometrics in 1996. She started work as a statistician at the NFI in 2002. She teaches statistics courses, provides statistical consultancy and scientific research. Her main areas of research are measurement uncertainty and models for evidence evaluation, both from a frequentist and a Bayesian point of view. Application areas include drugs and gunshot residues. She has contributed to many peer-reviewed papers, books and presentations.

Marjan Sjerps received her doctorate in theoretical biology in 1994. She started work as a statistician at the NFI in 1993, where she became involved in the emerging area of forensic statistics. Her activities include teaching, consultation, and research. Currently, she is employed as leader of a small team of forensic statisticians. She is also Professor (by special appointment) of Forensic Statistics at the Korteweg-de Vries Institute for Mathematics at the University of Amsterdam. Her research interests are interpretation and reporting of forensic evidence, especially concerning forensic DNA evidence.

Reinoud Stoel received his doctorate in psychometrics in 2003. He started work as a statistician at the NFI in 2008. He has developed as a psychometrician and statistician with broad practical experience in both teaching, and research (from behavioural genetics to forensics). His main research interests are in (the prevention of) cognitive bias and context effects in experts, and in the application of psychometric models in forensic science.

Ivo Alberink received his doctorate in Mathematical Statistics in 2000. He started work as a forensic scientist at the NFI in 2002 in the field of image analysis and biometrics. He conducted research on the use of earprints for forensic identification, body height measurements on persons in images, velocities of vehicles in CCTV footage, and 2D-3D comparison of facial images. From 2006 he has specialized as a forensic statistician, focusing on measurement uncertainty for small samples, optimization of sample sizes, and the calculation and formulation of the strength of evidence on the basis of likelihood ratios, both from a frequentist and a Bayesian point of view. He is an organizer of the FORSTAT Research group, a yearly research meeting of European experts on forensic statistics, associated with the FORSTAT training workshops.

Alberink,I. and Bolck,A. (2008) Obtaining confidence intervals and likelihood ratios for body height estimations in images, Forensic Science International, 177, 228-237.
Bolck,A. Weyermann,C., Dujourdy,L. Esseiva,P., van den Berg,J. (2009) Different likelihood ratio approaches to evaluate the strength of evidence of MDMA tablets comparison, Forensic Science International,191, 45-51.
Sjerps,M. and Meester,R. (2009) Selection effects and database screening in forensic science, Forensic Science International 192:56-61. Epub 2009 Sep 10
Stoel, R.D., Garre, F.G., Dolan, C., and van den Wittenboer, G. (2006). On the likelihood ratio test in structural equation modeling when parameters are subject to boundary constraints. Psychological Methods, 11, 439-455.

2.2.4 Participant 4: *Instytut Ekspertyz S• dowych (IFR)*

The Institute of Forensic Research (Instytut Eksperty Sadowych - IES) was established in Warsaw on the basis of the decree of the Minister of Justice issued on November 25, 1929. IES is the only forensic laboratory under the auspices of the Ministry of Justice in Poland. The Institute provides forensic expertise and research in the following areas: Toxicology, Illicit Drugs, DNA Profiling, Traffic Accidents, Forensic Engineering, Paint, Glass, Fibres and Textile, Gunshot Residues, Toolmark, Footwear, Tire impressions, Phonoscopy, Forensic Photography, Handwriting, Questioned Documents, Fingerprints, Forensic Psychology.

The leading scientists in the evidence interpretation area are:

Grzegorz Zadora, PhD. In 2001 he obtained the title of doctor of chemistry at the Jagiellonian University, Krakow, Poland. His doctorate's thesis subject was classification and comparison of glass microtraces for forensic purposes. He has been employed in the IES since May 2001 (Department of Criminalistic, Section for Physico-Chemical Examinations). His fields of interest are focuses on problems of application of analytical chemistry to forensic sciences (e.g. determination of physicochemical features of glass fragments, paint, fibres, inorganic gunshot residues, fire debris, explosives) and statistical methods of interpretation of such data for forensic purposes. During last 7 years he published 36 papers in peer-reviewed journals (including 20 papers in journals having Impact Factors) and 8 book chapters in Polish books. He is author/co-author of three book chapters in English, e.g. in Encyclopedia of Analytical Chemistry by Willey and Sons. He is co-organiser with (UEDIN, 2) of FORSTAT (e.g. www.ies.krakow.pl/forstat2009) supported by ENFSI. He gives tutorials to students of forensic chemistry (Department of Chemistry, Jagiellonian University). He is Associate Editor in Problems of Forensic Sciences (papers.forensicscience.pl).

Recent publications:

Aitken C. G. G., Zadora G., Lucy D. (2007) A two-level model for evidence evaluation, Journal of Forensic Sciences, 52, 412-419.

Zadora G.(2009) Classification of Glass Fragments Based on Elemental Composition and Refractive Index, Journal of Forensic Sciences, 54, 49-59.

Zadora,G., and Neocleous,T. (2009) Likelihood ratio model for classification of forensic evidences, Analytical Chimica Acta, 64, 266-278.

Zadora G., Ramos D., Evaluation of glass samples for forenisc purposes - an application of likelihood ratio model and information-theoretical approach, Chemometrics and Intelligent Laboratory, 2010 (102) 63-83.

Wojciech Branicki, DSc. He received his doctorate in medical biology in 2001 and in 2010 he obtained a postdoctoral degree at Jagiellonian University. He works in IES since 1997 dividing his time among expert work, teaching and research. His main research interest is prediction of physical traits based on DNA examination. During the last 5 years he published 20 papers in peer-reviewed journals (including 12 papers in journals having Impact Factors). He is Assistant to the Editor-n-Chief in Problems of Forensic Sciences (papers.forensicscience.pl).

Recent publications:

Branicki W, Brudnik U, Wojas-Pelc A. Interactions between HERC2, OCA2 and MC1R may influence human pigmentation phenotype. Ann Hum Genet. 2009, 73, 160-170.

Bogdanowicz W., Allen M., **Branicki W.**, Lembring M., Gajewska M., Kupiec T., Genetic identification of putative remains of the famous astronomer Nicolaus Copernicus. Proc Natl Acad Sci USA. 2009, 106(30), 12279-82

Paulina Wola• ska-Nowak, PhD. She received her doctorate in forensic genetics in 2001. She started work as a forensic geneticist in 1994, where she became involved in routine forensic practice including interpretation and reporting the value of DNA evidence from Bayesian point of view. Her activities include teaching and research. During the last 12 years she published 30 papers in peer-reviewed journals (including 10 papers in journals having Impact Factors).

A recent publication:

Wola• ska-Nowak P., Branicki W., Parys-Proszek A., Kupiec T., Examples of combining genetic evidence—Bayesian network approach, Forensic Science International: Genetics Supplement Series 1 (August 2008), 669-670.

2.2.5 Participant 5: *Lancaster University (ULANC)*

Lancaster University has an international reputation in statistics and just over three years ago opened a new Centre of Postgraduate Statistics which will enhance that status. The Department of Mathematics and Statistics at Lancaster University has a large and vibrant research community. Much of the research has a strong applied emphasis with research typically being focused at the interface between methodology and applications. Research at Lancaster University has three distinctive but complementary strengths: the development of advanced probabilistic and statistical theory; a well-defined methodological focus based upon statistical modelling; and extensive collaborative links with colleagues throughout the university and researchers elsewhere. Recently the Department has been a awarded Doctoral Training Centre, only one of two awarded in mathematics for the United Kingdom, and will insure that Lancaster remains at the forefront of statistical research for many years to come.

The Department of Mathematics and Statistics has underlined its commitment to forensic science by embedding a forensic statistics course, taught to postgraduate students and external participants, into its programme of masters level courses.

Participation by Lancaster University will be conducted by **David Lucy**, a lecturer in Applied Statistics in the Department of Mathematics and Statistics. Additional support will be available from other members of the Department.

Dr. Lucy, the lead scientist for the project at Lancaster University, has a background in the natural sciences, and is an applied statistician. He has worked on a diverse array of statistical problems in archaeology, anthropology and other biological and environmental sciences. However a common theme between these disparate threads is the adoption of a Bayesian approach where possible. Lately he has specialised in numerical techniques and data analysis in forensic science, and other legal contexts. His current research involves the analysis of multi-level, hierarchically arranged, multivariate continuous observations, to solve problems of matching between objects. Example applications are where trace element, and isotopic ratio data are used to establish links between objects recovered from a crime scene, and those recovered from a suspect. He also maintains an active consultancy on statistical matters arising from criminal cases in Scotland, Ireland and England. His clients have included: The Home Office, Her Majesty's Customs and Excise, The Serious Crime Unit, Scottish Sheriff courts and numerous defence advocates and English and Welsh Constabularies. Some of the work undertaken for these clients has informed investigative procedures at a national level. He has appeared in court as an expert witness in a number of criminal cases.

Academic Career

2006- Lecturer in Applied Statistics, Department of Mathematics & Statistics, Lancaster University.
2001-2006 Research Fellow in statistics at The School of Mathematics, The University of Edinburgh (UEDIN, 2).
1997-2000 NERC post-doctoral research associate on project in numerical techniques in palaeoclimatic research.

2.2.6 Participant 6: *Forensic Science Service Ltd. (FSS)*

The Forensic Science Service (FSS) is the leading supplier of forensic services to police forces in England and Wales and has a global reputation for excellence in the development and deployment of new and advanced techniques. The Forensic Science Service pioneered the development and implementation of DNA technologies. It also paved the way for the establishment of the world's first DNA database, launched in April 1995. The drive for innovation continued to yield ground-breaking results, with the introduction of the National Firearms Forensic Database in 2003 and Footwear Intelligence Technology (FIT), the UK's first online footwear coding and detection management system, in 2007.

Leading scientist: **Roberto Puch-Solis**, M Sc, M Sc, Ph D. Statistical consultant at the FSS since 2003. Activities includes: participation in setting policies regarding casework practices, providing training, casework support, research on fingerprints and DNA statistics. Relevant publications:

- C. Neumann, C. Champod, **R. Puch-Solis**, N. Egli, A. Anthonioz, A. Bromage-Griffiths (2007). "Computation of likelihood ratios in fingerprint identification for configurations of any number of minutiae". J. of Forensic Sciences, Vol. 52, Issue 1.
- P. Gill P, **R. Puch-Solis** and J. Curran (2009). The low-template-DNA (stochastic) threshold: its determination relative to risk analysis for national DNA databases. Forensic Sci. Int. - Genetics, (2), 104-111.

Statistical consultant, in a multidisciplinary group, in European-commission funded project: DAONEM. Relevant publication:

- **Puch, RO**, P Astrup, JQ Smith, HP Wynn, C Turcanu & C Rojas-Palma (2002) "A data assimilation methodology for the plume phase of a nuclear accident", In Developments and application of computer techniques to environmental studies IX (CA Brebbia and P Zannetti Editors), Wessex Institute of Technology Press, Southampton, UK

Ph D in Statistics, Department of Statistics, University of Warwick, UK. Topic: probability propagation in Bayesian networks. Relevant publication:

- **Puch, RO**, JQ Smith and C Bielza (2003) "Hierarchical junction trees", In Advances in Bayesian networks (JA Gamez, S Moral & A Salmeron, Editors), Springer, London.

M Sc in Statistics (with distinction), Department of Statistics, University of Warwick, UK.
M Sc in Applied Statistics, Mathematics Department, Tulane University, USA.

Anjali Mazumder, MA, M Sc, Ph D. Statistical consultant at the FSS since 2009. Activities includes: participation in setting policies regarding casework practices, providing training, casework support, research on DNA statistics.
Research Associate. Institute for work and health, Canada. 2002-2006. Activities included providing statistical support to health researchers.
Ph D in Statistics, Department of Statistics, University of Oxford, UK. Topic: Planning in forensic DNA identification using probabilistic expert systems (Supervised by S. Lauritzen). Relevant publication:

- Lauritzen, S. L. & **Mazumder, A.** (2008). *Informativeness of Genetic Markers for Forensic Inference – A Decision-Theoretic Approach*. Forensic Science International: Genetics Supplement Series, 1(1).

MA (Masters of Arts) in Education, Ontario Institute for Studies in Education (OISE), University of Toronto, Canada.
M Sc in Statistics, Department of Statistics, University of Toronto, Canada

Lauren Rodgers, M Sc, Ph D. Statistical consultant at the FSS since 2009. Activities includes: participation in setting policies regarding casework practices, providing training, casework support, research on DNA statistics.
Ph D in Statistics, Department of Statistics, University of Newcastle, UK. Topic: Analysis of treatment effect in crossover designs with missing data (Supervised by J.N.S. Matthews).
M Sc in Mathematics and Statistics. University of St Andrews.

2.2.7 **Participant 7:** *University of Glasgow (UGLAS)*

The School of Mathematics and Statistics at the University of Glasgow hosts one of the largest statistical groups in the UK, with an international reputation for research excellence in Bayesian methods, biostatistics, genetics and genomics, statistical modelling, and environmental and forensic statistics.

The leading scientist, Tereza Neocleous, graduated from the University of Cambridge in 1998, and obtained her MSc and PhD degrees in Statistics from the University of Illinois at Urbana-Champaign in 2000 and 2005 respectively. From 2006 to 2007 she worked as a postdoctoral researcher in forensic statistics at the University of Edinburgh under the supervision of Professor Colin Aitken, and since 2007 she has been employed by the University of Glasgow as a lecturer in statistics.

She has co-authored several peer-reviewed journal articles in statistical methodology and forensic statistics, and she is a lecturer at the annual FORSTAT workshops that take place under the auspices of EAFS and ENFSI. She is a Fellow of the Royal Statistical Society, and a member of the American Statistical Association, the Institute of Mathematical Statistics and the Statistical Modelling Society.

Currently her research involves statistical modelling of chemometrics data and open-source software development for evidence identification and evaluation.

Recent publications:

- Zadora, G., Neocleous, T. and Aitken C.G.G. A two-level model for evidence evaluation in the presence of zeros. Journal of Forensic Sciences (2010) 55, 371-384.

- Zadora, G., and Neocleous, T. Evidential value of physicochemical data - comparison of methods of glass database creation. Journal of Chemometrics (2010) 24, 367-378.

- Dowlman, E., Martin, N., Foy, M., Lochner, T. and Neocleous, T. The prevalence of mixed DNA profiles on fingernail swabs. Science & Justice, (2010) 50, 64-71.

- Zadora, G., Neocleous, T. Likelihood ratio model for classification of forensic evidence. Analytica Chimica Acta, (2009) 642, 266-278.

2.2.8 Participant 8: *Universidad Autonoma de Madrid (UAM)*

The ATVS - Biometric Recognition Group at Escuela Politecnica Superior of UAM is devoted to research in the areas of biometrics, pattern recognition, image analysis, and speech and signal processing, with application to person authentication and forensics. The group maintains European public projects, national projects and diverse contracts with companies and public and private organizations that are leaders in this sector.

UAM has worked for more than 15 years in forensic speaker recognition in collaboration with the Criminalistics Service of the Spanish Guardia Civil police force (GUCI, 9), with consequential beneficial impacts for the scientific community, for example in the development and deployment of speaker recognition systems for the assistance of the forensic scientist in daily casework. Also, GUCI has been providing UAM with speech databases from real forensic cases. Such databases are extremely valuable for the forensic speaker recognition community in order to adapt and validate their systems for real-world applications. Another relevant scientific contribution of UAM is the adaptation of automatic speaker recognition and biometric systems to the likelihood ratio framework. This has generated many beneficial contributions to the community, as well as recognition in the form of best-article awards and invited contributions. UAM has been an invited member of the ENFSI Forensic Speech and Audio Analysis Working Group for several years, indicative of the degree of collaboration with the forensic practitioner and the relevance of their work..

Daniel Ramos was awarded his doctorate 'Forensic Evaluation of the Evidence Using Automatic Speaker Recognition Systems' in 2007. He has worked at UAM from 2006 as an Assistant Professor. He has received several distinctions and awards, national and international, including the IBM Research Best Student Paper Award at the Odyssey 2006 Speaker and Language Recognition Workshop, and the Telecommunication Engineer Best PhD Thesis Award in 2007-2008 from the Official College of Spanish Telecommunication Engineers (COIT). He is the author of many publications in national and international conferences and journals with impact factor in ISI-JCR. He has also participated in several international competitive evaluations of speaker and language recognition technology, such as NIST Speaker Recognition Evaluations since 2004 (and was leader of the technical staff in 2008) and the Forensic Speaker Recognition Evaluation NFI/TNO 2003. He is a regular invited speaker at national and international conferences. He has been an invited member of the Forensic Speech and Audio Analysis Working Group of ENFSI since 2009.

Joaquín Gonzalez-Rodriguez was awarded his doctorate in electrical engineering in 1999. He has been an Associate Professor since 2006 in the Computer Science Department at UAM. He is director of the ATVS – Biometric Recognition Group at UAM. He is an invited member of ENFSI. He has been an invited speaker in several conferences, including a plenary speaker at Interspeech 2008. He was Vice-Chairman of Odyssey 2004 in Toledo, Spain and of BioID-Multicomm workshop on biometrics (2009) in Madrid, Spain.

Relevant publications:

Ramos-Castro, D., Gonzalez-Rodriguez, J. and Ortega-Garcia, J. (2006), Likelihood ratio calibration in a transparent and testable forensic speaker recognition framework, in Proc. of IEEE/ISCA Odyssey 2006, the Speaker and Language Recognition Workshop, 2006.

Gonzalez-Rodriguez, J., Rose,P. Ramos, D., Toledano, D. T. and Ortega-Garcia, J. (2007), Emulating DNA: rigorous quantification of evidential weight in transparent and testable forensic speaker recognition, IEEE Transactions on Audio, Speech and Language Processing, 15, (7) 2104-2115, 2007.

Ramos, D., Gonzalez-Rodriguez, J., Gonzalez-Dominguez,J. and Lucena Molina, J. J., (2008), Addressing database mismatch in forensic speaker recognition with Ahumada III: a public real-case database in Spanish". Proceedings of Interspeech 2008.

2.2.9 Participant 9: *Guardia Civil Espanola (GUCI)*

The Civil Guard is one of the two State Police Forces in Spain. It is in charge of approximately 99% of the Spanish territory and the whole territorial sea, and 40% of the population. It has 80.000 members spread around Spain and belongs to the Ministry of Interior except for personnel policy whose case is dependent of the Ministry of Defence. Within its organization, the Criminalistics Service fits into the Judicial Police, therefore there are people specialised in crime scene investigation, all kind of forensic laboratory fields and legal aspects who ordinarily participate as full members in the corresponding ENFSI Working Groups, INTERPOL, Europol, and so on.

Previous experience relevant to the planned tasks:

- The leading scientist **Juan José Lucena Molina** has been working in Criminalistics since 1988. The first one making handwriting and document examinations, the three following years leading the Civil Guard's integration into the Spanish AFIS system belonging to the Ministry of Interior, and since 1992 onwards being audio and image processing forensic expert in the Criminalistics Service. During more than 10 years (1998-2008) he was the Head of the Acoustics and Image Department, being member of the Speech and Audio Analysis Working Group of ENFSI, and at the same time member of its Steering Committee from 2003 to 2008.
- Since 1997, once signed an official agreement of collaboration between the Civil Guard and ATVS-Voice Biometric Group, a research university group currently integrated in the Universidad Autónoma de Madrid (UAM, 8), some automatic speaker recognition systems were developed for forensic and police investigation applications. In 2004, the forensic application for voice comparisons was able to calculate likelihood ratios and the Criminalistics Service of the Civil Guard was the first Spanish official laboratory using this kind of reporting scheme in conclusions related to this forensic field. At the same time, it was one of the first European laboratories being able to do that (besides French Gendarmerie laboratory and the *Ecole of Sciences Criminelles* of the University of Lausanne (UNIL, 10)). So far more than 300 forensic reports have been made calculating likelihood ratios in voice comparisons in different channels, languages, way of speaking, audio digital formats, and other relevant variables.
- At the same time, the Civil Guard financed a doctoral thesis grant allowing Daniel Ramos to make relevant scientific contributions to validate systems calculating likelihood ratios. Therefore, from 2006 onwards, the Civil Guard reports in voice comparisons incorporated APE plots using case-adapted data bases. ATVS and our laboratory organised a specific course in 2007 to explain to ENFSI members of the Speech and Audio Analysis Working Group notions such as calibration, strictly scoring rules, APE and ECE plots, and so on, in order to understand the new way of ranking automatic speaker recognition systems by NIST's evaluations.
- In 2008 the Statistics Department in the Civil Guard central laboratory was created. Juan Molina is in charge and has a continuing collaboration with the Quality Department in order to implement the ISO 17.025 norm in many fields. His responsibility is linked to statistical issues. During the four last years he ahs been reporting in trials based-LR voice comparisons, and this professional experience will be useful for the project.

2.2.10 Participant 10: *Université de Lausanne (UNIL)*

The University of Lausanne. School of Criminal Justice (ESC) through its Institut de Police Scientifique (IPS) has an international reputation of excellence for research in forensic science (Ph.D. students and post-doctoral researchers) and education (BSc and MSc in forensic science, ML in Criminal Justice, in Criminology and New Technologies). Since its foundation in 1909, IPS has played a central role in research and development of identification methods, forensic analytical techniques and crime analysis techniques applied to the context of legal investigations. It has a long experience in researching identification fields through a multidisciplinary program of PhD research efforts, covering all forensic fields except legal medicine and toxicology. IPS currently manages several research programs funded by the Swiss National Science Foundation as well as the US government. IPS participates at the forefront of the development and application of probabilistic graphical models for inference in forensic science. IPS maintains very close relationships nationally with practitioners from scientific and technical police services throughout Switzerland and internationally through the European Network of Forensic Science Institutes. IPS has been since 1989, the coordinator for fingerprint and mark evidence for the Interpol Forensic Science Symposium. The IPS was in charge of the organisation of The 7th International Conference on Forensic Inference and Statistics which was held in Lausanne in August 2008.

Franco Taroni is full professor in forensic statistics. He received his M.Sc. and Ph.D in forensic science respectively in 1990 and 1995 from the Faculty of Law at the University of Lausanne. He was awarded two European Community Training and Mobility of Researchers Grants, working with Colin Aitken (UEDIN, 2). He spent four years as research project manager at the Institutes of Forensic Medicine of the Universities of Lausanne and Zürich. He has authored more than 80 peer-reviewed journal articles, is a co-author of the leading books on forensic statistics and on the use of Bayesian networks in forensic science. He is an editor of *Law, Probability and Risk*, and has given international workshops on forensic interpretation.

Christophe Champod received his M.Sc. and Ph.D. both in forensic science, from the University of Lausanne, in 1990 and 1995, respectively. From 1999 to 2003, he led the Interpretation Research Group of the Forensic Science Service (FSS, 6), before taking a professorship position at the School of Criminal Sciences (ESC). He is deputy director of the ESC and in charge of education and research on identification methods (detection and identification). He was contracted for two projects dedicated to the statistical analysis of partial fingerprints (US Department of Defense (TSWG), 2004-2006 and TSWG and the National Institute of Justice, 2006-2008). He has authored more than 50 peer reviewed articles, co-authored books (on fingerprints and footwear marks), edited two encyclopaedias in forensic science, and given international workshops on forensic interpretation.

Alex Biedermann graduated in forensic science from University of Lausanne in 2002 and was awarded his doctorate from there in 2007. From 2002 to 2010, he has been working for the Swiss Federal Department of Justice and Police as a forensic scientist and collaborated closely in casework and research with the School of Criminal Justice (ESC). Currently, he holds a part-time (30%) replacement at the ESC for Professor F. Taroni (in sabbatical, also a member of UNIL) for both lectures on the probabilistic evaluation of scientific evidence and research. In addition, he currently holds a position of principal assistant 50% at the ESC. Alex Biedermann has authored several peer reviewed articles, conducted workshops on the use of Bayesian networks in forensic science and co-authored a book on this topic (Bayesian networks and probabilistic inference in forensic science, 2006) with other authors including F. Taroni and C.G.G. Aitken (UEDIN, 2). Together with Professors Taroni, Garbolino, Bozza (UNIVE, 11) and Aitken, a book on forensic data and decision analyses was published for John Wiley & Sons, Ltd. in 2010.

2.2.11 **Participant 11:** *Università Ca'Foscari Venezia (UNIVE)*

The Department of Statistics, created in 1994, is part of the Faculty of Economy of the University Ca' Foscari of Venice, Italy.
Currently, the number of members amounts to about 20, besides Ph.D. students, grant researchers and other administrative staff. Research interests involve areas such as quality control, model selection (dynamic linear models and spatio-temporal models), computational intensive methods for inference and forecasting (genetic algorithms, neural networks, bootstrap, MCMC methods), time series, likelihood methods and robust statistics.

Silvia Bozza received her PhD in Statistics at the University of Padova in 2002. Since January 2004 she is Assistant Professor in Statistics at the University Ca' Foscari of Venice, Department of Statistics. Previously, she was Research Associate at the same Department. The main areas of research include complex Bayesian models and intensive computational methods for inference and forecasting (MCMC methods, evolutionary computational procedures) as well as Bayesian inference and decision methods in forensic science.
She has given seminars and invited presentations at international conferences, and authored several peer reviewed articles. She was visiting researcher at the School of Mathematics of the University of Sheffield, and at the School of Criminal Sciences of the University of Lausanne (UNIL, 10).

Some recent publications are:

Bozza, S., Taroni, F., Biedermann, A., Garbolino, P., Aitken, CGG (2010). Data analysis in forensic science: a Bayesian decision perspective. John Wiley & Sons.

Biedermann, A., Taroni, F., Bozza, S. (2009): Implementing statistical learning methods through Bayesian networks (part I): a guide to Bayesian parameter estimation using forensic science data. Forensic Science International, 193, 63-71.

Biedermann, A., Bozza, S., Taroni, F. (2009): Probabilistic evidential assessment of gunshot residue particle evidence (part I): likelihood ratio calculation and case pre-assessment using Bayesian networks. Forensic Science International, 191, 24-35.

Bozza, S., Taroni, F., Marquis, R. and Schmittbuhl, M. (2008), Probabilistic evaluation of handwriting evidence: likelihood ratio for authorship. Journal of the Royal Statistical Society, Series C, 57, 329-341.

Biedermann, A., Taroni, F., Bozza, S., Aitken, C. (2008), Analysis of sampling issues using Bayesian Networks. Law, Probability & Risk, 7, 35-60.

Taroni, F., Bozza, S. and Biedermann, A. (2006), Two items of evidence, no putative source: an inference problem in forensic intelligence. Journal of Forensic Sciences 51, 1350-1361.

2.2.12 **Participant 12:** *Bundesskriminalamt (BKA)*

The Bundeskriminalamt (founded in 1951) is a subordinate agency to the Federal Ministry of the Interior in Germany. It works on the basis of a clear legal mandate, which is defined in the German Constitution and in the "BKA Law" (Law on the Bundeskriminalamt and the Co-operation between Federal and State authorities in Criminal Police Matters). The core tasks of the BKA are described by the following functions:

- Function as a Central Agency of the Police in Germany
- Investigative Functions
- International Functions
- Protection Tasks and Preventions
- Administrative Functions.

In response to changing requirements in the fight against crime, the organisational structure of the BKA is frequently optimised. At the moment, the BKA is fulfilling its tasks within the framework of nine organisational units, one of these being the Forensic Science Institute (KTI).

The core competencies of the KTI, such as forensic casework, research and development, maintaining collections and expert systems, as well as education and consultancy, are always aimed at increasing the validity of the evidence. In order to be able to process the assignments of the prosecution authorities competently and with state-of-art science and technology, the KTI not only possesses the technical and scientific equipment necessary to achieve this, but also meets its statutory obligations with a high level of technical specialisation. About 300 employees (including 80 scientific experts) are divided into five groups as follows:

- Physics and Chemistry
- Firearms and Material Science
- Biology and Toxicology
- Documents
- Handwriting, Linguistics, Speaker Identification and Information Technology.

Due to the increasing importance of the application of statistics in forensic sciences and also to international research in this field, the BKA decided to institutionalize the field of Forensic Statistics and Evaluation of Evidence and, as a consequence, established Forensic Statistics as a discipline at the KTI in 2005. The main tasks of this unit are to support all fields of forensic sciences concerning the application of statistics and the development of new methods to assess the value of the evidence.

Sonja Menges, the leading scientist of the Forensic Statistics unit at the KTI is a mathematician specialised on probability theory and statistics. She graduated from the University of Dortmund in 1998. As a member of the research staff, she worked at the University of Dortmund from 1999 to 2005 and obtained her Ph.D. in Mathematics in 2004. She started to work in the field of Forensic Statistics at the BKA Forensic Science Institute when it was established in 2005.

2.2.13 **Participant 13:** *Universitetet for Miljø og Biovitenskap (UMB)*

UMB is is recognised as a leading international centre of knowledge, focused on higher education and research within environmental- and biosciences. The Biostatistics group has its major research activities in the scientific borderland between bioinformatics and applied statistics. The scientific staff consists of six permanent positions in bioinformatics and statistics and several post-docs and PhD-s. Prof. Egeland will head this group from January 2010 transferring from the Institute of Legal Medicine, University of Oslo.

Egeland will continue his longtime commitment to statistical methods in forensics. The first international publication was [1]. The output of this work is both methods and software. In 1995 the development of the freeware program Familias [2] started. This freeware program is designed to handle complicated cases of identification based on DNA evidence and is the most commonly used program worldwide for the types of applications it addresses. The development of Familias has continued and extensions are currently being implemented. Software has also been developed in other areas. For instance, FEST [3] is a freeware package for simulation and likelihood calculations involving distant family relationships using as many as 500000 SNPs.

Statistical methods were developed to infer the most likely geographical origin of mtDNA sequence profiles. Again, freeware accompanied the paper [4]. In [5] a much discussed topic is addressed: The DNA database controversy. The ambitious task of the paper was to bridge the gap between different approaches to interpreting DNA evidence following a hit in a database.

Egeland has also been involved in the teaching of various courses with a forensic content, for instance statistical courses for lawyers. He has also written on statistical interpretation of evidence based on experience from case work

Selected publications

1. Bølviken E, Egeland T. Arson, statistics and the law: Can the defendant's proximity to a large number of fires be explained by chance? Science and Justice 1995;35:97-104.

2. Egeland T, Mostad PF, Mevåg B, Stenersen M. Beyond traditional paternity and identification cases: Selecting the most probable pedigree. For. Sci. Int. 2000 May 8;110(1):47-59.

3. Skare O, Sheehan N, Egeland T. Identification of distant family relationships. Bioinformatics. 2009 15;25(18):2376-82.

4. Egeland, T., Bøvelstad, H.M., Storvik, G and Salas, A. Inferring the most likely geographical origin of mtDNA sequence profiles. Annals of Human Genetics (2004) 68, 461-471

5. Storvik, G and T. Egeland. The DNA database search revisited: Bridging the Bayesian-Frequentist gap. Biometrics, 2007.

2.2.14 Participant 14: *Keskusrikospoliisi (NBI)*

The National Bureau of Investigation (NBI) Finland is an independent unit within the Finnish Police force. Its duties are to prevent international, organised, professional, economic and other types of serious crime, to carry out investigations, to develop methods for crime prevention and criminal investigation and to design and maintain police information systems. The NBI Forensic Laboratory carries out all forensic investigations requested by pretrial investigation, supervisory, prosecuting of judicial authorities in Finland. It is the only forensic laboratory in the country and its activities cover all the typical fields in forensic science.

NBI is accredited according to ISO/IEC 17025 for the majority of its operations.
NBI is also responsible for research and development in forensics as well as training and support of the policemen and crime scene investigators.

Key Personnel:

Rossana Moroni, **M.Sc. (statistics)** has worked on forensic statistics projects since 2005. Her research topics have been related to forensic DNA evidence interpretation - particularly on paternity testing and mixture analysis, developing new statistical models for blood alcohol content measurement uncertainty and Bayesian adaptive approach to determine sample sizes for seizures of illicit drugs. She will defend her PhD thesis in March 2011.

In addition, Rossana Moroni is working as the statistical expert at NBI and supports the forensic scientists on the use statistical tools in case work. She is also training forensic scientists by organizing seminars and courses.

Publications:

- R. Moroni, D. Gasbarra, E. Arjas, M. Lukka, I. Ulmanen; Effect of Reference Population and Number of STR Markers on Paternity Testing. Forensic Science International: Genetics Supplement Series 1 (2008); 654-655.
- R. Moroni, D. Gasbarra, E. Arjas, M. Lukka, I. Ulmanen; Effect of Reference Population and Number of STR Markers on Positive Evidence in Paternity Testing. (submitted).
- R. Moroni, P. Blomstedt, L. Wilhelm, T. Reinikainen, E. Sippola, J. Corander; Statistical modelling of measurement errors in gas chromatographic analyses of blood alcohol content. Forensic Science International; 202 (2010): 71-74.
- R. Moroni, L. Aalberg, T. Reinikainen, J. Corander; Bayesian adaptive approach to determine sample sizes for seizures of illicit drugs. (accepted for publication in Journal of Forensic Sciences).

2.2.14 **Participant 15:** *Universidad de Castilla – La Mancha (UCLM)*

The *University of Castilla-la Mancha* (UCLM) is a Spanish public institution founded 25 years ago. From its creation, the UCLM has fostered the research in all the fields of knowledge, in particular in those of social and juridical sciences. In fact it counts with many institutes and centres of research related to the several areas of law. Participation by UCLM will be conducted by Marina Gascón and helped by Gema Marcilla, who currently carry out their research at the *Faculty of Law*, located in the campus of Albacete.

Marina Gascón is Professor of Philosophy of Law at the University of Castilla-la Mancha. She holds a Philosophy Degree (University Autónoma of Madrid), Law Degree (University Complutense of Madrid) and PhD. in Law (University Autónoma of Madrid, 1990). She has carried out research in the *Istituto Giuridico, Facoltà di Giurisprudenza della Università degli Studi di Torino* (1992) and *Istituto di Filosofia del diritto della Università di Genova (Italia), (*1993). She is the author of numerous publications in specialized journals concerning several topics related to constitutionalism and guaranties, theory of law and mainly theory of proof and law of evidence. In the past ten years she has focused her work as a researcher on the topic "Law of Evidence". Currently she is working on *Scientific Evidence*, in particular on the problems of *admissibility* of the proofs, *standards* of proof and how forensic evidence should be *presented* by expert witnesses in courtroom and *evaluated* by judges.

Publications include:
- *Los hechos en el Derecho. Bases argumentales de la prueba,* Madrid, Marcial Pons, 1999. ISBN: 84-7248-736-9, 230 pp. (3ª edición, 2010).
- Sobre la racionalidad en la prueba judicial, en L.Triolo (coord.) *Prassi Giuridica e Controllo di Razionalità, Analisi e Diritto*, Turín, Giappichelli, 2001.
-La prueba judicial: valoración racional y motivación, en *Jueces y derecho. Problemas contemporáneos* (M.Carbonell, H.Fix-Fierro y R.Vázquez coords.), México, Porrúa-UNAM, 2004.
-Sobre la Posibilidad de Formular Estándares de Prueba Objetivos, en *Jueces para la Democracia*, 54, noviembre de 2005. Págs.82-89. También en *DOXA*, 28 (2005), pp.127-141.
-Validez y valor de las pruebas científicas: la prueba del ADN, en *Cuadernos Electrónicos de Filosofía del Derecho*. Núm.15 (2007).
-Razones científico-jurídicas para valorar la prueba científica: una argumentación multidisciplinar (autores: Marina Gascón, José Juan Lucena y Joaquín González), en *Diario La Ley*, 4 de octubre de 2010.
-Pruebas científicas: la necesidad de un cambio de paradigma (con José Juan Lucena), *Jueces para la Democracia*, nº 71, nov/2010.
-Prueba científica: mitos y paradigmas, en *Anales de la Cátedra de Francisco Suárez*, Granada, 2010 (forthcoming).

Gema Marcilla, PhD, is a young lecturer of Philosophy of Law at the University of Castilla-la Mancha. She participated in the project "Justice and Legality in the Constitutional Rule of Law" under the leadership of Prof. Luis Prieto. Her first research topic was related to legislative drafting and currently she is carrying out her research in the field of Law of evidence under the direction of Marina Gascón.

2.3 Consortium as a whole

The proposed consortium has its base in the FORSTAT Research Group that was established in Edinburgh June, 2008. The establishment was the natural result of long period of informal contacts and cooperation between the individuals in research and training. This group consists of statisticians and forensic scientists working with evaluation, interpretation, quality aspects, software implementation and much more in various fields of forensic science. Some are academics affiliated at universities while other are more practitioners affiliated at forensic laboratories and institutes. To form the consortium this group has been enlarged by the inclusion of people working closer to police organisations (GUCI, 9) and lawyers (UEDIN, 2; UCLM, 15).

The suggested Work package 1 collects all issues of evaluation and interpretation that are taken up within the working groups of ENFSI. The participants representing a forensic laboratory (participants 1, 3, 4, 6, 9, 10, 12, 14) are all members of ENFSI, which ensures efficient communication with these working groups. Further, many issues of evaluation and interpretation have either been taken up in previous co-work between the participants of the consortium or have been identified by the involvement of people from the participating bodies in daily case-work covering the whole path from the laboratory to the court. The participants have different specialities in and different experiences from forensic science and the outcomes of this work package will heavily depend on these complementary inputs. The work package has been designed to maximise the benefits of working as a consortium such that the whole is greater than the sum of its parts.

The complementarities of the participants in the project would be best illustrated by considering the competences and skills of the persons within each institute that will take part in the project. A majority of the participants are involved in different stages of the process from laboratory to court, but the persons involved have different areas of expertise. A brief illustration of the participants' various roles in the project is given in the fishbone-diagram of Fig. 2.3. This diagram shows that there are no stages in the process where competence is missing and the concentration of many participants at some of the stages reflects the size and complexity of that stage with respect to the objective of the project.

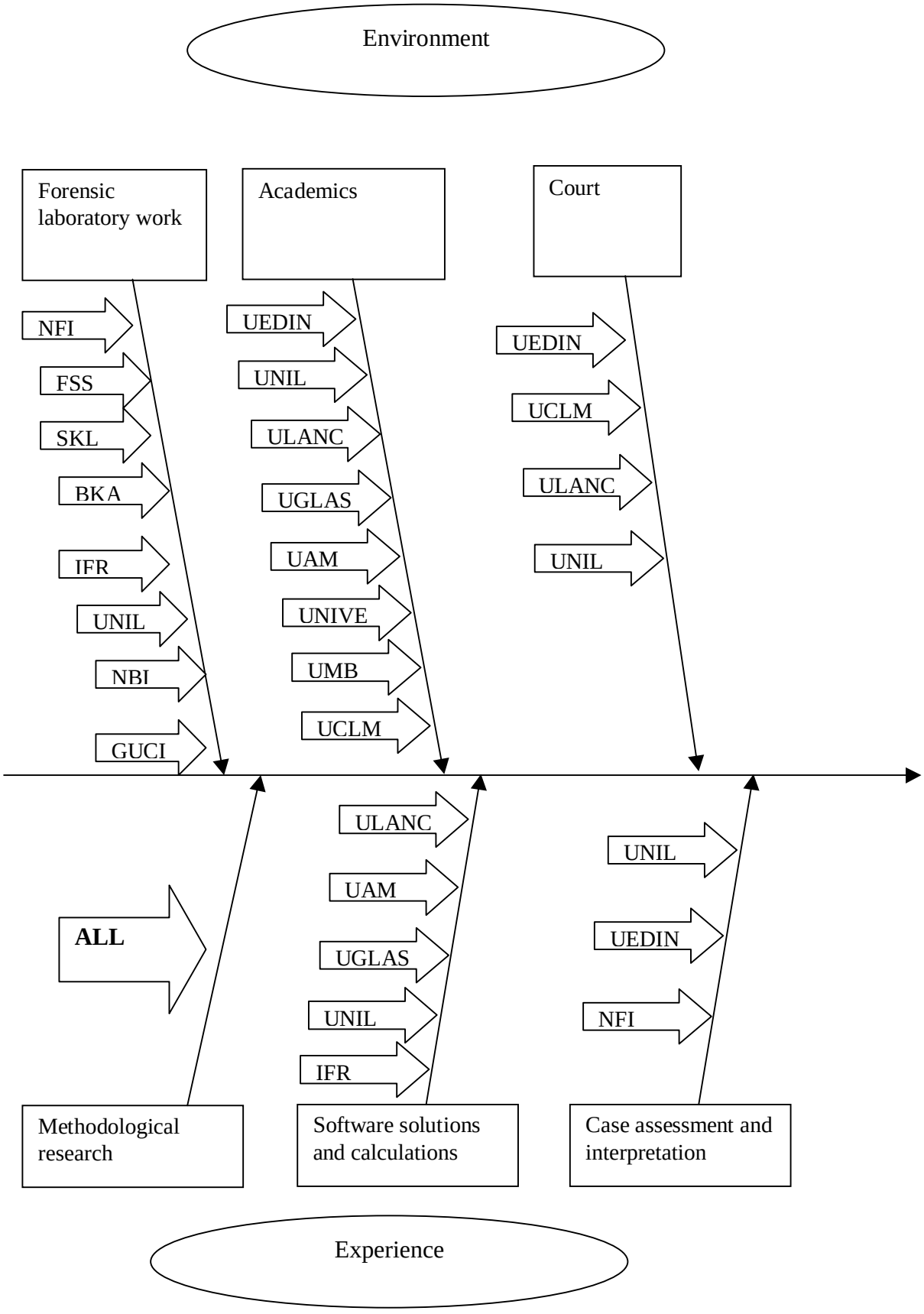

Figure 2.3 The participant's various roles in the project

2.4 Resources to be committed

The project is a coordination action and has defined necessary resources from that stand-point. The coordination activities planned will require a dense schedule of general project meetings completed with attendances at meetings of the ENFSI Working Groups and visits at European and overseas authorities and laboratories. The dissemination at scientific conferences including the scheduled deliverables is planned to include all participants of the consortium. Thus, much of the necessary resources will be allocated to cover expenses for travel and accommodation.

Successively planned sub-tasks within the suggested work packages will be worked on between the general project meetings and personnel costs have been allocated for this. Planned sub-tasks that will require short-time exchange of personnel will be decided upon at project level.

Financial project auditing will be prepared by the coordinator before each general project meeting and each meeting from number two on will decide the amount for the period since the last meeting to be claimed for reimbursement. Eligible costs following the last point of communication, the final workshop, will be summarised by the coordinator and decided upon per capsulum.

Below are summarised budgeted costs for activities (besides ordinary work time).

- general project meetings:

  Project year 1: Euro 69503
  Project year 2: Euro 70540
  Project year 3: Euro 66616

- dissemination at conferences, meetings and the final workshop:

  Project year 1: Euro 77706
  Project year 2: Euro 32832
  Project year 3: Euro 87179

- short-time exchange of personnel:

  Project year 1: Euro 17784
  Project year 2: Euro 19839
  Project year 3: Euro 18599

These costs are based on different taxes for hosting meetings, travel expenses and daily allowances and including a predicted increase by 3% per year.

3. Impact

3.1 Expected impacts listed in the work programme.

The objective of the proposal fits well with that of the Security theme. The objective is to develop a framework based on the interpretation and evaluation of evidence. Evidence is by nature uncertain; without uncertainty there would be no need for trials. The emphasis is on probabilistic and statistical analysis as this approach alone provides the ability, taking due account of this uncertainty, to check the quality and robustness of the decisions made on the basis of the practices and methodologies of forensic science. The analysis also enables robust consideration of subjective evidence in the absence of databases because of proper consideration of the uncertainty that arises from this absence. Procedures based on consideration of the likelihood of the evidence under each of two propositions provide a more coherent evaluation of the evidence than one based on an assessment of consistency with some proposition or on a statement of some putative source for the evidence, in isolation of other possible sources.

Proper consideration of the procedures proposed in the framework will improve the efficiency of the provision of justice and the prevention of miscarriages of justice. They will guide forensic scientists, and investigators, judges and lawyers through the process of the detection and solution of crime. The availability of a framework will aid all involved in the administration of justice and it will ensure resources of personnel, time and finance are used as efficiently and effectively as possible. This will have a major impact on criminal investigation. The application will be world-wide. Such a framework does not currently exist and the production of one will have a considerable beneficial impact on the administration of justice across Europe and, with appropriate dissemination, elsewhere in the world. The state of the art and the needs and priorities for future research and development will be clearly highlighted. The framework will provide a solid basis also for the development of new academic curricula and forensic protocols and will provide input to standardisation activities. Standards for the interpretation and evaluation of evidence will be developed in liaison with the ENFSI Monopoly project. There are several partners in common between the two projects.

The proposal will investigate various lines of research and will give clear guidance for research priorities. It will provide recommendations for the development of a coherent European strategy for the investigation, analysis, evaluation and interpretation of physical evidence.

The most experienced and talented researchers in Europe in the area of investigation and evaluation of evidence are brought together in the consortium which will work on this proposal. There will be no unnecessary duplication of effort. Also, the exploration of synergies in this area will be greatly eased with the regular contact, both electronically and in six-monthly meetings, of members of the consortium. The consortium includes many researchers who have been fundamental in the development of currently available technology. During the time of the proposal they will continue to research and develop new technology.

One of the benefits of the funding of this consortium for this coordination action will be the development of a virtual centre of research. The fifteen member institutes of the proposed consortium are the most supportive of, and house the most outstanding researchers, in forensic statistics in Europe. There is considerable breadth of expertise in the network, ranging from academic statisticians, forensic scientists and lawyers, to practising statisticians and forensic scientists in forensic science institutes and police investigators. The opportunity, provided by funding of this proposal, to meet on a regular basis, make exchange visits and correspond continuously for several years will be invaluable. A basis will be laid from which it will be possible to make strong applications for further research funding to continue the work beyond this period of four years and create a centre of world-wide international excellence in the evaluation and interpretation of physical evidence.

The proposal also aims to develop a roadmap for the software required to provide the tools to put the theory into practice. This will enhance the administration of justice and increase the security of the

citizens of the European Union through enhanced capabilities for the investigation and detection of crime, the conviction of the guilty and the exoneration of the innocent.

Through a well-managed policy on dissemination, all relevant institutions in Europe will be encouraged to use the framework and report back on its efficacy to the website. In addition, the appropriateness and performance of the framework will be demonstrated to all interested parties in Europe. This will be a key factor in the take-up of the output of the proposal and its implementation by security and policing institutions.

Attention will be paid to the impact of the proposed statistical developments on society. Care will be taken to ensure a fair and ethical approach to the interpretation and evaluation of evidence which, in turn, will maximise the utility of the system for the administration of justice throughout Europe with respect for human values. There will be considerable technological impact with the provision of a repository of on-line recommendations with links to recommended software platforms and examples of their use. A web-based platform will be provided with detailed instructions for downloading, installing and launching open-source software.

The proposal will lead to increased public confidence in the judicial system. The framework will describe a route for the provision of an objective and balanced procedure for the evaluation of evidence, with the consideration of the likelihood of the evidence under each of two or more propositions.

The framework developed will not only be of interest to legal and forensic practitioners. It will also be of interest to those charged with the responsibilities for the development of relevant academic curricula, forensic protocols. It will also inform the development of standardisation activities and continuing professional development.

There will be considerable legal impact in Europe with a report describing the current status of interpretation at European courts and with recommendations for communication of the probabilistic aspects of forensic evidence conformed to different jurisdictional systems. A watching brief will be kept on government and parliamentary publications and committee reports in order to be able to contribute to consultation documents or to discussion papers for proposed legislation.

In order for the impact of the proposal to be effective there will have to be a willingness on the part of the user community of forensic science institutes to interact with the members of the consortium. Time needs to be set aside by the Directors of these institutes for their staff to attend workshops, read reports and discuss issues on the website. There needs to be an openness to consider the ideas put forward by the consortium and to engage in meaningful discussions. The members of the consortium will meet with forensic scientists throughout Europe, for example through the working groups of the European Network of Forensic Science Institutes and will provide ample opportunity for an exchange of views.

More detailed impacts of the work packages follow.

WP1: This will be a review of the current state of the art in various areas of evidence interpretation and evaluation. A report will be published on completion which will be a comprehensive summary of the current level of knowledge. There will be a review which covers many types of evidence. There will also be a review of the development of statistics in forensic science, from relative frequencies and including the use of discriminating power, significance probabilities, likelihood ratios, case assessment and interpretation with associated ideas of different levels of proposition and on to Bayesian belief networks.

General forensic scientific topics will include DNA profiling, drug profiling, GSR analysis, trace evidence analysis in general including hairs and fibres, shoe marks and voice pattern recognition. Statistical topics will include methodological development such as Bayesian hierarchical multivariate

random effects models, sample size estimation (as in tablets in drug consignments), uncertainty of estimates, such as may be associated with post-mortem interval estimation. There will be a survey of probabilistic reasoning and decision-making under uncertainty. There will be consideration of the hierarchy of propositions, the use of evidence obtained from databases, and assessments of the quality of performance of various methods for the evaluation of evidence. Bayesian belief networks will be investigated, including their role in the hierarchy of propositions, case pre-assessment and in coherent evaluation of evidence which is a combination of various types of evidence, not necessarily all mutually independent.

The consortium consists of the main researchers in Europe in this area. Other national and international research activities within Europe are mainly conducted within the institutes to which the members belong. Activities within these institutes of relevance to the proposal include drug profiling, GSR analysis, voice-pattern recognition, and DNA profiling among many others. There will be a survey of related work carried out outside Europe, including the USA, Australia and New Zealand.

WP2: This will consider a general framework for case assessment and interpretation (CAI). The impact will be to provide a guide for scientists in their decision-making and to help them provide a value-for-money service that meets the needs of the criminal justice system. Good forensic scientific practice can be identified and formalised. The methods of CAI are underpinned by logical thinking using conditional probabilities which provides a means of dealing with uncertainty and an aid to coherent thinking.

The impact of this work package will be the dissemination of these ideas throughout Europe, using in particular the expertise of those members of the consortium (FSS, UNIL) with the greatest experience of the application of these ideas.

WP3: This will consider selected case studies within different areas of evidence evaluation and from different stages of the path from laboratory to court. Topics will include DNA, chemistry, forensic speaker recognition, biometrics, visual inspection, and data mining. The associated report will provide a useful and important reference source of examples of the applications of a rigorous and coherent approach to the evaluation and interpretation of evidence. There will be flow schemes of the work from laboratory to court. The report will be made available to all ENFSI working groups.

WP4: *Training and communication*: There will be considerable impact here because of the dissemination of the work of the consortium throughout the European forensic scientific community that the training programme will provide, both at practitioner and student level. Communication will also be carried out through use of the website, which will also ensure impact and dissemination world-wide. The proposed content of the website is given in Section 3.2, Dissemination.

Legal aspects: It is important that the developments are made known to the legal community throughout Europe. The work of related initiatives, such as that of the UK's Royal Statistical Society's working group on statistics and the law of which Colin Aitken (UEDIN,2) is Chairman, will also be of relevance to this work package. Links with the judiciary in Europe directly through UEDIN, UCLM and GUCI and also developed by the forensic scientists in the consortium will be exploited through correspondence and seminars to ensure maximum impact. In line with best practice in comparative legal research, a range of scenarios (covering requests for evidence across borders, decision to prosecute and court proceedings) will be developed and integrated into an online survey targeted at legal practitioners. On this basis, a comparison between practitioner perspectives (law in action) and abstract legal requirements (law in books) will be made.

The science side will cover a multitude of forensic disciplines. Legal experts will be involved with each activity of the network partners and with every one of these disciplines that is studied in our project to ensure that any proposed recommendations are in line with European Human Rights and fair process provisions, and are compatible, to the extend that this is possible, with national legislation.

Where this is impossible, or where for other reasons what is scientifically desirable does not match with what is legally permissible, the issue will be indicated and solutions proposed.

On the basis of the scientific findings, the legal experts will provide a framework for teaching materials for non–scientists (judges, prosecutors) from which teaching materials may be developed. Provision of the framework will involve liaison with national agencies responsible for training programmes for judges and other legal professionals.

This work will include the provision of a number of typical case studies where heterogeneous evidence informs a legal decision (to prosecute, to issue a warrant, to decide on guilt, to determine sentence). The models proposed by the science partners will then be incorporated in these case studies to identify any problems legal professionals have in using or understanding them. The national agencies above will be approached for their views concerning a comparison of the scientifically best solution (e.g. in terms of allocating evidentiary weight) with the solutions that would be proposed by lawyers. The outcomes of these comparisons will inform the construction of the framework for teaching materials.

WP5: Open architecture and tools: These will be provided as open-source software, available through the website. The impact has the potential to be very high as use of the tools spreads through the forensic scientific community internationally. Feedback from the community will also help continuing development of the software and enhancement of its quality.

WP7: Coordination of the outcomes to a framework: The framework will be the output of the proposal with the greatest impact. It will link the website with theoretical models, practical implementations, software downloads and case studies. There will be clear identification of the requirements for future research and development. The framework will be an invaluable guide to researchers and those involved in the justice system from criminal investigators to judges and advocates.

3.2 Dissemination of / or exploitation of project results and management of intellectual property.

The consortium includes two participants who are end users of the proposed framework. These are the Guardia Civil of Spain (GUCI, 9) and the Bundeskriminalamt (BKA, 12) of Germany. Other members of the consortium are involved in criminal investigation and the evaluation of evidence and its presentation in court. These are the Statens Kriminaltekniska Laboratorium (SKL, 1) of Sweden, the Netherlands Forensic Institute (NFI, 3), the Instytut Ekspertyz Sadowych (IFR, 4) of Poland, The Forensic Science Service (FSS, 6) of UK, the Université de Lausanne (UNIL, 10) of Switzerland, and the Keskusrikospoliisi (NBI, 14) of Finland. The presence of these participants will aid in the improvement of the security of the citizens of the EU.

The proposal fits excellently with the description of the topic entitled ‘Advanced forensic framework’ (SEC-2011.1.4-3). The proposal will consider best practises, methodologies and technological standards for the investigation of crimes with the aim to improve interpretation and presentation in all stages of the legal process: from police briefings, case conferences through to expert testimony in court without breaking the chain of custody. It will be applicable in all EU member states and associated states. Recommendations will be provided for the development of an open architecture and tools to support the proposed methodologies and standards for the recording of scenario-driven evidence collection and decision making. This last topic is the subject of a book[3] published by Wiley in which four of the authors are members of this consortium. The recommendations will be built on the existing work of the consortium members, work which will continue to be developed through the lifetime of the proposal. The geographical spread of the consortium is large with nine nationalities

[3] Taroni F., Bozza S., Biedermann A., Garbolino P., Aitken C, *Data Analysis in Forensic Science*, Chichester: Wiley, 2010.

represented. This will help members of the consortium to raise the awareness of the EU political stakeholders and will help them shape a proper legal environment for the implementation of the procedures for the evaluation and interpretation of forensic evidence in case flows. The large geographical spread will also help the development of common practices and standards.

Background Intellectual Property (if any) shall remain the property of the Party introducing it. Any Foreground Intellectual Property within a deliverable shall be the property of the partner institution(s) generating it. Access rights to Foreground and Background IP will be granted in accordance with the provisions of the EU Grant Agreement (Annexe II General Conditions), and will be addressed specifically in a consortium agreement between the partners.

Reports: Reports on the outcomes of certain work packages, which are not submitted to a peer-reviewed journal, will be made publicly available as pdf downloads from the project website. These will include reports on the work of

a) WP2: the reviewed framework, the SWOT analysis and ramifications for the forecast of future implementation of the case assessment and interpretation framework.
b) WP3: selected case studies within different areas of evidence evaluation and from different stages of the path from laboratory to court.
c) WP4: comprehensive guidelines comprising suggested packages of lectures and scenario-driven exercises including the use of designated software.
d) WP5: a repository on the website as indicated below.

Training programmes: see WP4:

a) FORSTAT: a series of annual workshops on evidence evaluation supported by ENFSI.
b) E-learning course on statistics and the evaluation of evidence at UNIL (Participant 10).

Further workshops will be developed and offered as the project progresses.

***Peer-reviewed papers*:**

WP1: An article will be written for submission to an appropriate forensic science journal, such as *Forensic Science International.* This article will review the current state of the art in the logical investigation and evaluation of evidence and propose steps in research and development for the implementation of best practices and methodologies.

WP4: The report describing the current status of interpretation at European courts and with recommendations for communication of the probabilistic aspects of forensic evidence conformed to different jurisdictional systems will be submitted as a paper to an appropriate peer-reviewed journal, such as *Law, Probability and Risk.*

Web site:

A web site will be developed and maintained with material relating to all the work packages and to the overall theme of the proposal. The website will include drafts and final versions of reports, software programs in R code, data sets, case studies, platforms for downloading open source software with instructions and an inventory of current practice and of needs for development.

There will be a private section. This will include

a) a wiki discussion board for on-line discussions amongst members;

b) draft versions of review papers, reports and test versions of software.

There will be a section with restricted access only. Those to whom access will be permitted will include members of ENFSI working groups and institutes as well as European Union reviewers. Draft forms of the framework will be available here.

There will be a public section in which final public reports will be presented and news of activities related to the theme of the proposal. As software is developed, there will be a repository here of on-line recommendations with links to recommended software platforms and of platform independent open-source numeric libraries that are available across the web.

Conference presentations:

There will be several presentations at each of two important international conferences during the three years of the project: EAFS 2012 and ICFIS9, scheduled to be held in 2014.

There will also be presentations to meetings of the working groups of ENFSI for European forensic scientists.

Offers will be made to present the work of the project to members of judicial training boards in Europe, for example the Judicial Studies Board in England and the Judicial Studies Committee in Scotland. Both these training boards are supporting work, sponsored by the Nuffield Foundation of the UK, by the Statistics and Law working group of the RSS on guidelines for the judiciary on probabilistic reasoning in the law, DNA profiling, case assessment and interpretation, and Bayesian belief networks.

Public understanding of science:

Where the opportunity arises, presentations describing the work will be made in meetings of issues of general interest to the public.

Review articles:

Occasional articles may be written in journals and magazines in general circulation so as to inform the public and media of our work.

4. Ethical issues

The project will be involved with databases such as registered DNA profiles of convicted persons. The personal information contained in such databases will not be considered within any output of the project and the cooperation with authorities responsible for such databases will be made in such a way that personal information is not disclosed to any of the participants involved.

ETHICS ISSUES TABLE

	Research on Human Embryo/Foetus	YES	Page
*	Does the proposed research involve human Embryos?		
*	Does the proposed research involve human Foetal Tissues/ Cells?		
*	Does the proposed research involve human Embryonic Stem Cells (hESCs)?		
*	Does the proposed research on human Embryonic Stem Cells involve cells in culture?		
*	Does the proposed research on Human Embryonic Stem Cells involve the derivation of cells from Embryos?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

	Research on Humans	YES	Page
*	Does the proposed research involve children?		
*	Does the proposed research involve patients?		
*	Does the proposed research involve persons not able to give consent?		
*	Does the proposed research involve adult healthy volunteers?		
	Does the proposed research involve Human genetic material?		
	Does the proposed research involve Human biological samples?		
	Does the proposed research involve Human data collection?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

	Privacy	YES	Page
	Does the proposed research involve processing of genetic information or personal data (e.g. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?		
	Does the proposed research involve tracking the location or observation of people?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

	Research on Animals	YES	Page
	Does the proposed research involve research on animals?		
	Are those animals transgenic small laboratory animals?		
	Are those animals transgenic farm animals?		
*	Are those animals non-human primates?		
	Are those animals cloned farm animals?		

	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

Research Involving ICP Countries		YES	Page
	Is the proposed research (or parts of it) going to take place in the one or more of the ICP countries?		
	Is any material used in the research (e.g. personal data, animal and /or human tissues samples, genetic material, live animal, etc) a) collected in any of the ICP countries?		
	b) Exported to any other country (including ICPC and EU Member States)?		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

Dual Use		YES	Page
	Research having direct military u		
	Research having the potential for terrorist abuse		
	I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL	X	

5. Consideration of gender aspects

The consortium of this proposal constitutes a mixture of female and male researchers. Gender aspects of the project work will thus have the potential to be identified, discussed and integrated with the project outcomes.

6. Security sensitivity issues

The proposal is not security sensitive.