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concerning

Advanced Informatics in Medicine

**(AIM)**

- Progress Report '89 and Mid-Term Review -

(presented by the Commission pursuant to Articles 6/3 and 9 of the Council Decision of  
4/11/88 on the AIM Exploratory Action)

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### Summary

*Health Care is growing rapidly and technology opens up new possibilities to address needs. In some developed countries as much as 10% of GDP is addressing health care. Europe's citizens will expect to receive the best possible care at acceptable cost. Information and communication technologies (I&CT) offer significant potential for cost-performance improvements.*

*It is for this reason that the sector actors and national administrations defined the AIM (Advanced Informatics in Medicine). The Council of Ministers adopted AIM on November 4th 1988 for an initial period of 24 months starting June 1988.*

*AIM is a pre-competitive / pre-normative R&D programme which is designed to develop new technology, specifically information and communications technologies, and to bring benefits from these developments into Medicine and Health Care, in order to improve the quality and cost-effectiveness of the services provided and to strengthen the competitiveness of the European I&CT industry. Achieving this requires action on a European scale, and much of that action is needed at the administrative level, in this instance from the Commission.*

*The present first phase consists of an Exploratory Action, with limited Commission funding (20 million ECUs) representing 50 % share of the cost of research and development, the other half being paid by the bidding consortia.*

*The Council Decision proposed a review after 12 months. This communication includes a report on the implementation of the programme, the results of the "12 months review" and the investigation of future requirements and options.*

*The programme will provide sector actors and national administrations with an improved insight and first results in exploiting the potential of advanced informatics in medicine. It has demonstrated the willingness and ability to collaborate in this domain.*

*This document is based on the outcome of audits of AIM conducted by independent experts and in close collaboration and association of the AIM Management Committee.*

*The outlook to future collaborative work in this domain is based on the work of a Requirements/Strategic Review Board.*

*In the light of the results of the AIM Exploratory Action so far and the advice of sector actors consulted, further collaboration in the domain of medical and bio-informatics is considered to be of great importance and appropriate for Community objectives and actions. The completion of the internal market will place new and growing demand on providing health service transnationally. Pre-normative and pre-competitive R&D can play here a key role in preparing standards and regulations as well as strengthening the international competitiveness of the associated industries and services.*

## 1. Introduction

The demand for health care services is increasing (at present it is up to 10% of the GDP). People with special needs (the disabled) are a group of particular concern. An appropriate introduction of new information and communication technologies allows an increase in efficiency of providing health care and thus a reduction in their collective cost while ensuring a high quality of services.

Technology as such is often not enough, complementary efforts of an interdisciplinary character are required for the benefit of technological progress to become effective. The purpose of the work under AIM is to engage the supplementary technological efforts in areas which are directly relating to pressing socio-economic needs prevailing throughout the Community. The combined potential of information technology and communications can offer new and more effective solutions to several socio-economic problems while also leading to markets of considerable export potential.

This is the background against which sector actors and national administrations collaborated to carry out the AIM Exploratory Action. Besides its technological objectives it is to provide the Member States and Sector Actors with analyses and results which will help them to meet challenges and minimize risks in this fast moving and highly competitive domain.

The present report, which has been edited by the Commission's services, summarises and documents the results of the audits of AIM conducted to date in the context of the original objectives of the Council Decision.

The report addresses the context, organisation and results of the Programme in Section 2. The context, organisation and results of the audits of the Programme are described in Section 3. Conclusions regarding the future strategic direction are developed in the light of the results of the audits and the views of a panel of experts which considered the future development of the Programme in Section 4.

The AIM audits have two distinct components:

- **A Requirements and Strategic Audit**, which evaluates the performance of AIM as a whole with respect to the strategic and policy objectives of the Community in an international context and future developments,
- **A Programme Management Audit**, which evaluates the performance of the Commission in its responsibility for the management of the Programme.

The detailed conclusions of the audits are described in the annexes to this document.

Further annexes summarise the work of AIM and list the participating organisations. A list of references, glossaries and an index are also provided.

## 2. The context and approach of the AIM Exploratory Action

### 2.1 Meeting the challenge of biomedical informatics

The AIM Programme addresses the challenge of exploiting the development of information and communications technologies (I&CT) in the fields of Medicine and Health Care. The impetus behind this pre-competitive/pre-normative R&D programme stems from :

- the combination of ever-growing expectations from the population in the Community and increasing costs of providing the best health care services,

- the rapid development of I&CT, which provides ideal opportunities to improve quality, accessibility, efficiency and economy of health care services.

The development and introduction of information systems in health care are pulled by the necessity to achieve both better quality and higher efficiency. These goals are still a stimulus for the introduction of a host of different systems, such as laboratory automation, computer-assisted monitoring of medication, computerized intensive care, etc. Besides, there may be other reasons for employing information systems : usage for research and education, especially of interest for universities with educational responsibilities, or for the quality assessment of medical care.

The health sector has been lagging behind in the optimal application of I&CT as compared with most other sectors which have traditionally been managed in a professional "business" perspective. This is particularly true in Europe, where health is viewed as a responsibility for the State, thus making it a "service activity" rather than a "business". A key characteristic of Europe, has been to give high priority to health as part of the social policy of the Member States. The greater possibilities offered by new technology and the pace of technological change are well known to the public, who are becoming more and more demanding in terms of quality of care and related quality of life. At the same time the health care that is demanded is changing, as the result of modifications in the age distribution of the population and of changes in the types and pattern of diseases.

Health constitutes a key sector for Europe, especially to maintain its 'cultural' independence and difference, to valorize the high potential of its health care professionals and medical researchers, and to consolidate the worldwide position of its industry. A collaborative strategy at the European level is needed not only to economise on research and development, but most importantly to allow transnational/multidisciplinary/cross-sectional co-operation in a field which suffers greatly from fragmentation of markets and partitioning of efforts.

The increasing public consciousness within the Community will undoubtedly apply to medicine and health care, and make it a natural assumption that medicine and health care are harmonised across Europe instead of held back by former parochial/regional practices.

## 2.2 The Objectives of AIM

The global objective of AIM is :

*"the sustained improvement of Health Care in the Community within economically acceptable limits by exploiting the potential of information technology and telecommunications being applied to it"*

Given this general theme, the Council expressed its concern with realisation of the following goals :

1. Improve the quality, accessibility and flexibility of Health Care;
2. Increase the effectiveness of patient care, bringing about a reduction of unit costs;
3. Contribute to the establishment of minimum standards and common functional specifications;
4. Contribute to agreed codes of good practice, protection of privacy and reliability;
5. Stimulate collaboration and concertation in the analysis of the requirements and opportunities of I&CT applied to Health Care;

6. Contribute to the common adaptation of the regulatory framework to advances in the nature of Health Care.

How these objectives are addressed and what impact can be expected by the ongoing projects is described in Table 1 below.

As the AIM Programme develops the necessary links, with related actions within the Community, especially the "Medical and Health Research Programme of the European Community", and particularly its sub-Programme II, Target II.1 (Medical Technology Development) and Target II.2 (Health Services Research), will be established through concertation and co-ordination of activities.

Review of the "Objectives" stated in the Decision of the Council

Objectives	Ways in which these objectives are addressed	Global Impact expected of the AIM work
<i>Improve quality, accessibility and flexibility of health care</i>	Collaboration in the investigation of requirements and options with the sector actors concerned Development of a coherent approach to the exploitation of IT&T in health care conform to the specific requirements and conditions applicable Assessment of the use of knowledge-based systems	Development of introduction strategies for integrated hospital PACS Definition of common framework for intensive care computer systems Outline specifications for intelligent medical image processing workstations Development of an approach to "telemedicine" Development of a common approach to laboratory data exchange Design of a general architecture for medical expert systems Development of an Integrated Biomedical Laboratory concept
<i>Increase the effectiveness of patient care, bringing about a reduction of unit cost</i>	Assessment of the cost-performance and socio-economic potential of IT&T applied to health care and medicine	A common framework for the assessment of information systems in medicine Development of systems supporting clinical and hospital management Designing of uniform reference model for medical data , incl. severity of cases, resource costs data and resources availability
<i>Establishment of minimum standards and common functional specifications</i>	Investigation of the characteristics and benefits of the use of Integrated Health Information Environment under European conditions Analysis of standardisation requirements	Timely definition of requirements and specifications for the next generation Design of integrated information environments for several typical situations Approach to standardisation of clinical data exchange Proposal for medical software quality assurance standards
<i>Agreed codes for good practice, protection of privacy and reliability</i>	Clinical data and process modelling Assessment of the needs and organisational impact of Patient Data Cards Investigation of privacy and data protection requirements	Modelling and implementation of information systems for chronic health care Development of an Health information and decision support workbench Concertation and consolidation of views on Patient Data Card usage Identification of main privacy concerns and option in collaboration with AIM Management Committee
<i>Collaboration and concertation in the analysis of requirements and opportunities in IT&amp;T and its application to health care</i>	Techno-economic investigation and information gathering on the use and impact of IT&T use in health care Investigation of the special skill requirements and options to meet them	Impact assessment and forecasting of the future development internationally and of the implications for Europe Identification of future requirements and options as well as the implications for technology, services, infrastructures, standardisation , management and regulations
<i>Common adaptation of the regulatory framework to advances in health care</i>		Alignment with work by CEN-CENELEC, Council of Europe, WHO, member states regulations and medical informatics societies

### 2.3 The scope and status of the work of the AIM Programme

The AIM Workplan<sup>1</sup> formed the basis for a "Call for Tender" published in the Official Journal on 8th November 1988 and was distributed to more than 2000 actors and organisations in the field. It pointed at 7 areas in which strategic research and development were needed and recommended 42 specific tasks, distributed as follows:

- development of a common conceptual framework for cooperation (2 tasks);
- medical informatics environment (3 tasks);
- data structures and medical records (4 tasks);
- communication and functional integration (12 tasks);
- integration of knowledge based systems into Health Care (7 tasks);
- advanced instrumentation, equipment and services for Health Care and medical research environment (6 tasks);
- non-technological factors (8 tasks).

The AIM Workplan was structured as three separate Action Lines. These three Action Lines and their individual actions are strongly inter-related and should contribute together to the convergence of classical health care techniques with advanced I&CT. One fundamental objective of AIM is to facilitate this convergence by concentrating not only on medico-technico problems (Action Line II) but also on the development of a common conceptual framework (Action Line I) and "non-technological" factors (Action Line III). The Action Lines were distributed among 7 chapters, Action Lines I and III being addressed by one chapter each, Action Line II by 5 chapters. The Workplan for the Exploratory phase was developed under the headings of:

- Action Line 1 (27%)  
*Improvement of the effectiveness of public and private actions,*
- Action Line 2 (60%)  
*Strengthening Europe's position in Medical Bio-informatics and Health Care,*
- Action line 3 (13%)  
*Creation of an environment favorable to the rapid introduction and appropriate application of Medical Bio-informatics in Health Care.*

Within the call for tender launched in November 1988, most of the work defined by the Decision for the Exploratory Action has been taken up within the resources given to it.

37 AIM projects began in June 1989. Six additional projects, which had been approved by the Management Committee on 3 July 1989 [AMC-7], started later in October.

The distribution of the financial resources of the action is summarised in Table 2.

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<sup>1</sup> AIM Workplan, ref.: AIM 100, 24 October 1988.

**TABLE 2**  
**SUMMARY OF USE OF FINANCIAL RESOURCES IN THE AIM PROGRAMME**

AIM PROGRAMME	DECISION		ACTUAL	SHIFT
	(MECU) (%)		(%)	(%)
Action Line I	4.80	27.0	9.6	-17.4
Action Line II	10.70	60.3	84.4	+24.1
Action Line III	2.25	12.7	6.0	-6.7

The table below gives a global overview on AIM. More is given in the Annex and for the details reference is made to the Technical Report "AIM 89"<sup>2</sup>, that provides a detailed description of the work undertaken by individual projects in relation to the precise objectives and the context of the work as described in the Decision of the Council.

#### 2.4 Overview of AIM and first results

The AIM Exploratory Action has already achieved a great success in creating a small community of sector actors working together in the field of information and communications technologies applied to Medicine and Health Care. The Call for Tender launched in November 1988 gave rise to an outstanding response which highlighted both the needs of the sector actors and their willingness and ability to co-operate in collaborative pre-competitive and pre-normative R&D projects.

However, the work initiated under the AIM Exploratory Action is only the first, albeit essential, step towards improved communications and better integration in Health Care in Europe. The next step should be to build on the current work in order to expand and consolidate the links which have been established between the health care community, research institutes, universities and industry.

The AIM Exploratory Action will result in significant advances in the European health care telematics environment. In particular, it will lead to :

- Consensus formation on a wide range of health care issues and technology options for subsequent submission to standards bodies and public administrations concerned,
- development of Technology based on the outcome of the theoretical and experimental investigation of technical problems which must be solved to enable the implementation of the next generation of health care telematics systems,
- User interaction at an early stage in the planning of the next generation of systems in Europe,

<sup>2</sup> Technical Report "AIM '89", September 1989.

- **Alignment with the similar or relevant work carried out by standards bodies, World Health Organisation, Council of Europe, medical informatics societies, public administrations in member states, etc.**

**These combined developments are leading to awareness creation on a European scale of the market opportunities and macro-economic benefits which will accompany the development of an advanced health care telematics infra-structure in Europe.**

**Awareness facilitates the early reaction of the European actors to the dramatic changes which are taking place in the overall health care environment.**

**In developing early awareness and reaction to change, the AIM programme is making a significant contribution to enabling the European sector actors to satisfy the needs of the population, and obtain a strategic competitive advantage in the exploitation of the growing global market opportunities.**

AIM Programme Overview

General Description	Implementation of AIM
Decision	Council decision of 04.11.88 88/577/EEC
Title	Advanced Informatics in Medicine (AIM) - Exploratory Action
Duration	01.06.88 to 30.05.90
Community Financial Contribution	20 MECU representing less than 50% of the total effort estimated at 42 MECU
Financing of EFTA participants	Universities and research institutes can claim 100% EC contribution of marginal costs incurred by projects Partners from EFTA countries do not receive funding from the Community but inversely, contribute to the management expenses EFTA national administrations establish, in general, comparable financial conditions for EFTA partners
Number of actors involved	An estimated 250 partners collaborate in the 43 projects adopted as of July 3, 1989
Overall objective	The sustained improvement of Health Care in the Community within economically acceptable limits by exploiting the potential of information technology and telecommunications being applied to it
Scope	Action Line I : Improvement of the effectiveness of public and private actions Action Line II : Strengthening Europe's position in the application of IT and telecommunications to Health Care Action Line III : Creation of an environment favourable to the rapid introd. and appropriate application of IT & T in Health Care
Nature of the cooperation	Pre-normative, technology exploration and investigation of non-technological factors
<b>Participation in AIM</b>	<b>Is open to all organizations established in the Community and EFTA countries</b>
Health service providers	43 unique participations
Universities and Research Establishments	130 unique participations
IT&T Manufacturers and other industries	58 unique participations
Other	1 other type of organization
Small and Medium Sized Undertakings	98 unique participations
EFTA participation	9 unique participations and 12 participations overall
Number of consortia	43
Number of organizations involved	232
Number of participations in projects	278
<b>AIM interworks with</b>	<b>Organizations active in related subjects</b>
CEN/ CENELEC	Periodic consultation meetings
Council of Europe	Via periodic meetings and expert advice
DG XII 4th Medical Research Programme	Via Commission internal collaboration
European Federation of Medical Informat. (EFMI)	Via joint activities (meetings, conferences, etc.)
EFTA national administrations	Periodic briefings and consultation sessions
ESPRIT	Via Commission internal collaboration
FAST	Via Commission internal collaboration
WHO, Regional Office for Europe	Via periodic briefings, consultation meetings and expert advice
<b>AIM integrates with</b>	<b>Other policies at Community and national level</b>
Standardization policy	Via COM DG XIII/E and SOG-ITS
<b>AIM Management</b>	<b>Follows industrial practice</b>
Programme management	Responsibility of the Commission supported by the AIM Management Committee
Project Management	Responsibility of the project consortia

AIM Programme Overview

<b>AIM Workplan</b>	<b>Describes in the context of the objectives all work which is to be carried out under the programme</b>
Definition of the rationale and tasks Revision and update Impact Assessment and Forecasting	Developed with the sector actors concerned Results are reviewed by the Commission after 12 months and reported to the European Parliament and Council A systematic survey of world-wide developments in the field of IT&T applied to Health Care and Medicine is undertaken by a "Medical Informatics Review" Group. In addition regular contacts with Member States to identify specific requirements
International Contacts	Visits and contacts of projects with related actions world-wide and participation in conferences and meetings
<b>Dissemination of AIM Results</b>	<b>Is built into the programme</b>
Programme level Project level  Within the Programme  Within the Project Consortia Quality control	This is carried out via yearly progress reports to Council and Parliament as well as yearly "Technical Reports" Projects disseminate their own results in scientific fora Deliverables from AIM projects are shared with related AIM projects and final results are mostly in the public domain Every six weeks, concertation meetings bring together all project leaders and some of their team members with the Commission to review progress and disseminate results Regular project internal meetings assure transparency, coordination and dissemination of the results while the work is progressing Project Officers assess the deliverables and follow the monthly management reports Once a year independent external experts carry out a Technical Audit of all projects.
<b>Tendering &amp; Evaluation of Proposals</b>	<b>Public call for tender followed by independent anonymous evaluation by experts</b>
Competitive Tendering Conditions for participation  Technical and Managerial Evaluation Strategic and Political Evaluation Contracting  Monthly Management Reports Red Flag Procedure  Yearly Project Progress Report Annual adjustment of the Project Adjustment in the course of the year  Deliverables	After adoption of the Workplan, the choice of proposals was made on the basis of a public tender (08.11.88) Two independent partners not all established in the same Member State, at least one industrial partner At least one partner concerned with health care, 50% of project cost to be contributed by partners. Proposals submitted were unanimously assessed by independent experts With Member States via the AIM Management Committee A Model Contract is offered which has been developed with sector actors It is used for all contracts, although some adaptations are made to accommodate specific problems This serves essentially the needs of Project Consortia to monitor progress of work and identify problems If a project or a partner in a project encounters unforeseen serious problems he signals this to partners and the Commission by "raising a Red Flag" in the Monthly Management Report. If invited the Commission calls a meeting to resolve the problem, otherwise the issue is addressed within the consortium. Each Project prepares once a year an Annual Report After one year, the Technical Annex of the contracts are reviewed and adapted for the following period Adjustments can be carried out in the light of the results of the "concertation meetings" Unless these are major changes they are agreed with the Project Officer and recorded without amendment of the contract Each project identifies tangible results which are referred to as "Deliverables" Quality and timeliness are verified by Project Officers and as part of the Technical Audit
<b>AIM Auditing</b>	<b>Follows industrial practice conform to Community rules</b>
Mid-term Review  Strategic Audit and Requirements Assessment  Technical Audit Management Audit Financial Audit	Communication reviewing the progress of AIM against the objectives stated in the Decision. It is based on the results of specific "audits" addressing the strategic, technical, managerial, and financial performance Done by independent experts as a basis for the AIM mid-term review and revision of the Framework Programme it examines AIM with respect to strategic and policy objectives of the Community in an international context Evaluates the performance of all AIM projects with respect to specific objectives Evaluates the performance of the Commission in its responsibility for the management of the programme Verifies the correct use of public moneys. Projects and the Commission Service in charge of AIM are investigated
<b>Exploitation of AIM Results</b>	<b>Is part of the contractual commitment of the projects</b>
Industrial property rights	Rest with the partners in a project. Depending on the circumstances special provisions are agreed between the partners. The Model Contract considers graduated provisions for access to the results of other projects and the conditions for exploitation

### 3. The audits of AIM

#### 3.1 Introduction

This section begins with an overview of the evaluation process employed by the Commission in relation to AIM. The results of the audits conducted are summarised and the general impact of the results on the Community is described.

#### 3.2 Evaluation as an on-going process

In view of the rapid development of technology and user requirements, evaluation is a process which is pervasive in the preparation of the programme, its implementation and its execution.

The evaluation started with the collaboration of the sector actors in the planning of the programme and the development of the Workplan in relation to workshops. The initial workplan was evaluated, revised and refined by a group of national representatives of Member States before its adoption<sup>3</sup>. In addition, while the programme is running, there is a continuous informal process of monitoring progress via established mechanisms (Concertation Meetings).

The impact of the application and introduction of I&CT to health care, both on European and international levels, is being continuously evaluated in the framework of a "Medical Informatics Review" initiated by the Commission.

#### 3.3 The Programme Audits

The mid-term review of the Programme (12 months review) is based on the outcome of several audits of the Programme by groups of independent experts.

Article 9 of the Council Decision states : "The result of the action shall be reviewed after 12 months. The Commission shall report to the European Parliament and the Council on the results of this review". By Article 6/3, third indent, the Commission is to refer the programme review to the Management Committee for opinion.

The work on biomedical informatics needs to be reviewed both with respect to evolving demand and new technological developments. Three related but distinct evaluation processes need to be addressed :

- **The strategic aspects**, evaluating the performance of AIM as a whole with respect to strategic and policy objectives of the Community in an international context
- **The technical aspects**, evaluating the performance of the projects with respect to the specific objectives, and
- **The programme management**, evaluating the performance of the Commission in its responsibility for the management of the programme.

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<sup>3</sup> The "AIM working group" of national representatives held regular meetings in Brussels during a period of one year (October 1987-October 1988).

In view of the recent start of the projects, the AIM Management Committee decided on 27 July 1989 [AMC-8] to defer the technical audit until February or March 1990. As a result, this audit has been omitted from the «Progress Report '89 and Mid-Term Review».

The strategic and programme management audits have been complemented with a forward looking investigation of future requirements and options in the framework of "Operation 1992"<sup>4</sup> in which leading strategy, policy and technical experts collaborated in the task of identifying requirements and options. A summary of the Requirements Board and Strategic Audit reports are enclosed as Annex I to this document.

### 3.4 Review of the results of AIM by the Audit Panels

The main conclusions of the review can be summarised as follows :

#### ■ Strategic orientation

- The basic AIM objective remains valid : Integrated Health Information Environment (IHE) development is appropriate and necessary for Europe.
- Key target dates should be identified for IHE, in particular with respect to standardisation of data, protocols and systems. They should be consistent with requirements and with evolution worldwide.
- The current emphasis in AIM on the different areas covered is about right. Because of limited financial resources, priorities have had to be set. Roughly 10 % of the effort is dedicated to the development of a common conceptual framework for cooperation, 84 % is devoted to developing key technologies, and about 6 % to linkage with non-technological factors.
- However, in a next phase, coherence of the work should be re-inforced through :
  - a clear identification of the health care field in information and communication technologies,
  - using a European multidisciplinary infrastructure to obtain European added value in health information and communication systems development, well adapted to health specific problems and issues (e.g. protection of personal data, friendly and safe environment for users and patients, multilingual systems requirement etc.),
  - with practical means to obtain standards and networks, which are the basis of an integrated health information environment, e.g. greater emphasis on integration, promotion of standard processes in health care, establishment of strong links with CEN/CENELEC and OSI, creation of a European office for specific health information standards etc.,
  - and user-oriented information systems rather than technically driven applications.

<sup>4</sup> As part of the on-going exploration of requirements and options but in particular, as part of the preparation of the revision of specific programmes and of the Framework Programme, a Planning Exercise "Operation 1992" has investigated the domains of communications and the use of telematics services of major socio-economic interest.

- Given the important achievement of the AIM exploratory action that already has
  - . initiated a fruitful dialogue between various partners among European countries,
  - . identified a market with social values, where European small and medium enterprises could gain IT and T acceptability and industrial competitiveness,

there is a need for continuity in this action, taking into account the difficulty to move from pilot temporary research projects to a medium and longer term strategy.

- Beside the priority for "safety critical systems" and handling of specific problems (legislation and standards, training and cultural needs), further cooperative pre-competitive research efforts are needed in order for Europe to stay in the forefront of advanced health care information and communication technologies.

■ **Programme management - Conclusions of Audit**

- The AIM programme has largely adopted an industrial programme management approach. The conclusion of the Management Audit was that the main elements of this approach :
  - workplan preparation in close cooperation with sector actors
  - importance given to system engineering aspects
  - consensus making through information exchange

are on the whole appropriate and well-adapted to the typical objectives and general situation of the programme.

- The system engineering part is considered of prime importance to the extent that without it the whole action of the Community through these programmes would be severely restricted in its effectiveness.
- The negotiation process was on the whole seen as satisfactory but payment of the advance on contract signature needs to be done faster; the same goes for payment after approval of deliverables.
- Cooperation among projects towards consensus on technical aspects is being promoted by regular Concertation Meetings, attended by representatives of all projects. The "cost-effectiveness" of these Concertation Meetings could be improved by making them more attractive and more interesting and also less frequent.
- The number of partners involved in projects should not exceed 5-6, which seems to be the practical limit in terms of optimal efficiency.

The Audit Team considers the management approach that DG XIII/F applies to RACE, DRIVE, DELTA and AIM to be both original and appropriate; it is highly successful in accomplishing the specific and general objectives set for the programmes; in several aspects it distinguishes itself favourably from what - in the experience of the Auditors - is normally found in comparable programmes and initiatives.

The overall impression is unequivocally good, even very good. Any remaining difficulties are of a minor nature. The Commission, in particular DG XIII/F, should definitely continue in its application of this approach, taking care to make the necessary improvements and adaptations as the programmes evolve.

#### 4. Future Perspectives

In January 1989 a *Call for Ideas* was launched. More than 150 groups or individuals responded with a higher proportion of Industry as compared with that in the retained projects. Together with the ideas contained in the proposals to the Exploratory Action they constitute a very substantial background for an enforced R&D activity in the domain.

The very fact that the Exploratory Action has engaged so many groups and brought so many requirements and options for the future in full daylight represents a strong rationale and an interesting background for a fruitful outcome of follow-up activities. This opportunity deserves exploitation in the light of the objectives of the AIM Action.

Several further key research and development issues have arisen from a review of the results of the call or have already been identified through the «AIM Operation 1992» exercise. They are listed below arranged under the headings of AIM's three high level policy objectives of improved quality, efficiency and competitiveness.

##### 4.1 Improved Quality of Care

Ensuring quality of care requires information systems which facilitate data collection and analysis and are capable of tabulating data input in a standard format suitable for continuous surveillance. The availability of valid scientific data is a prerequisite for good clinical and policy decisions at local, national and international levels. Information systems which facilitate continuous systematic monitoring are necessary to allow the various units (primary health care centres, hospital wards,...) to be constantly aware of their present situation and also to allow the quick detection of even small changes in outcome. The definition of comparable minimum data sets would facilitate analyses of regional variations, with the overall goal of improvement in units performing poorly.

All European countries are now considering the use of uniform data sets in hospitals in order to assess productivity and quality of care.

The development of adequate information systems for these objectives has been made mandatory in the USA at the Federal level in 1983 for *Medicare*, e.g. for patients aged 65 years and beyond ; "Diagnosis Related Groups" (DRGs) were chosen there to define case-mix. Although European countries might appear to be 5 to 7 years late in such coordinated development, several characteristics of European social and health systems offer specific opportunities. Among those, the following are the most important : a medical data set in Europe will most likely cover all age groups and not be restricted to old inpatients ; nomenclatures of acts exist already in most European countries, in a uniform way by country, while USA is only beginning to generate them, with larger variations by hospital and by region ; more homogeneous cost regulation measures exist in Europe, while in USA billing data are inhomogeneous, standards are lacking in external controls, and there is a strong competition in health care delivery systems.

These differences should be taken into account in the future, in case of comparisons between American and European hospitals. A longer length of stay and lower costs of labour and ancillary services in Europe should be correctly interpreted.

Furthermore, general practice has an important function in Europe that is not comparable to the one in USA neither in Japan. Access of the populations to Health Care is another relevant European challenge, as it has not been achieved to such a high degree in any other region of the world.

Due to budget constraints and the limits placed on the scope of the workplan of the AIM exploratory action, the current set of AIM projects does not cover this area satisfactorily. The work urgently required can be summarised as follows :

- to pursue development of a minimum basic data set in order to allow international comparisons,
- to select areas for experimentations (e.g., hospital mortality, obstetrics and blood losses, anesthesia, specific diseases and operations, specific treatments in ambulatory care),
- to associate productivity measures to quality of care measures,
- to develop structured information feedback for health care practice, for the benefit of patients and providers who become increasingly mobile within the Community.

#### 4.2 Improved Efficiency of Health Care Systems

Rapid progress in medical knowledge and technology enables much more to be done to enhance and prolong life. However, there is a definite gap between the resources currently being made available for Health Care and the expectations of the population. The resulting pressure leads not only to a search for additional resources but, most importantly, to a sustained search for improved efficiency in providing Health Care and in utilizing manpower, for improved methods of training health care professionals, for improved planning and location of health facilities, for greater patient involvement in his/her health care decision making, etc. "Same day" treatment including ambulatory surgery is increasingly becoming the normal approach to therapy and there is much greater concern with medical audit, quality assurance, etc.

Efficiency of Health Care has been described as a key component of the AIM exploratory action, yet budget constraints have resulted in a broad "non coverage" of the necessary research, particularly on the following topics :

- development of descriptors of productivity (MBDS in hospital and in ambulatory care, linked to costs), based on databases comparisons,
- development of European models of reference to describe pathologies and costs by case,
- development of standards for data comparisons,
- development of an appropriate infrastructure to organize the effective management of these measures (what can be decentralized, what should be decentralized ?).

#### 4.3 Improved Worldwide Competitiveness of the European Sector

The medical engineering market, i.e. health care equipment using information and communication technologies, is estimated to grow at an average rate of 10 % per year, with a total estimated figure of almost 20 billion ECUs. The growing needs of developing countries and the necessity for industrialized countries to limit their health expenditures make this trend likely to continue in the future for technologies which improve the efficiency of Health Care delivery.

There has been changes in the structure of the European industry in the last few years. There is a clear trend towards the entry of American and Japanese manufacturers. This has been noticeable with several mergers resulting in a reduction of "European" suppliers. This regrettable trend may well continue in the future as the market for health technologies requires a broad base to generate sufficient turnover, thus enabling the on-going development of future systems to be financed despite the introduction of cost containment schemes (DRGs, etc.) which affect the purchase of equipment negatively.

The market characteristics are very specific : the "output" from the health industry cannot, for obvious reasons, be considered as an ordinary product. Then one needs to fulfil very stringent regulations; demand comes mainly from "institutions" requiring the most sophisticated and up-to-date yet cost-effective equipment available, but also an important degree of technical support and a high level of training; because of the relative narrowness of the market as well as the necessity to generate important 'economies of scale' in R&D, manufacturing and marketing in order to reach the "critical size", the industry is a *global industry*, and competition can only take place on an international scale.

In this context, the European health industry suffers, among other things, from the fragmentation of its market, its inability to design appropriate and competitive applications or solutions for the worldwide market in equipment, hardware and software, and also from a stiffening competition within Europe of the American and Japanese companies. In the light of Europe approaching "1992" and the internal market, it becomes of utmost importance to help the European industry prepare itself for this target, which implies mainly co-operation in R&D at pre-competitive level (competitiveness depends primarily on the ability of industry to design and develop advanced equipment and systems suitable to the international demand) and at pre-normative level (standards are costly to define and are manpower intensive).

There must be sufficient incentives for industry to get involved and strive to meet most Health Care demands, from diagnostic instruments to complete hospital management systems. A strong and competitive European industry will emerge only if there is a market for it. This requires full involvement of the health care professionals in the production of common functional specifications and "products", in order to make the medical profession define precisely its requirements and realise that I&CT can be a means to perform its task more efficiently and with a better result for less expenditure.

This interdisciplinary/intersectional cooperation between the various actors in Europe has been an essential and specific element of the AIM strategy since it developed from 1985 onwards. Significant progress is being achieved with the Exploratory Action, yet much effort will need to be done to consolidate the fruitful dialogue that has started.

#### 4.4 Steps Towards Sector Integration

I&CT has already proved its value in medical applications through the introduction of several systems indispensable in the practice of Medicine today. However, these are mainly singular solutions of specific applications and are not integrated into the 'Health Care scenario'.

With on-going developments in I&CT, it should be possible to integrate such individual solutions into a total scenario improving the acquisition or generation of data, processing, distribution, display and archival of relevant patient information within the Community.

Moreover, since the installation of the first meteorological and air defense systems in USA in the mid sixties, one knows that information systems cannot be developed, implemented and managed successfully if social aspects have not been taken into consideration. Also legal aspects have become an integral part of the design of health and medical information systems, especially those containing sensitive personal information. More recently, ergonomics proved to be a major aspect of system's success and therefore, systems for the computer illiterate health care professional need a specifically designed user interface.

Successful development of health and medical systems needs a close co-operation of various research and industrial sectors to guarantee useful, up-to-date and competitive products for the international market.

#### 4.5 Proposed Action Lines

Sections 4.1 - 4.4 above identified various issues and requirements for research efforts which, if carried out, would lead to significant benefits for Europe, the medical profession, the health industry and the citizens. The research outlined above should be structured with a view to addressing the following action lines :

*Quality and Completeness of Basic Medical Data*

*An Integrated User Environment*

*Communication of Medical Data, including Medical Language and Terminology*

*Transfer of Medical Knowledge across Europe*

*A Methodology of Software Design and Maintenance and Portability of Systems*

#### 4.6 Conclusion

The table below - which has been taken from the Requirements Board report - presents an analysis of the promising areas for European "I&CT applied to Health Care" and their potential contribution to industrial competitiveness, quality of care and standards, efficiency of care and economic aspects.

18 / 19 / 20 / 21

**An assessment of the potential contributions  
from health care informatics**

**++ high importance**  
**+ important**  
**o neutral**

AIM fundamental Objectives

	European Industrial Competi- tiveness	Quality of Care and Standards	Efficiency of Care and Economic Aspects
<u>Promising areas for European Health Care Informatics</u>			
<b>Community Care</b>			
Primary Care	+	+	++
Prevention	+	+	++
Home Care	+	+	+
Ambulatory Care	+	+	++
Occupational Med.	o	+	+
Disabled	+	+	+
<b>Care in Institutions</b>			
Hospitals	+	++	++
Departments	+	++	++
Clinical laboratories	+	+	++
Management	+	+	++
<b>Decision support</b>			
Telemedicine	+	+	+
Expert systems	+	+	+
Knowledge bases	++	+	+
Reference tools	++	++	++
<b>Education and Training</b>			
	+	++	++
<b>Medical Research</b>			
	++	+	+
<b>Technical developments</b>			
Medical records	+	++	++
Med. instrum. & robotics	++	++	+
Imaging	++	++	+
Networking	++	++	++
Telecommunication	+	+	++
Medical metalanguage	++	++	++
Multimedial workstation	++	++	o
Multi-language system software	++	++	++

**ANNEXES**

## I. Summary of the report of the Requirements Board/Strategic Review Team

### A. Overviews

*Advanced Informatics in Medicine (AIM)* has attracted great interest from the *informatics* industry, from practical doctors, nurses, managers and other health care professionals and from academic researchers throughout the countries of the European Community. Over 200 consortia were formed to develop project proposals within the AIM framework and 43 consortia were finally invited to participate in the contracted first phase of the programme. This work provides a major focus for developments towards the Single Market in Health Care Services from 1992. Specialists in health care *informatics* are now meeting and collaborating on a regular basis as they address their chosen technical problems with enthusiasm and urgency. This is just the beginning of the work needed to establish effective health information systems and useful health care technology throughout the European Community.

### B. AIM Requirements Board

Towards the end of 1988, the Commission of the European Communities assembled a group of multi-disciplinary specialists to examine urgently and on a wider basis the factors that will influence health care within the European Community during the coming decade and the implications of the development of the Single Market from 1992. It was, also, necessary to explore the basic infra-structure that will be needed to ensure that health care can benefit most effectively from developments in Information and Communication Technologies (ICT).

The overall scenario of health care in Europe is that of an increasingly elderly population for whom more life-saving and life-enhancing services can be provided. The public awareness of these possibilities is increasing and there are correspondingly greater expectations from individuals that such services will in fact be available when they are needed. All these factors lead to an increasing demand for health care services at a time when the pool of individuals available to staff these services and to support them economically is diminishing. Solutions will not become available quickly so there is an urgent need to start tackling these problems before they become overwhelming. The advent of the Single Market offers both the incentive and the spur to gear up the information and communication technology industry for the clearly expressed health care needs of the European Community.

It is known from actors throughout Europe that advanced information systems can help the health care professionals in organising and presenting relevant information as well as in providing assistance with their decision-making. Additionally, it is believed that a more educated and aware population will be able to accept more responsibility for their life-style and the decision-making in respect of their health care. All EC countries are concerned about controlling costs in the health care services and these approaches offer the best hope for achieving a balance between the costs and the benefits of these various services.

### C. European vision of health care

There is a wide variety of ways of organising health care in the European Community and it is not expected that this variety will diminish. However, it is recognised that cost-effective health care is likely to involve a much greater exchange of patients and patient records across Europe than has happened before as the citizens of Europe exercise their rights of movement and work across the European Community. It is envisaged that the arrangements will continue to be General Practitioner oriented with the General Practitioner acting in most countries as the "Gate-Keeper" for Health Services.

The records should be patient centred and linked to allow continuous monitoring of the quality of health care and its relevance. The information systems should support epidemiological studies and the health care evaluation of diagnostic and therapeutic activities. In addition, the planning of health care should be based on episode data collected in different clinical settings. The quality of health care is seen as important European Community's objective.

Within this framework it is the opinion of the Requirements Board that :

- (1) EC citizens should have access to continuous health care throughout the European Community
- (2) Health care records should be transferable, secure and confidential and available where needed
- (3) Patients should "own" their health records, although it is natural that various legal and ethical situations in EC countries should be taken into account
- (4) Patients should have access to educational tools to enable them to understand their health situation and health care
- (5) Patient care should be vertically integrated between Primary Care and Hospital Care
- (6) Networks should provide horizontal integration between health care providers and institutions.

Information technology can provide facilities to enable these requirements to be established.

#### E. European opportunities in health care

The use of computing facilities within health care is increasing as more terminals and computers are installed and linked together, as more powerful systems are devised dealing with the central issues of health care and as the systems become more critical to the delivery of health care. The «industrialized» approach to the delivery of high quality and closely specified health care products and services with lower unit costs and better management together with an effective Single European Market offers opportunities for the European *informatics* industry that can lead to better health care within the European Community and that could have significant effects on its world-wide competitiveness. These objectives require the development of an *Integrated Health Information Environment* with all the security and supporting systems to enable it to be utilized safely.

#### F. "Safety First Principles" for the information infra-structure

As advanced *informatics* systems provide health professionals with more important information for patient care and provide assistance in medical decision-making, it becomes vital that effective steps should be taken to ensure that such systems can be utilized safely. The basic requirements for the European health infra-structure have been identified as the following :

1. **Friendly Environment for Users** to ease the use of the systems and to reduce training needs.
2. **Safe Environment for Users** to ensure that no one is damaged by the operation or non operation of the systems.

3. **Secure Environment for Users** to ensure that information is not lost, corrupted or made available to unauthorized persons.
4. **Legally Satisfactory Environment for System Suppliers** concerning the legal responsibility for the development, marketing, maintenance and use of systems.
5. **Legal Protection of Software Products** to encourage the development and marketing of systems.
6. **Multi-lingual Systems** to avoid errors from inadequate understanding of the local language and to facilitate the spread of systems throughout the European Community.

Detailed technical and legal work is required to develop the technical standards necessary to ensure that systems satisfy these «Safety First Principles».

#### G. The technological bridge to better health care

The full document indicates a wide variety of proposals for developing various areas of information and communication technologies to provide advanced *informatics* systems that can assist in providing better health care in many different areas. These proposals stretch the boundaries of present knowledge both in health care and in *informatics*. They concern the Individual, the Family, the General Practice area, the Hospital District, the Region, the Country and the whole European Community. They deal with problems of accurate data collection, definition, classification and medical language as well as with the creation, storage, exchange and linkage of records for individual patients.

The coding, classification and definition of medical information gives rise to considerable problems of understanding and standardisation that requires special attention if computer systems are to assist reliably in medical decision-making and in the development of improved medical methodologies for treating patients. The opportunities for achieving improved health records, and hence improved health care, using the so-called «Smart Card» for holding transportable, computer-readable records are considerable.

The applications concern the handling of numerical material, text and images and they use pattern recognition, artificial intelligence and evaluation techniques to assist in medical decision-making. The current challenge is to explore advanced techniques and then test, certify and market them for routine use in health care. Such systems will need to be tested just as extensively as the testing required by powerful drugs and they must be just as safe and reliable in use as drugs. The health care services of the future will utilize many «Safety Critical Systems» and the techniques of ensuring safety must be researched and implemented before patients are damaged. The European Community will need effective standardisation procedures to achieve these objectives.

The *AIM Requirements Board* elaborates these proposals for the focus needed to achieve the pre-competitive development of these systems and the infra-structure to ensure their safe employment. The report of the Technical Panels provides a detailed examination of a series of specific tasks on which the next stages of the development of the AIM Programme should be based. The development of a safe organisational and technical infra-structure can give rise to an explosion of valuable techniques and systems supporting the delivery of health care just as the advent of the micro-computer has led to an explosion of valuable techniques and systems supporting the delivery of health care just as the advent of the microcomputer has led to an explosion of practical uses of computing in everyday activities at work and in the home.

## II. Programme Management Audit / Executive Summary<sup>(5)</sup>

### A. The Audit Procedure

It is important in any research and technology development programme that there is regular and effective evaluation.

The Council Decisions covering the Framework Programme and the specific actions under it (including RACE, DRIVE, DELTA and AIM, for which DG XIII/F is responsible) imply a systematic evaluation/review of the performance with respect to strategic and policy objectives, precise technical objectives and programme management.

To address the first two aspects, DG XIII/F organises Strategic and Technical Audits on a regular, yearly basis. The Management Audit that is the subject of this report covers the third aspect; it needs to be done only once in the lifetime of each programme, before the Mid-Term Review, and at a time when most projects are still in their early stages, so that results can be fed back into the operation.

Because of the uniform management approach of DG XIII/F it was possible to hold one common Management Audit addressing all four programmes. The Audit was performed in the period June-September 1989 by a team of independent experts, chosen for their direct experience in the essential programme management operations. It addressed the whole "life-cycle" from workplan preparation through to contract execution.

A set of questions was sent to all project partners and to a selection of representatives of rejected proposals; this written enquiry was supplemented by interviews with project managers and Commission project officers.

### B. The Management Audit Team

Mr. A. Vyverman, ASCENT Consultancy (chairman)  
 Prof. C. Salema, JNICT (vice-chairman)  
 Mr. W. Collin, NCC  
 Prof. L. Donato, CNR  
 Prof. J.-L. Funck-Brentano, Hôpital Necker  
 Mr. H. Giertz, Ericsson  
 Mr. J.J. Jimenez Lidon, Telefonica  
 Mr. A. Lauer, CETUR  
 Prof. W. Lenz, BAST  
 Mr. C. Ouannes, Min. de la Rech. et de la Technologie<sup>(6)</sup>

### C. Results of Programme Management Audit

As a general conclusion, the Audit Team considers the management approach that DG XIII/F applies to RACE, DRIVE, DELTA and AIM to be both original and appropriate; it is highly successful in accomplishing the specific and general objectives set for the programmes; in several aspects it distinguishes itself favourably from what - in the experience of the Auditors - is normally found in comparable programmes and initiatives.

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(5) For full details please refer to the Programme Management Audit.

(6) Participated until 1 September 1989, and withdrew from Audit Team after that date, for personal reasons.

**The overall impression is unequivocally good, even very good. Any remaining difficulties are of a minor nature. The Commission, in particular DG XIII/F, should definitely continue in its application of this approach, taking care to make the necessary improvements and adaptations as the programmes evolve.**

In pronouncing itself on the general appropriateness of the management approach the Audit Team has taken into account not only the precise objectives of each programme, but also - and even mainly - the wider objectives of the Community Framework Programme and of the Communities as a whole, of which these objectives are a part.

**The first conclusion was that the main elements of this approach :**

- workplan preparation in close cooperation with sector actors
- importance given to system engineering aspects
- consensus making through information exchange

**are on the whole well-adapted to the typical objectives and general situation of the programmes, and that any improvements to be made are of a minor nature.**

The system engineering part is considered of prime importance to the extent that without it the whole action of the Community through these programmes would be severely restricted in its effectiveness.

As regards promoting awareness of the programmes with potential proposers, the physical and logistic effort spent by each of the Central Offices is at the limit of what can be done with current staffing levels.

Available data show that a wide and balanced participation in the programmes has been obtained. However, while this goal is certainly very important, the Audit Team is of the opinion that quality of participation should have precedence after all. The way the programmes are prepared and the way the technical evaluation is handled satisfy this requirement.

**On the basis of the information available to it, the Audit Team notes that the programmes are on the whole well-structured and well-managed. Consequently, its general recommendation is for DG XIII/F to continue to apply this approach to the management of RACE, DELTA, DRIVE, AIM and any future programmes of similar nature.**

At the same time, the Team has pointed out a number of detailed issues where improvements can be made, that will enable the programmes as a whole to perform even better in reaching their objectives.

These detailed issues include in particular<sup>(7)</sup>:

- efforts to promote and explain the programmes well-ahead of Calls for Proposals;
- reaffirmation of the evaluation procedures, so as to avoid misunderstandings and disappointment;
- payment of the advance on contract signature;
- cost-effectiveness of Concertation Meetings;
- functioning of the system engineering and consensus formation projects;
- optimum size of consortia
- efforts to disseminate information

(7) A summary of the main recommendations is given below.

On the other hand, it was noted that:

- the preparation of the workplan is successful in achieving a workplan which reflects the priorities of the sector
- the negotiation process was on the whole seen as satisfactory
- there are no major problems with monthly control reports and Technical Audit
- the role of the Project Officer is judged to be well-performed

Main recommendations for improvement

The general recommendation is for DG XIII/F to continue to apply its approach to the management of RACE, DELTA, DRIVE, AIM and any future programmes of similar nature.

The efforts of the Central Offices to inform potential proposers and to promote awareness of the programmes are generally appreciated. There are indications of a positive correlation between proposal acceptance and awareness of the programme during the preparation stage. This suggests that especially in the earlier years of a programme, when the circle of those who are directly involved is necessarily small, more should be done to promote and explain the programme well-ahead of a Call for Proposals.

It is necessary to reaffirm the procedure for evaluations, so as to avoid any possibilities for misunderstanding and disappointment : the procedure as currently practiced should be rigorously maintained, and potential proposers should be made more aware of it.

The procedure of having advance payments is considered a good principle. However, in practice payment delays are a source of problems; the Commission is urged to take the necessary steps to correct this situation. In case the delay remains important the partners' additional cost of financing should be allowable under the contract.

The Concertation Meetings are a very good forum for information exchange and to promote contacts, and their function is an essential element in the execution of the programmes. Because the Concertation Meetings are very expensive (travel costs and time spent away from work), one should do everything to make them more attractive and more interesting. Better prepared Concertation Meetings could be organised less frequently.

The concept of having special projects to take care of system engineering and consensus formation (as concretised in RACE and DRIVE already) is vital. However, the experience gained so far in RACE is that these projects do not perform optimally.

The topic of Information Dissemination is still addressed insufficiently.

One should be careful not to create projects with more partners than are needed to provide the resources required. In general 5 to 6 partners is the practical limit, except for pre-normative and coordination-type projects.

### III. Summary Description of AIM

#### A. The Call for Proposals

Following the Council of Ministers adoption of the AIM Exploratory Action, the Commission of the European Communities issued a Call for Tender for the Advanced Informatics in Medicine Exploratory Action, published in the Official Journal of the European Communities # C284 of 8th November 1988.

Proposals were first evaluated individually on their technical merits, and on the suggested management arrangements. Then, the capacity of bidders to achieve the objectives set in the proposals was judged. Based on these judgements each proposal was classified as acceptable, acceptable with some modification and unsuitable for the AIM Exploratory Action. Then, acceptable proposals were judged in terms of the overall coverage of the workplan and available resources. The result was a list of recommended proposals and a reserve list, to be considered if the necessary funds were available.

The recommendations of the Technical Evaluation were judged by the AIM Management Committee, in terms of their strategic and political implications. This resulted in a final list of 43 proposals to be adopted and funded by the AIM Exploratory Action, representing a CEC investment of 17 million ECUs.

#### B. Evaluation of Proposals

Over a period of two weeks, a panel of 59 international experts representing the leading edge of 'Medical Informatics' in Europe convened in Brussels to review and carry out a technical and managerial evaluation of the 212 proposals that were submitted in response to the call. They recommended that the Commission fund 34 of those proposals and listed another 11 for their high quality and relevance to the field of 'Medical Informatics'. Many other proposals had high scientific merit but could not be funded under the budgetary limits of the Exploratory Action.

A total of 986 European organisations were involved in the proposals, representing the interests of industry, health services and research institutions for the twelve Member States, as well as their links with EFTA countries. Proposals would request an effort of 40 000 man-months and an EC investment of more than 198 million ECUs.

Following the technical and managerial evaluation, the AIM Management Committee conducted a strategic and political evaluation which finally resulted in the approval of 43 projects. These propose to study and develop a range of advanced information and telecommunications technologies to improve the quality and efficiency of Health Care. They address important public health problems such as : cancer, hypertension and cardiovascular diseases, diabetes, renal failure, accidents and emergencies, the problems of the elderly and the handicapped, anemia and psychiatry. They also address important health care management issues : management information systems for in-patient, out-patient and home care, for resource management and health care financing. For dealing with these problems, they suggest applying advanced I&CT, such as integrated broadband communications, knowledge based systems, sensors, picture archiving and communication systems, 3 dimensional imaging and multimedia integration.

Selected projects cover 26 out of 42 specific tasks described in the AIM Workplan. Many of the remaining tasks are partially addressed in different proposals, but some important tasks in areas AL II-4 and AL III-7 of the AIM Workplan have not been addressed. The detailed situation in the different Action Lines of the AIM Workplan is reported in sections 2.1 through 2.7 below.

Despite the small scale of the Exploratory Action, the work to be done is expected to help harmonize European advanced I&CT as tools for Health Care delivering systems, contribute to the European internal market, and increase the competitiveness of European industry in the field.

### C. Description of AIM Projects

#### 1. Development of a Common Conceptual Framework for Cooperation (AL I-1)

The function of the first action line is to establish agreement between the parties concerned on exactly what is meant by important components of medicine and health care in relation with information technology and telecommunications, on what common approach can be adopted, and on how to achieve a balance between technical requirements, social demands and economic constraints. The fundamental point was that the agreement should apply across Europe instead of within each Member State, and to all sectors of Health Care instead of limited classes of "actors".

Consequently the proposals were invited against tasks described under 'Development of a reference model for I&CT applied to Health Care', 'Data requirements analyses for I&CT applied to Health Care', and 'Assessment of the cost-performance potential of I&CT applied to Health Care'.

Four projects are addressing satisfactorily the issues described under Action Line I. One is aimed at assessing the information requirements for medical practice and making available relevant and validated information on medical technologies. Another one investigates case based hospital management and clinical evaluation in Europe. A third project is concerned with integration of primary care, hospital and other users of information systems in health care.

As regards the cost-performance of I&CT applied to health care, one project is developing an assessment framework and identifies the key aspects of benefits and costs along with social, organisational and health service factors.

#### 2. Medical Informatics Environment (AL II-2)

In the context of rapid development of technology and automated information systems, standards are required to enable comparisons and exchange of health information at Community level. Medical data availability and comparability in Europe will allow better understanding of the patterns of evolution of chronic diseases, and optimise use of resources.

The growth of information technology in medicine is now leading to a proliferation of independent systems. Thus, there is a danger of an increasing lack of compatibility between medical information systems that will limit the possibility of large-scale, national or international studies, as well as the possibility of evaluating and comparing the efficiency and quality of care at the European level.

A total of 21 proposals were submitted in this area and addressed the above mentioned issues. The retained proposals are developing results in the following areas :

- **International comparison of diagnoses and procedures related to cost.** Full coverage of the listed objectives and areas of technical approach in the task was achieved.
- **Definition of a MBDS (Minimum Basic Data Set) for ambulatory care in Europe.** Two proposals were overlapping in their objective but were accepted, given the importance of the area as well as the need for new developments and experimentation in Europe.

In the following area no proposals were received :

- **Semi-automatic encoding of standard medical data for classification systems in Europe.**

The selected projects demonstrate a considerable balance of technical soundness, relation to AIM objectives, understanding of the state of the art, management arrangements and capability of the given consortium to deal with the execution and the diffusion of the results of its project.

### 3. Data Structures and Medical Records (AL II-3)

The data necessary to meet the information requirements must be carefully identified if they are to be comparable, consistent, aggregated, interpreted, exchanged and shared. As the data will be processed and stored in computers of different types at different locations, they must be seen within a model which defines their structure. The AIM Exploratory Action considers this a prerequisite for the computerisation of medical records.

Considering the abundance of initiatives in hard- and software development, most of them without any conceptual links to one another, there is a clear need for collecting more complete, reliable and comparable patient data. Only major breakthroughs in the conceptualization and development of the medical record can at the same time enhance the quality of medical care and really open up the market.

The AIM Workplan, therefore, stimulates work at a European level in the development of medical data and process models as a key to progress with information technology in health care. Concertation should be fostered on the common functional specifications and minimum standardisation required for the computerization of medical records.

A total of 32 proposals were received addressing the above mentioned issues. The retained proposals are developing results in the following areas :

- **Clinical data and process modelling.** A considerable number (12) of proposals claimed to cover this workplan task, and four were finally accepted.
- **Case-studies- effects of using medical records on the quality of care.** The largest number of proposals (13) were received in this area but the task coverage was not satisfactory. Only one project (ICSIS) can claim to address this task. This is unfortunate in view of one of the main objectives of AIM, namely "to make available to citizens and health services, at minimum cost and minimum delay, improvements in health care, thereby contributing to social and economic objectives" (Council Decision, 4 November 1988, Article 1, paragraph 2).
- **Medical image and signal interpretation, pattern recognition.** One proposal (AVICA) partly covering this task was accepted.

Some of the proposals received were very ambitious and were submitted by well-known actors in this area, but were starting from scratch without taking note of existing work. It was felt that the tasks could not be completed in the short time scale of the Exploratory Action.

As regards the assessment of the need for, and organisational impact of, patient data cards, all the proposals received tended to carry out experimentations and/or product development and, in most cases, focused on a particular area of health care telematics where the "smart card" was presumed to be a solution. None fully met the objectives set out under this task and the Commission, in compliance with a decision taken by the Management Committee on 27 July 1989 [AMC-8], is to organise a *co-ordinated action* in this domain.

#### 4. Communications and Functional Integration (AL II-4)

The functioning of a hospital is highly information-intensive and has stringent requirements. The information should be available when and where needed, often with no notice or even in real-time. Establishing communications between the range of equipment and information systems will offer considerable savings in terms of cost, and even more importantly in terms of time and flexibility. Within modern health care systems there is a growing need for wide area communication systems.

The projects selected in this domain will investigate the requirements and technology options of hospital information and communication services, standard communication protocols, picture archiving and communication systems (PACS), wide area networks and telemedicine systems, both to assist in medical diagnosis and to contribute to the improvement of health services.

The application of telecommunication in health care offers great opportunities for monitoring and managing patients in remote places (home, primary care sites and small hospitals). The selected AIM projects will study the requirements, opportunities and strategies for telemedicine services and systems. Quality of care reports, cost analysis, recommendations for standards and the assessment of medico-legal implications will be undertaken, and four telemedicine demonstrators implemented.

The projects selected addressing PACS will evaluate the impact of the introduction of these systems in hospitals, define the clinical requirements and analyse the current clinical practice. The development of a second generation of PACS will be supported by the study of standards, data flow structures, networks and human interfaces, along with the identification of technical problems and the evaluation of advanced workstations and mathematical models.

Two projects are being carried out in the area of departmental systems, and more specifically in intensive care units. They will study the medical and technical requirements, produce functional specifications and models of the data structures, processes, human tasks and roles. Prototypes for user interfaces and for the inference and reasoning process will be developed.

In the field of standard protocols the chosen projects will develop standards for clinical laboratory data interchange at three levels : semantic level, syntactic level and layered reference model. Standardization of protocols for the transmission of digital ECG between different systems will also be undertaken, including recommendations for encoding and compression, and models for storage.

### 5. Integration of Knowledge Based Systems into Health Care (AL II-5)

Knowledge based systems and artificial intelligence techniques can accommodate human expertise, provide easy human-computer interaction and support the reasoning and decision making processes. Therefore, they are particularly well suited to cope with the non formal empirical character of part of medical knowledge. Knowledge based systems also constitute an emerging sector for the European information technology industry.

A significant number of proposals dealing with the integration of knowledge based systems into health care were received. This reflects the intense activity in this field in Europe. The selected projects will explore the opportunities of KBS and related technologies in health care and identify the common functional specifications prerequisite for the emergence of a competitive European market in these promising areas.

- **KBS to provide better access to medical information**  
Two projects deal with the application of KBS and natural languages to provide better access to medical information. They will study the use of natural languages, graphics, hypertext and other artificial intelligence techniques to assist the doctors and nurses to access medical records and data bases. The automatic extraction of medical knowledge will also be addressed.
- **KBS applied to image interpretation and diagnosis assistance**  
Selected projects will define the requirements and develop prototypes for the application of KBS to medical image interpretation and diagnosis assistance. One project will analyse the role of image interpretation in current medical practice and define the functional requirements for an intelligent decision support system. The integration of developments in image processing, computer vision and domain knowledge to define a clinically useful image interpretation system will be undertaken by other projects.
- **Medical knowledge representation and reasoning techniques**  
Three projects deal with the definition and realisation of general architectures for medical experts systems, knowledge acquisition, representation and reasoning techniques. Scenarios to envisage the features of a new generation of medical KBSs will be produced. The integration of experts systems with hospital information systems and the clinical evaluation will also be addressed. Small KBSs will be produced to represent diagnosis and treatment of anemia and breast cancer.
- **Tools for medical software development**  
The issue of medical software development is to be addressed. One project will produce the functional specifications for a Software Engineering Environment (SEE) dedicated to medical applications. A prototype will be developed based on the experience achieved with two medical applications (Ward Information System and Ward Image Management Sub-system).

The selected projects provide a good coverage of the application of KBSs in health care. The area of user interfaces is well covered by several projects, even though none of them address specifically the development of a user interface generator. The issue of user interface generator systems could be a topic for future actions.

## 6. Advanced instrumentation, Equipment and Services for Health Care and Medical Research Environment (AL II-6)

In modern health care systems, diagnostics, therapeutics and rehabilitation activities generate a world market for biomedical technologies of about 20 billion ECUS, with an average growth rate of 6 % per year. These technologies, which include diagnostic imaging, clinical laboratory equipment, monitoring and physiopathology devices, therapy devices, artificial organs and prosthetic devices, rehabilitation and aids for impaired persons, make an increasing use of information technology, leading to a rapid move towards integration of instrumentation with imaging techniques, knowledge-based systems, etc.

An important number of proposals (44) were received addressing this fast-developing field. The selected projects will particularly explore the opportunities of integrating instrumentation, monitoring systems, image analysis techniques and other IT-related techniques, and identify the common functional specifications that are required both to address the specific needs of the health care professionals and to promote the emergence of a strong, worldwide competitive industry in Europe.

These projects will address the following areas :

- **Rehabilitation**  
one project has been retained in this area. It will integrate existing instruments to build a knowledge base on movement analysis, and will define protocols for data capture and processing in different clinical situations.
- **Integrated Biomedical Instrumentation**  
Three projects will define the requirements and the functional specifications, and develop prototypes for the application of information technology and knowledge-based systems to medical instrumentation. One project will investigate a new environment for microscope imaging to improve significantly medical practice in pathology laboratories. Another one will support the development of a new generation of knowledge-based, real-time medical monitoring systems. The third one will develop a powerful workstation integrating various biomedical units.
- **Database clinical applications**  
One project concerns a multimedia medical diagnostic assistant which could be used even for education in medical schools taking advantage of satellite transmission facilities.

The selected projects provide a fair coverage of advanced instrumentation, equipment and services for Health Care and medical research environment. The area of integrated biomedical instrumentation is well covered by very promising projects. However, important areas including multidimensional reconstruction and imaging, technology management and biomedical sensors, are not covered at this stage. Also, the issue of rehabilitation is only partly addressed and could remain a topic for future actions.

## 7. Non-technological Factors (AL III-7)

The AIM Exploratory Action is expected to explore the socio-economic impact of advanced health care telematics and to consider the organisational and managerial issues involved in implementing advanced I&CT in the health care sector.

The AIM Workplan considered exploring the opportunities for closer collaboration in Europe, a review of the functional specification, standardisation and certification practices, identifying the requirements of data protection, authentication and security, an assessment of the requirements and options in training health care personnel for using new technologies, a review of the European legal and regulatory framework for applying I&CT to health care, the promotion of awareness and acceptability of AIM and an assessment of the economic potential of advanced I&CT in the sector.

Few proposals addressed these issues and, when they did, many contemplated only part of the required work. To compensate for these gaps different kinds of actions will take place.

The involvement of almost 1000 enterprises in the AIM network and concertation meetings that will be held among AIM projects will ensure the opportunities for a new level of collaboration between the health care community, research centres and industry, also between Member States and EFTA countries.

Two adopted projects address specific issues related with standardisation and quality assurance. More general standardisation issues are being addressed in joint activities with other branches of the Commission Directorate General XIII.

The needs and options for special training, related to the introduction of new technologies in health care, have not been addressed by adopted projects and will be studied by means of a working conference involving the major actors in the field of medical education.

For dealing with the legal and regulatory framework of health care informatics in Europe, another area which was not appropriately addressed by adopted projects, a working conference is already being organised. Also, all adopted projects have been asked to consider in their final reports, the legal and regulatory implications of their work.

No proposer attempted specifically to promote awareness, acceptability and acceptance of health care telematics systems and services. Considering the level of interest which has already been created and the work the Commission already devotes to this activity, it may not be necessary, at this stage, to engage in further efforts.

One successful project will assess the socio-economic potential of health care telematics, as was suggested in the AIM Workplan.

#### D. Programme Management

##### 1. Introduction

The character of the AIM programme as a strategic action with a technical objective, as described in Section 2, puts particular requirements on its management. The management of AIM has been divided into the following aspects.

- Project Management is the responsibility of the prime contractor of each AIM Project. The project manager has to ensure that the project fulfills its objectives within the agreed budget and time frame.
- Programme Management is the responsibility of the European Commission, Directorate XIII/F, AIM Central Office (ACO). Its primary purpose is to ensure that the programme remains on target with regard to the overall objectives and that the funds are spent in the interest of the Community. It is responsible for the interactions with the AIM Management Committee and other official bodies. For this purpose it uses the programme management tools described below.

- Consensus Management is also the responsibility of the AIM Central Office. It ensures that the strategic results from AIM have undergone a consensus and consultation process.

## 2. Concertation Mechanism

All AIM projects are considered to contribute to the objective of AIM, i.e. the "sustained improvement of health care in the Community within economically acceptable limits by exploiting the potential of information technology and telecommunications". Therefore, close collaboration among practically all projects is a prerequisite for success. The Concertation Mechanism provides the framework for such collaboration.

The major constituent part of the Concertation Mechanism is the series of Concertation Meetings which take place at about six weekly intervals and are attended by all AIM projects. The projects are represented by their project manager and one or two key researchers. The meetings last normally two days and are split into plenary and group sessions of variable geometry. Projects report on their findings, and special themes are selected for each meeting in order to maximize synergy.

## 3. Programme Management Tools

Described below are some of the tools used by the AIM Central Office, which are particular to the programmes of DG XIII/F.

### **a) Deliverables Management**

Deliverables from AIM projects are "stepping stones" in the achievement of the AIM objective. They are therefore to be used as inputs to other projects (obviously observing the contractual provisions for confidentiality). A data base recording the planned inter-project flow of deliverables is maintained and published by the ACO.

### **b) Yearly Cycle and Technical Audit**

Like for the other programmes of DG XIII/F, AIM projects follow a synchronized yearly cycle. By October each year, a report is produced by all projects, including a self-assessment of the work performed so far in the year, a detailed plan for the following year and proposals for a revision of the overall project plan. This report is subjected to a Technical Audit, in which all projects are reviewed together in the presence of all auditors. The Audit reports serve as a basis for the ACO's negotiations concerning the detailed plan for the following year and any other adjustment to be made. The detailed plan for the following year is then appended to the existing contract as an addendum.

### **c) Red Flag Procedure**

Difficulties encountered by projects, which cannot be resolved from within the project itself, are communicated to the ACO as part of the monthly report under the "red flag" procedure. The Commission takes then the necessary steps to resolve the problem and lowers the flag. The ACO can also invoke the red flag procedure when any part of the programme appears to be failing to honor its commitments. Red Flags are normally brought to the attention of the Management Committee. In this case, as foreseen in the contract, the project concerned may be subject to detailed technical and/or financial audit.

#### IV. Summaries for Projects

**A1023 ADAM** [ADvanced Architecture in Medicine] is a project that is set up to develop information technology for Primary Health Care and General Practice. It aims at creating an information environment to support general practitioners and at integrating it with other parts of the health system, namely public health services and hospitals. Requirements will be defined, a general architecture will be designed, and specific tools for clinical database management, for systems integration and security will be created. The project is led by Prisma Informatica S.p.A. (I) and involves seven other partners from the Federal Republic of Germany, Greece (2), Italy (2), the Netherlands, Portugal, and the United Kingdom.

**A1018 AEMI** [Advanced Environment for Medical image Interpretation] will define the requirements for, and assess the feasibility of a cooperative knowledge based medical image interpretation environment. The project will analyse the role of image interpretation in current medical practice, define the functional requirements for an intelligent decision-support system, and develop a formalism for human-computer communication. The consortium is led by the Medical School, University of Manchester (UK), and includes five other partners from France (2), Germany, and Italy (2).

**A1041 AIDMED** [Assistant for Interacting with Multimedia Medical Databases] is to provide an easy-to-use, knowledge-based interface to medical databases, and an easy method of accessing and merging heterogeneous information sources. An architecture for a system meeting these goals will be defined, and a prototype will be built and evaluated. The project is led by University of Leeds Industrial Services Ltd. (UK), and has also two other partners from the United Kingdom and Spain.

**A1016 ASSIST** [ASSESSment of Information Systems and Technologies in medicine] develops a framework for assessing information systems and technologies in Medicine, taking as material projects in the exploratory phase of AIM itself. A plan for the assessment of completed projects will be produced. The Centre for Health Economics at University of York (UK) leads the team, which includes four other members from France, Denmark, Sweden and Finland, and draws on contacts from most EEC states.

**A1001 AVICA** [Advanced Video endoscopy Image Communication and Analysis] is to investigate the feasibility of introducing image analysis techniques for macroscopic images issued from instruments such as endoscopes, colposcopes, etc. in the current medical practice. Deliverables will include reports, specifications (demonstrator functional requirements, demonstrator evaluation protocol) and one prototype (demonstrator for numerical videoendoscopy). The consortium is led by Alcatel-TITN (F), and includes four other partners from Germany, Belgium (2) and France.

**A1027 BIOLAB** [an integrated BIOMedical LABoratory] aims at an IBL concept constructed around a powerful workstation which integrates various biomedical units. In this phase specifications of the workstation architecture, of a uniform message protocol, and of an automated histology machine will be produced as well as evaluations of parallel hardware for medical image understanding and of a classifier for general medical diagnosis using Neural Nets. OI Pliroforiki Ltd. (GR), leads the consortium that further comprises partners from Germany, Belgium and the United Kingdom (2).

**A1022 CACOHIS** [Computer Aided Community Oral Health Information System] attempts to create an information environment in a public health setting, specifically in Oral Health. It will deal with the problems of data format, data capture from mobile workstations, data analysis and presentation, utilization of data for training and organisational development. The appropriateness and acceptability of a prototype of information system will be assessed. The project is led by the Mid-Western Health Board (IRL) and involves three other partners from France, Ireland and the United Kingdom.

**A1028 CAMAC** [Case based hospital Management and Clinical evaluation] is a project in the area of information systems that links clinical care to health care management. It will identify the requirements for collection, coding and classification of hospital activity and cost data, as well as specifications for prototype modules, to measure the hospital case-mix and costs based on case-mix. The results of this project will cross-fertilize with those of HOSCOM. The Project is led by SANESCO S.A. (France), and includes eight other partners from France (2), the Netherlands, the United Kingdom (2), Ireland, Norway and Sweden.

**A1012 CAMARC** [Computer Aided Movement Analysis in a Rehabilitation Context] is the only AIM Exploratory Action project in the area of rehabilitation. It studies movement analysis, trying to integrate existing instruments, to build a Knowledge Base on movement analysis, and to define protocols for data capturing and processing in different clinical situations. The project will produce specifications, technical and normative reports, and hardware and software prototypes. The consortium is led by the University of Ancona (I), and includes eight other partners from France, Italy (4), the Netherlands and the United Kingdom (2).

**A1026 CHIC** [Community Health Information Classification and coding] intends to develop a European minimum basic data set (MBDS) defining all the data items which are relevant to the management of health services outside the acute hospital environment. The overall strategy is to build on a preliminary MBDS developed in the United Kingdom, and to validate it primarily in the United Kingdom, France, Germany and Belgium via a survey of its acceptability. The project will produce specification of an MBDS for non-institutional care (in English, French, German and Dutch) and reports (on the results of the survey, on linking MBDS to cost determinants, on proceedings of a final workshop). The consortium is led by STC Technology Limited (UK), and includes four other partners from the United Kingdom, Belgium, Germany and France.

**A1011 COVIRA** [Computer Vision in Radiography] will specify system hardware and software for the interpretation of cranial magnetic resonance images suitable for applications in diagnostic radiology, stereotactic neurosurgery and radiation therapy planning. Deliverables will include specification reports (of clinical requirements for computer vision systems in radiology and of a complete computer vision system for radiological data sets), a prototype demonstrator, tools for computer assistance, and reports. The project is headed by Philips Medizin Systeme (D), with partners from the United Kingdom, Italy, Germany and Spain.

**A1010 EPIAIM** [A Knowledge Based System for Epidemiology] is a project to design an integrated environment for the management of an epidemiological study, from study planning to statistical analysis. The project will draw the conceptual framework, describe the requirements, and create the tools for knowledge acquisition and representation in epidemiology. A demonstrator prototype will be produced and its applicability in medical education will be assessed. The Project is led by Enidata S.p.A. (I) and involves five other partners from Greece, Spain, and Italy (3).

**A1033 EUCLIDES** [A European Standard for Clinical Laboratory Data Exchange between Independent Information Systems] involves a great number of prominent laboratories and systems houses in eight different countries in an effort to define standards for Laboratory Specific Information exchanges for requests, results and otherwise. Standards will be defined on three levels : semantics; syntax; and a layered reference model. The project includes the coordination with other standardisation efforts, tests of the models, and the promotion of the results. The consortium is led by the University of Gent, with twelve other partners from Belgium (6), France, Ireland, Greece, Italy, the United Kingdom and Norway.

**A1019 EURODIABETA** [Modelling and Implementation of Information Systems for Chronic Health Care] will develop a model of chronic disease management and build a European consensus. The project will demonstrate through paradigm of a representative widespread chronic disease such as diabetes that architecture for a standard Europe-wide health care decision support system based on Information Technology is a realistic prospect. The consortium is led by St. Thomas' Hospital, University of London (UK), and includes fifteen other partners from Germany (4), the United Kingdom (5), Denmark (2), Spain, Greece, France and Italy.

**A1038 FEIP** [Front-End for echographic Image Processing] will in the exploratory phase be devoted to the functional specifications and the implementation of the hardware for data acquisition of radio frequency, echosignals and pre-processing of these data. Also software for this will be specified. The consortium is led by Nijmegen University Hospital and Medical School (NL) and includes one other partner from France.

**A1005 GAMES** [General Architecture for Medical Expert Systems] will study the problems involved in representing complex medical knowledge and reasoning processes, for use in building Knowledge Based Systems (KBSs). Small KBSs will be produced, to represent diagnosis and treatment of anemia and breast cancer. Also, paper and pencil scenarios will be produced to envisage the features of a new generation of medical KBSs. The consortium is led by ENIDATA (Italy), and includes eight other partners from Spain, Greece (2), Italy, the United Kingdom (2), France and Finland.

**A1035 HEALTHBENCH** [HEALTH information and decision support workBENCH] develops the concept of an Integrated Health Information and Decision Support Workbench which would provide a framework for tools and facilities to assist the implementation and operation of health computing applications. The project will define the basic requirements, model the most general objects in the medical universe, design a general architecture of the workbench and finally implement specific software prototypes in order to test the feasibility of the system. This is a project led by INESC (P), with four other partners from the United Kingdom, the Netherlands, Portugal and Spain.

**A1004 HELIOS** [Hospital Environment Language within an Information Object System] will define the functional specifications of a Software Engineering Environment (SEE) dedicated to medical applications software. The project will take into account recent developments in the domains of data representation and manipulation. It will define the functional specifications of two main medical applications (Ward Information System and Image Based Medical Subsystem) as a case study for the specifications and development of the SEE prototype. The consortium is led by Cap Sesa Innovation (F) and includes three other partners from France, Germany and Switzerland.

**A1008 HIPACS** [Hospital Integrated Picture Archiving and Communications System] aims at the modular conception of an experimental knowledge-based medical information management and distribution system. General objectives include PACS/HIS/RIS flow composition, integration PACS/HIS, medical image communication, adaptive user interfaces, requirements for multimedia databases, and image indexing by content. Deliverables will include various reports, specifications, and a data model. The project is led by PRIMIS from Belgium, with seven other partners from the United Kingdom, Germany (3), the Netherlands, Greece and Belgium.

**A1007 HOME** [Highly Optimized Microscope Environment] will provide the pathologists with the necessary tools to permit both the actual use of cell and tissue image processing in daily routine work and the integration of the microscopes in a network compatible with the informatics infrastructure of the pathology laboratories. The project will produce reports, specifications of HOME interfacing functionalities, three functional prototypes with their detailed user guides, and a documented software for public usage. The consortium is led by Laboratoire TIM3 at University of Grenoble (France), and includes seven other partners from the Netherlands (2), the United Kingdom (2), Italy, France and Germany.

**A1013 HOSCOM** [HOSPital COMparisons : medical and financial data] is one of two projects (the other being CAMAC) in the area of development of a European model in case based comparisons and case-mix management in hospitals. Taking into account the differences in Health Care systems in the Community, it will aim at designing a uniform reference model for medical data including severity of cases as well as for resources and costs data related to hospital inpatients stays. This model will be tested through hospital comparisons between countries. Coordination with CAMAC will be ensured to minimize duplication and optimise output. The consortium is led by the UCL, Centre d'Informatique Médicale (B), and includes six other partners from the Netherlands, the United Kingdom, Denmark, Germany, Spain, and Italy.

**A1025 ICSIC** [Integrated Communication System for Intensive Care] will define a common framework for Intensive care computer systems considered as a communication and coordination tool for the medical and nursing activities. The project will model the data structures, processes, human tasks and roles, will study the problem of user interfaces regarded as the interface of a system with a team of different users with different roles, and will design a common computer input and output language. Prototypes will be developed and implemented in different intensive care units in four hospitals in three EEC countries, as local computer networks, connected to the hospital information system. The consortium is led by Drägerwerk (D) and includes seven other partners from Belgium (2), France (3) and Germany (2).

**A1029 INFORM** [INFORMation management and decision support in high dependency environments] will contribute to solve the problem of the "data overload" that arises with critically-ill patients in intensive care units, coronary care units, etc. A conceptual model of hospital high dependency environments (HDE), the development of an architecture using KBS methodology, and the prospects of the most advanced monitoring equipment will lead to functional requirements for a system, in which the decision support is based on a layered structure. This phase will be concluded by the collection of the information requirements for the ICU and a functional specification. Kontron Instruments Ltd. (UK) leads the consortium, in which research institutes in the United Kingdom (3), France, Italy, Sweden, and Finland take part. Medical specialists of six different countries form a clinical review board.

**A1014 IRHIS** [an Intelligent adaptive information Retrieval system as Hospital Information System front-end] explores a solution to the problem of overload of medical information, using techniques of graphics, hypertext and artificial intelligence, taking the example of Haemato-Oncology. The consortium is led by BIM S.A., a software company from Belgium, with six other partners from the United Kingdom (2), France (2), the Netherlands and Greece.

**A1021 KAVAS** [Knowledge Acquisition, Visualization and Assessment Study] is carried out by a group of experts which had scientific contacts before. The project focuses on the definition of a knowledge acquisition tool for the development of correct, valid and transferable medical decision support systems. The ultimate goal is to develop a system based on knowledge engineering and machine learning techniques with methodologies for validation. Computer Resources International A/S at Birkerød (DK) leads the consortium, which includes partners from Greece, Denmark, the United Kingdom, the Netherlands, Ireland and Finland.

**A1006 KISS** [Knowledge-based Interactive Signal monitoring System] aims at producing a framework to support the development of a new generation of knowledge-based, real-time medical monitoring systems. The project will need to integrate a number of disciplines such as medical monitoring systems, coronary care unit monitoring, knowledge representation and reasoning, architecture modelling, intelligent workstation, and user interface modelling. It will produce reports, specification of a reference model and of the validation environment, and a prototype environment simulating a coronary care unit. The consortium is led by Volmac (the Netherlands), and includes four other partners from France, Italy (2), the United Kingdom and Portugal.

**A1042 LEMMA** [Methods and Architectures for Logic Engineering in Medicine] will develop an architecture for medical knowledge based systems. The consortium will develop a PC version of a system kernel consisting of the Oxford System of Medicine, a patient record system and a medical reference book (Oxford textbook of Medicine). The kernel will be posted to an institution in another country to investigate its usefulness in another language and a particular medical environment. The project also includes studies of very large knowledge bases used in the system, possibilities of a "language-neutral" kernel and "deep" reasoning. The consortium consists of partners from the United Kingdom, Portugal and France, and is led by the Imperial Cancer Research Fund (UK).

**A1017 MASQUES** [Medical Applications Software Quality Enhancement by Standards]. This is one of the AIM projects on pre-standardization. Its objective is to develop a proposal for Medical Software Quality Assurance Standard (SQA) to be submitted to the standardization bodies. The project will draw on generic work in SQA (ISO 900 series, ESPRIT results, etc.) and will investigate the specificities of medical software applications. This will be done by setting up a hospital and clinic club and a series of workshops. The project will produce a Draft Software "Process" Quality Standard, a Planning Study Report on Software "Product" Quality Assurance and a Health Community Requirements Report. The consortium is led by Brameur Ltd. (UK) and includes five other partners from the United Kingdom, France, Germany, Greece and Spain.

**A1009 McACE** [Measurement, Characterisation and control of Ambulatory Care in Europe] sets out to develop harmonised mechanisms to handle ambulatory care provision, and makes recommendations for their implementation in Europe. The project is to provide a set of concepts and models as a framework for the definition of a European minimum basic data set for ambulatory care, and for proposing a suitable model for such an MBDS. MARI Applied Technologies Ltd. from the United Kingdom leads a team which includes five other partners from the United Kingdom, Spain, and the Netherlands (3).

**A1037 MEDICA** [The Multimedial Medical Diagnostic Assistant] will be a core tool for artificially intelligent multimedial diagnostic support. As the initial part the actual project in the AIM Exploratory Action will develop a set of working criteria for such data bases in neuro-psychiatry based among other tools on interactive video and satellite communication. The prime contractor is the Audio-Visual Centre of the University of East Anglia at Norwich (UK). The consortium, which shows a multidisciplinary composition, includes partners from the Netherlands, the United Kingdom (2) and Sweden. Relations are established with clinical departments and laboratories in six different countries which form a receiver and evaluation group.

**A1036 MIMI** [Medical workstation for intelligent Interactive acquisition and analysis of digital Medical Images] will conduct investigations related to the requirements of a workstation which will be used in the 'medical imaging environment'. MIMI will report on present practices in Hospitals and Digital Image Formats, study the interaction of the Image and the Diagnostic Process and, in collaboration with two other PACS projects, specify the functional requirements for a central workstation for specific organ studies. The consortium is led by Federated Dublin Voluntary Hospitals from Ireland, and includes two other partners from Ireland and the United Kingdom.

**A1040 MMOMS** [Multi-Modal Organ Modelling System] aims to produce the user requirements for a clinically useful organ modelling system. It will start with a study of a model of the brain, to indicate the problems that are likely to be encountered with a model, and to provide an insight into the viability of producing knowledge-based organ models. The project, which is led by GSF-Medis-Institut (D), also includes partners from Federal Republic of Germany (4) and the United Kingdom.

**A1039 MURIM** [MULTidimensional Reconstruction and Imaging in Medicine] is a feasibility study aimed at proposing a framework and guidelines for a fully integrated computer-assisted analysis and intervention environment, based on multi-dimensional imaging (i.e. image data visualization and analysis) and knowledge information from different modalities. The state of the art in each relevant area will be appraised, and the research programme necessary to establish a European implementation will be identified, together with the centres of excellence within the Community that are best placed to undertake this work. The project, which includes thirteen partners led by the University of Amsterdam (NL), is managed by a "Board of Three", chaired by the prime contractor.

**A1003 NLPAD** [Natural Language Processing of PATient Discharge summaries] deals with the application of KBSs in Medicine and human-computer interfaces. This project will apply KBSs and natural languages to provide better access to medical information. Two prototypes will be developed. The first one will perform an intelligent automatic extraction of data from the patient discharge summaries and will store them in a database. These data could afterwards be accessed and retrieved using natural language with the second prototype. The medical domain selected for the project is oncology. The project results will include a report on information and knowledge needs, models for the extraction and retrieval modules and the two prototypes. The consortium is led by BIM S.A./N.V. (B) and includes another partner from France.

**A1002 OAR** [specification of an Open Architecture for Reasoning] will specify and define knowledge representation schemata, and construct a prototype query generator for literature retrieval. The types of relations and reasoning which are needed to support storage and retrieval of medical documents will be investigated. Evaluation will be done with real medical knowledge, real patient record, and real medical literature. The consortium is led by Academisch Ziekenhuis Groningen (NL), and includes two other partners from the Netherlands and the United Kingdom.

**A1030 PACS IMACS** [Operational Evaluation and Basic Requirements for prospective evolution of PACS technology] will evaluate the impact of the introduction of PACS systems in hospitals. The project will produce a taxonomy of users, equipment and services involved in PACS, assess the impact of PACS including organisation, cost-effectiveness and confidentiality aspects, and undertake a clinical evaluation of PACS. The project will also evaluate some advanced workstations and mathematical methods to improve image quality and investigate the interfaces, data formats and protocols to integrate PACS in the hospital information systems. The consortium is led by Philips Sistemi Medicali (Italy) and includes nine other partners from Italy (4), Belgium, Germany, France and Spain (2).

**A1043 PRECISE** [PProspects for Extra-mural and Clinical Information Systems Environment] is a merger of three proposed projects concerning medical workstations for :

1. the integration of patient care, departmental management and medical research,
2. nursing and primary care.

The project will result in requirements and specifications for the environment in which systems in medicine and health care have to be embedded and will be carried out as three closely coordinated studies. The consortium, which includes three partners from Federal Republic of Germany and the Netherlands (2), is led by GSF-Medis-Institut (D).

**A1034 QAMS** [Quality Assurance of Medical Software] is a project to outline general proposals and procedures for quality assurance of medical software. It will deal with general approaches to software standards, analysis of needs, surveys of software standardisation and planning study, including seminars with medical practitioners. The user requirements will be defined for quality assurance standards in the fields of nuclear medicine, anaesthesia, intensive care, clinical physiology, neurophysiology and cardiology. Relations will be established to other projects in this area and to standardisation agencies, like CEN and CENELEC. The project is led by St. Bartholomew's Hospital & Medical College in London (UK) with four other partners from Germany (2), the United Kingdom and Finland.

**A1024 QUIRT** [real time imaging and QUality control In Radiation Therapy] is a project undertaken by four members of the EORTC Radiotherapy Cooperative Group : the Netherlands Cancer Institute in Amsterdam (NL) as prime contractor, the University of Leuven (B), the Centre Georges-François-Leclerc at Dijon (F), and the Radiological Institute at Florence (I). This group is supported by Varian TEM Ltd. (UK). The project will develop an on-line areal dosimeter and start development of a real time imaging device; design software (sophisticated image processing and pattern recognition software) to obtain a method for the quantification of treatment errors; carry out field tests in the four institutes, collect and analyze the results.

**A1015 SCP-ECG** [Standard Communications Protocol for Computerised Electrocardiography] is a continuation of projects on ECG standards supported by other CEC programmes. Three developments for digital ECG data will be undertaken : a universal protocol for two-way digital ECG data transmission and communication between heterogeneous ECG computer systems; recommendations for digital ECG data encoding and compression; and a conceptual reference model for digital ECG data storing. The consortium is led by the Katholieke Universiteit Leuven (B) and includes five other partners from Germany, France, the United Kingdom, the Netherlands and Italy.

**A1031 SESAME** [Standardization in Europe on Semantical Aspects of Medicine] is to establish a procedure for the standardization of medical terminology at the European level. This will be done by the creation of a European Committee for standardization of medical terminology, with representatives of the national bodies working in this field. The identification of the appropriate representatives and the willingness to co-operate at the European level will be key issues. The proposed starting work for this Committee will be the harmonization of classification systems for primary health care, medical procedures and drugs. This project will also evaluate existing classification systems, and propose common structures and mapping between the different systems. The consortium is led by Nationale Raad voor de Volksgezondheid (NL) and includes six other partners from the United Kingdom (2), the Netherlands, Germany, Spain and Italy.

**A1032 TELEMEDICINE** [TELEMEDICINE requirements, standards and applicability to remote care scenarios in Europe] will study the medical and technical aspects of telemedicine applications for the monitoring and management of patients in remote places (home, primary care sites, small hospitals). The project will produce a report on requirements opportunities and strategies for telemedicine, a quality of care and cost analysis, recommendations for standards and an assessment of the medico-legal implications. Four telemedicine demonstrators will be produced in the domains of renal dialysis, antenatal care, geriatric/EEG care and blood pressure. The consortium is led by Telefonica Sistemas S.A. (E) and includes ten other partners from the United Kingdom (3), Italy (2), Germany, Ireland, Portugal, Spain and Greece.

**A1020 VALIDATA** [Validated database for prescribers] also addresses the problem of the use made by doctors of available information, by examining ways in which new technologies could make it pertinent, valid and cost-effective. The outcome is to be a proposal for a series of procedures that could become the backbone of an independent system for collecting, selecting, reviewing, and disseminating to prescribers validated information on medical technologies, taking into account problems like independence, liability, audit, financing, etc. The leading partner is *Association pour la Promotion et la Réalisation des Essais Thérapeutiques* (A.P.R.E.T.) from France, with five other partners from Belgium, the Netherlands, Italy, Germany and France.

## V. Glossary

### Classification Systems

These systems are developed to order objects in classes on the basis of their relations. Identification of an object requires its allocation to the correct class.

A *concept* is any unit of thought; a *term* is a word which designates a concept. Consequently, a classification is the arrangement of concepts into groups or classes, according to established criteria. All the criteria or characteristics of a concept form its intension. The totality of objects that have the characteristics of the concept is the extension.

It is important to distinguish a *nomenclature* - the set of terms belonging to the professional "jargon" - from a *classification* and from a *terminology*, which is based on the definition (inclusion criteria) of each term.

A *thesaurus* is a storehouse of knowledge like an exhaustive encyclopedia or a computer-tape with a large index and synonyms.

*Patient classification schemes* include Diagnosis Related Groups (DRGs), Patient Management Categories, the Severity of Illness Index, the Computerized Severity of Illness Index, Disease Staging, the Medical Illness Severity Grouping System (Medisgrps), Acute Physiology and Chronic Health Evaluation (APACHE), the Commission on Professional and Hospital Activities' (CPHA) Body Systems Approach, and the International Classification of Diseases, 9th revision Clinical Modification (ICD-9-CM).

### Cost-benefit analysis

An economic analysis in which the costs of medical care and the loss of net earnings due to death or disability are considered. The general rule for allocation of funds in a cost-benefit analysis is that the ratio of marginal benefit (the benefit of preventing an additional case) should be equal to or greater than 1.

### Cost-effectiveness analysis

This form of analysis seeks to determine the costs and effectiveness of an activity, or to compare similar alternative activities to determine the relative degree to which they will obtain the desired objectives or outcomes. The preferred action or alternative is one that requires the least cost to produce a given level of effectiveness, or provides the greatest effectiveness for a given level of cost. In the Health Care field, outcomes are measured in terms of health status.

### Cost-utility analysis

An economic analysis in which outcomes are measured in terms of their social value.

### Effectiveness

The extent to which a specific intervention, procedure, regimen, or service, when deployed in the field, does what it is intended to do for a defined population.

Efficacy

The extent to which a specific intervention, procedure, regimen or service produces a beneficial result under ideal conditions. Ideally, the determination of efficacy is based on the results of a randomized controlled trial.

Efficiency

The effects or end-results achieved in relation to the effort expended in terms of money, resources, and time. The extent to which the resources used to provide a specific intervention, procedure, regimen or service of known efficacy and effectiveness are minimized. A measure of the economy (or cost in resources) with which a procedure of known efficacy and effectiveness is carried out.

Health Technology

The drugs, devices, and medical and surgical procedures used in medical care, and the organisational and supportive systems within which such care is provided.

Hospital Information System

A hospital information system (HIS) is the collection of application systems around a central data base - a patient index. The HIS should be highly conversational and aimed at high availability.

Integrated Health Information Environment

"Integrated" not only means "integrated services" (at the user level and at the appropriate network levels), it also points to "integrity" of the whole network, and therefore to the proper interworking of all its essential constituents.

Integration includes :

- data integration : data are being recorded once and thereafter used by many authorised users for many purposes;
- functional integration : authorised users have the flexibility to go from one function to another;
- technological integration : the users have access to late generation tools and data-nets in order to utilize the system facilities in a conversational mode and at the time needed.

Minimum Basic Data Set

The minimum basic data set (MBDS) is that minimum array of items having the greatest range of uses which should be available in any information system.

Quality

The quality of health care is the extent to which care provided achieves the most favourable balance between risks and benefits.

Norms are established by the professionals involved in a given activity, according to a set of accepted criteria and standards (thresholds).

Norms are set up for structures (facilities, organisation, manpower), processes (Health Care activities : diagnosis, treatment, nursing care, rehabilitation, etc.) and outcomes (patient satisfaction, patient final health status, complications of health care activities, etc.).

#### Quality Assessment

Quality Assessment is the act of detecting and measuring the difference between efficacy and effectiveness that can be attributed to care, including variations across regions and peoples. In practical terms, it is the measurement of the technical and interpersonal aspects of Medical Care.

#### Quality Assurance

This is the formal and systematic exercise of identifying problems in Medical Care delivery, designing activities to overcome the problems, and carrying out follow-up steps to ensure that no new problems have been introduced and that corrective actions have been effective. The ultimate objective is to improve the outcome of all health care in terms of health, functional ability, patient wellbeing and consumer satisfaction.

#### Quality of Medical Care

Quality of Medical Care is that component of the difference between efficacy and effectiveness that can be attributed to care providers, taking into account the environment in which they work.

## **VI. References**

**Council Decision of 4 November 1988 on an exploratory action in the field of information technology and telecommunications applied to health care - Advanced Informatics in Medicine (AIM), ref. : 88/577/EEC**

**Report of the Requirements Board ref. : XIII/F/AI0459, October 1989**

**Report of the Medical Informatics Review (MIR) Group ref. : XIII/F/AI0782, November 1989**

**Report of Operation 1992 (AIM extension) "Rationale for Action and European Cooperation in RD&T", ref. : XIII/F/AI0402, 1 July 1989**

**Technical Report "AIM '89", ref. : XIII/F/AI0497, October 1989**

**Report on the State of Science and Technology in Europe, COM(88) 647**

**Impact Assessment and Forecast of IT&T applied to health care, DG XIII/F, ref. : AI200B, February 1989**

**Management Audit of the programmes RACE, DRIVE, DELTA and AIM, ref. : XIII/F/GE0181**

**AIM Workplan, ref. : AIM 100, 24 October 1988**

**Briefing Package for the submission of proposals**

**AIM Workshops Proceedings, 23-27 November 1987**

**VII. Listing of Projects****Projects ordered by PROJECT Number**

<b>Proj. No</b>	<b>Title</b>
A1001	AVICA - Advanced Video Endoscopy Image Communication and Analysis
A1002	OAR - Specification of an Open Architecture for Reasoning
A1003	NLPAD - Natural Language Processing of Patient Discharge Summaries
A1004	HELIOS - Hospital Environment Language within an Information Object System
A1005	GAMES - A General Architecture for Medical Expert Systems
A1006	KISS - Knowledge Based Interactive Signal Monitoring System
A1007	HOME - Highly Optimized Microscope Environment
A1008	HIPACS - Hospital Integrated Picture Archiving and Communication System
A1009	McACE - Measurement Characterization and Control of Ambulatory Care in Europe
A1010	EPIAIM - A Knowledge Based System for Epidemiology
A1011	COVIRA - Computer Vision in Radiology
A1012	CAMARC - Computer Aided Movement Analysis in a Rehabilitation Context
A1013	HOSCOM - Hospital Comparisons : Medical and Financial Data
A1014	IRHIS - An Intelligent Adaptive Information Retrieval System as Hospital Information System Front End
A1015	SCP-ECG - Standard Communications Protocol for Computerized Electrocardiography
A1016	ASSIST - Assessment of Information Systems and Technologies in Medicine
A1017	MASQUES - Medical Application Software Quality Enhancement by Standards
A1018	AEMI - Advanced Environment for Medical Image Interpretation
A1019	EURODIABETA - Modelling and Implementation of Information Systems for Chronic Health Care / Example : Diabetes
A1020	VALIDATA - Validated Data Bank and Dissemination for Prescribers
A1021	KAVAS - A Knowledge Acquisition Visualization and Assessment Study
A1022	CACOHIS - Computer Aided Community Oral Health Information System
A1023	ADAM - Advanced Architecture in Medicine
A1024	QUIRT - Real Time Imaging and Quality Control in Radiation Therapy
A1025	ICSIC - Integrated Communication System for Intensive Care
A1026	CHIC - Community Health Information Classification and Coding
A1027	BIOLAB - An Integrated Biomedical Laboratory
A1028	CAMAC - Case Based Hospital Management and Clinical Evaluation in Europe
A1029	INFORM - Information Management and Decision Support in High Dependency Environments

- A1030 PACS IMACS - Operational Evaluation and Basic Requirements for Prospective Evolution of PACS Technology
- A1031 SESAME - Standardization in Europe on Semantical Aspects in Medicine
- A1032 TELEMEDICINE - Telemedicine Requirements Standards and Applicability to Remote Care Scenarios in Europe
- A1033 EUCLIDES - A European Standard for Clinical Laboratory Data Exchange between Independent Information Systems
- A1034 QAMS - Quality Assurance of Medical Standards
- A1035 HEALTHBENCH - Health Information and Decision Support Workbench
- A1036 MIMI - Medical Workstation for Intelligent Interactive Acquisition and Analysis of Digital Medical Images
- A1037 MEDICA - Multimedial Medical Diagnostic Assistant
- A1038 FEIP - Front-end for Echographic Image Processing
- A1039 MURIM - Multi-dimensional Reconstruction and Imaging in Medicine
- A1040 MMOMS - Multi-Modal Organ Modelling System
- A1041 AIDMED - Assistant for Interacting with Multimedia Medical Databases
- A1042 LEMMA - Methods and Architectures for Logic Engineering in Medicine
- A1043 PRECISE - Prospects for Extra-mural and Clinical Information Systems Environment

VIII. Listing of organisations by country**AIM projects<sup>(8)</sup>****Belgique - Belgie - Belgium**

Advanced Medical Information Management (A1033)  
 BIM S.A. (A1003)  
 BIM S.A., Research & Development (A1014)  
 Clinique Saint-Pierre - Unité de Soins Intensifs (A1025)  
 Datasoft Management C.V. (A1033)  
 Health Data Management Partners S.A. (A1033)  
 Heymans Institute of Pharmacology and Therapeutics, University of Gent - Medical School (A1020)  
 Institut Jules Bordet (A1001)  
 Katholieke Universiteit van Leuven - Div. Medical Informatics (A1015)  
 Katholieke Universiteit van Leuven - Universitaire Ziekenhuizen (A1024)  
 Medical Information Computerized Systems S.C. (A1033)  
 Rijksuniversiteit Gent - Dept. of Medical Informatics (A1033)  
 Staff S.A. (A1025)  
 Université Catholique de Louvain - Socio-Economie de la Santé (A1026)  
 Université Catholique de Louvain - Cliniques Universitaires Saint-Luc - Centre d'Information Médicale (A1013)  
 Université Libre de Bruxelles - Laboratoire d'Histologie (A1001)  
 Université Libre de Bruxelles - Hôpital Erasme (A1030)  
 Vrije Universiteit Brussel - Pluridisciplinary Research Institute for Medical Imaging Sciences (A1008)  
 Vrije Universiteit Brussel - Academisch Ziekenhuis (A1008, A1033)  
 Vrije Universiteit Brussel - ETRO Dept. - IRIS Unit (A1027)  
 Vrije Universiteit Brussel - INFO TW (A1033)

**Danmark - Denmark**

Computer Resources International A/S (A1021)  
 Danish Hospital Institute - Health Economics, Copenhagen (A1013)  
 Danish Hospital Institute - Technology for Health Care, Copenhagen (A1016)  
 Københavns Kommunes Hvidovre Hospital (A1021)  
 Judex Data Systemer A/S, Aalborg (A1019)  
 Nordjysk Udviklingscenter (NUC), Aalborg (A1019)

**Deutschland - Federal Republic of Germany**

Allgemeines Krankenhaus Altona (A1025)  
 Böhringer Mannheim G.m.b.H. (A1019)  
 Bull AG, Köln (A1040)  
 Deutsches Krebsforschungszentrum, Medizinische & Biologische Informatik (A1004)  
 Drägerwerk AG (A1025)  
 Georg-August-Universität Göttingen - Abt. Med. Informatik (A1031)

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(8) Projects numbers are given in brackets after each organisation title.

Gesellschaft zur Foerderung der Forschung an der Deutschen Klinik für Diagnostik,  
 Wiesbaden (A1040)  
 GSF - Inst. für Medizinische Informatik & Systemforschung (A1018)  
 GSF - Dept. of Institut für Medizinische Informatik und Systemforschung Medis  
 (A1023)  
 GSF - Medis Institut (A1019, A1040, A1043)  
 Hewlett Packard Company, Böblingen (A1030)  
 Institute für Med. Informationsverarbeitung, Biometrie und Epidemiologie,  
 München (A1020)  
 Klinikum der Johannes Gutenberg Universität (A1025)  
 Klinikum Bogenhausen, München (A1019)  
 Klinikum der Universität Giessen - Institut für Anatomie und Zytobiologie (A1039)  
 Ludwig-Maximilians-Universität - Inst. F. Med. Informationsverarbeitung -  
 Biometrie und Epidemiologie, München (A1013)  
 Medizinische Hochschule Hannover - Abt. Nuklearmedizin & Spezielle Biophysik  
 (A1034)  
 Medizinische Hochschule Hannover - Abt. Biosignalverarbeitung (A1015)  
 Medizinische Einrichtungen der Heinrich-Heine - Universität Düsseldorf (A1007)  
 Parsytec G.m.b.H. (A1001)  
 PCS Computer Systeme G.m.b.H. (A1027)  
 Philipps/Universität Marburg (A1039)  
 Philips Medizin System G.m.b.H. (A1008, A1011)  
 Philips G.m.b.H. / Forschungslaboratorium Hamburg (A1040)  
 Rheinisch-Westfälische Technische Hochschule-Klinik für Radiologische Diagnostik,  
 Aachen (A1008)  
 Rheinisch-Westfälische Technische Hochschule-Lehrstuhl für Messtechnik, Aachen  
 (A1008)  
 Rheinisch Westfälischer Überwachungs-Verein E.V., Essen (A1017)  
 Siemens A.G. - Data Systems Division, Application Programs (A1019, A1032)  
 Universitätsklinik Psychiatrie, Düsseldorf (A1040)  
 Universität Hamburg - Fachbereich Informatik (A1011)  
 Universität Hildesheim - Institut für Medizinische Informatik (A1034)  
 Universität Stuttgart - Institut für Physikalische Elektronik (A1039)  
 Zentralinstitut für die Kassen-Ärztliche Versorgung in der Bundesrepublik  
 Deutschland (A1026)

#### Ellas - Greece

01 Pliroforiki Ltd. (A1027)  
 Athens Technology Center Ltd (A1017)  
 Epsilon Software Ltd (A1023)  
 Foundation of Research & Technology Hellas - Institute of Computer Science  
 (A1005, A1032)  
 Foundation of Research & Technology - Institute of Computer Science, Heraklion  
 (A1008)  
 Institute of Computer Science - Foundation of Research & Technology Hellas,  
 Heraklion (A1014)  
 Intrasoft S.A. - R & D (A1010)  
 Intrasoft S.A. - (A1023)  
 Société Anonyme Industrielle des Télécommunications et Signalisations "ALPHA"  
 (A1021)  
 University of Athens, Department of Community Medicine (A1005)  
 University of Athens - School of Health Sciences (A1019)  
 University of Athens - Health Sciences (A1033)

## Espana - Spain

Consejeria de Salud. Comunidad Autonoma de Madrid - Hospital General Gregorio  
 Maranon (A1011)  
 Control Risk S.A. (A1017)  
 Galileo Iys S.A., Madrid (A1041)  
 Institut Catala de la Salut, Barcelona (A1009)  
 Institut Catala de la Salut (ICS) - Hospital Infantil vall d'Ebron - Dept. of  
 Radiology, Barcelona (A1030)  
 Instituto Nacional de la Salud (INSALUD), Madrid (A1031)  
 ITS - Ingenieria y Tecnologica de Sistemas (A1035)  
 Labein, Information Technologies & Production Systems (A1010)  
 National Institute of Health - General Directorate, Madrid (A1013)  
 Telefonica Sistemas S.A. - R & D Dept. (A1030)  
 Telefonica Sistemas S.A. - R & D Dept. (A1032)  
 Unisys, European Center for AI-(ECAI) (A1005)  
 Universidad Politecnica de Madrid - E.T.S.I. Telecommunication (A1019)  
 Universidad Politecnica de Madrid - Departamento de Tecnologia Electronica y  
 Bioingenieria (A1032)

## France

Association pour la Promotion et la Réalisation des Essais Thérapeutiques  
 (A.P.R.E.T.) (A1020)  
 AIX Marseille II Université - Département d'Information Médical (A1019)  
 Alcatel TITN - Agence Rhône-Alpes (A1001, A1018)  
 Association pour la Diffusion de la Médecine Préventive, Toulouse (A1033)  
 Bull Société Anonyme (A1025)  
 Bull S.A. - DCF-RCAD (A1028)  
 CAP SESA INNOVATION (A1004)  
 Centre de Lutte contre le Cancer - G.F. Leclerc (A1024)  
 Centre Hospitalier Régional de Lille - Département d'Anesthésie-Réanimation  
 Chirurgicale 2 (A1025)  
 Centre de Recherche - Faculté de Chirurgie Dentaire - Université Louis Pasteur  
 (A1022)  
 Centre d'Evaluation et de Qualité des Applications Technologiques dans le Domaine  
 de la Santé (C2ATS)- INSERM (A1016)  
 Fondation Bergonie - Medical Expert Systems Unit, Bordeaux (A1042)  
 Groupement d'Intérêt Public GIP ECLIMED - Hôpital Cochin (A1014)  
 Hôpital de la Conception - Département de l'Informatique Médicale, Marseille  
 (A1005)  
 Hôpital Universitaire Broussais - Formation Associée Claude-Bernard en  
 Informatique Médicale (A1004)  
 Institut National de Recherche en Informatique et en Automatique (I.N.R.I.A.), Le  
 Chesnay (A1039)  
 INSERM U103 (A1012)  
 INSERM U121 (A1015)  
 INSERM U279 (A1029)  
 Laboratoire d'Electronique Philips (LEP), Limeil-Brévannes (A1038)  
 Sanesco S.A. (A1028)  
 Service d'Informatique Médicale de l'Assistance Publique de Paris (A1003, A1014)  
 Télésystèmes (A1020)  
 UFR Kremlin-Bicêtre - Faculté de Médecine Paris-Sud - Serv. Central Anatomie et  
 Cytologie Pathologiques (A1007)  
 Université Joseph Fourier - Laboratoire TIM3-UA CNRS (A1001, A1007, A1018)

Université Joseph Fourier - Faculté de Médecine de Grenoble / IMAG (A1039)  
 Université de Lille II - CERIM (A1025)  
 Université de Rennes - Faculté de Médecine (A1030)  
 Université de Rennes I - Laboratoire Traitement du Signal (A1006)  
 Université de Saint-Etienne Jean Monnet - Faculté de Médecine (A1026)  
 Université de Saint-Etienne Jean Monnet - Santé Publique - Faculté de Médecine  
 (A1028)  
 Veridatas S.A. (A1017)

## Ireland

CAPTEC Ltd (A1036)  
 The Economic and Social Research Institute - ESRI (A1028)  
 Federated Dublin Voluntary Hospitals, St. James's Hosp. Dublin (A1036)  
 Irish Medical Systems - IMS (A1033)  
 Mid-Western Health Board - Dental Division, Limerick (A1022)  
 Trinity College - University of Dublin - Computer Science (A1021)  
 Trinity College - University of Dublin - Community Health Dept. (A1032)  
 World Health Organisation - Collaborating Centre Cork (A1022)

## Italia - Italy

Aitek S.r.l., Genoa (A1039)  
 Consiglio Nazionale delle Ricerche - Istituto di Fisiologia Clinica (A1006)  
 Consiglio Nazionale delle Ricerche - Istituto per Ricerche di Dinamica dei Sistemi e  
 Bioingegneria (A1015)  
 Consorzio Obbligatorio per l'Impianto, la Gestione e lo Sviluppo dell' Area per la  
 Ricerca Scientifica e Tecnologica nella Provincia di Trieste (A1030)  
 Enidata S.p.A. (A1005, A1010)  
 Fondazione pro Juventute Don Carlo Gnocchi Centro di Bioingegneria (A1006)  
 Hospital Dasco S.p.A. (A1032)  
 Informat S.R.L. (A1010)  
 Istituto Fisiologia Clinica C.N.R.,Pisa (A1012)  
 Istituto Nazionale per lo Studio e la Cura dei Tumori - Divisione di Anatomia  
 Patologica (A1007)  
 Istituto Superiore di Sanita - Department Epidemiology and Biostat., Roma (A1010)  
 Istituto Superiore di Sanita - Biomedical Engineering, Roma (A1012)  
 Istituto Superiore di Sanita - Lab. Epidemiology and Biostat, Roma (A1013)  
 Istituto Neurologico "C. Besta", Milano (A1039)  
 Istituto Nazionale per la Ricerca sul Cancro, Genoa (A1039)  
 Italsiel S.p.A. (A1030)  
 Laboratorio di Biochimica Clinica ed Ematologia - Ospedale Niguarda Ca Granda,  
 Milano (A1033)  
 LOG. IN. S.R.L. (A1012)  
 Mario-Negri Institute for Pharmacological Research (A1020)  
 Philips Sistemi Medicali S.p.A. - Projects & Systems (A1030, A1032)  
 Prisma Informatica S.p.A. (A1023)  
 SAGO S.p.A. (A1031)  
 Scuola Superiore S. Anna, Pisa (A1039)  
 SIMG - Societa' Italiana di Medicina Generale (A1023)  
 SOGESS S.R.L. (A1029)  
 University of Ancona - Dept. Elettronica e Automatica (A1012)  
 University of l'Aquila - Dept. of Radiology (A1018, A1030)  
 Universita di Bari - Istituto di Scienze dell'Informazione (A1010)

Universita' di Firenze - Radiological Institute (A1024)  
 Universita'degli Studi di Firenze - Dept. Clinical Physiopathology (A1030)  
 Universita di Genova - Dept. of Biophysical & Electronic Eng. (A1011, A1018)  
 University of Genoa - DIST (A1039)  
 Universita di Pavia - Dipartimento di Informatica e Sistemistica (A1005)  
 University of Perugia - Istituto di Patologia Speciale Medica (A1019)  
 Universita di Pisa - Dipartimento di Informatica (A1012)

#### Nederland - The Netherlands

Academisch Ziekenhuis Groningen (A1002)  
 Basis (A1008, A1035, A1043)  
 Basis - PCS Dept. (A1028)  
 Duphar B.V. (A1037)  
 Elsevier Science Publishers B.V. (A1002)  
 Elsevier Science Publishers B.V. - Biomedical Division (A1031)  
 Erasmus University Rotterdam - Dept. Medical Informatics (A1015, A1043)  
 Erasmus University Rotterdam - Center for Clinical Decision Analysis (A1020)  
 LHV - Landelijke Huisartsen Vereniging (A1023)  
 Nationale Raad voor de Volksgezondheid (A1031)  
 Netherlands Institute of Primary Care (NIVEL) (A1009)  
 Nederlands Kanker Instituut, Amsterdam (A1024)  
 SIG Services B.V. (A1009, A1013)  
 Rijksuniversiteit Limburg - Medical Informatics & Statistics (A1014)  
 Rijksuniversiteit Limburg - Medical Informatics & Statistics (A1021)  
 University of Amsterdam - Academic Medical Centre (A1039)  
 University of Leiden - Dept. of Cytochemistry of the Sylvius Laboratory (A1007)  
 University of Nijmegen - Faculty of Medicine & Dentistry (A1007)  
 University of Nijmegen - Medical Faculty - Dept. of General Practice (A1009)  
 University of Nijmegen - Biophysics Laboratory, Institute of Ophthalmology (A1038)  
 Volmac Software Groep N.V. (A1006)  
 Dr. Ir. H.J. Woltring - Biomechanics Consultant (A1012)

#### Portugal

Empresa de Investigacao E Desenvolvimento de Electronica S.A.(A1023)  
 INESC - Aveiro Group - Dept. Electronica - Universidad de Aveiro (A1032)  
 INESC - Information Systems Dept. (A1035)  
 Instituto de Engenharia de Sistemas e Computadores (INESC)-Aveiro Group-  
 Departamento de Electronica (A1006)  
 SIS -Servico de Informatica da Saude (A1035)  
 Universita Nova de Lisboa (UNINOVA) (A1042)

#### United Kingdom

Abies Informatics Limited (A1031)  
 Brameur Ltd (A1017)  
 Centre for Parallel Computing/Queen Mary College London (A1040)  
 CIPFA Services Limited (A1028)

City University - Centre for Measurement & Information in Medicine (A1019, A1029)  
 East Anglian Regional Health Authority, Cambridge- Regional Computer Services (A1017)  
 Eastern Health & Social Services Board, Belfast (A1022)  
 Ferranti Industrial Electronics Ltd (A1032)  
 Fulmer Systems (A1039)  
 Heriot-Watt University - Computer Science Dept. (A1032)  
 IBM United Kingdom Laboratories Ltd - Scientific Centre, Winchester(A1011)  
 IBM UK Ltd - Application Software, Warwick (A1019)  
 Imperial Cancer Research Fund - Biomedical Computing Unit, London (A1042)  
 Information Management Center, Birmingham (A1013)  
 Information Management Center - West Midland Regional Health Authority (A1019)  
 Kontron Instruments Ltd (A1029)  
 MARI Applied Technologies Ltd. (A1009, A1023, A1041)  
 Medical Research Council Head Office, London (A1007)  
 MRC Human Genetics Unit - Western General Hospital (A1039)  
 Oxford Metrics PLC (A1012)  
 Psychiatrist Research Fellows - c/o University of East Anglia - Audio Visual Centre (A1037)  
 St. Bartholomew's Hospital Medical College - Dept. of Histopathology (A1007)  
 St. Bartholomew's Hospital - Nuclear Medicine Dept. (A1034)  
 St. George's Hospital Medical School, London (A1014)  
 South Birmingham Health Authority - Selly Oak Hospital (A1033)  
 South Lincolnshire Health Authority (A1034)  
 STC Technology Ltd (A1026)  
 Thorn EMI Computer Software Ltd (A1028)  
 United Medical and Dental Schools of Guy's & St. Thomas' Hospitals, London (A1019)  
 University of Aberdeen - Department of Computing Science (A1005)  
 University of Aberdeen - Depts. of Computing Science & Psychology (A1029)  
 University of Bradford - Electrical Engineering (A1006)  
 University College of London - Department of Statistical Science (A1005)  
 University College of London - Clinical Operational Research Unit (A1029)  
 University College of London - Computer Science (A1027)  
 University College of Wales - Computer Science (A1026)  
 University of East Anglia - Audio-Visual Centre (A1037)  
 University of Edinburgh - Dept. of Obstetrics & Gynaecology (A1032)  
 University of Edinburgh - Medical Physics & Medical Engineering (A1036)  
 University of Glasgow - Dept. of Medical Cardiology (A1015)  
 University of Leeds Industrial Services Ltd. ULIS - Department of Psychology (A1041)  
 University of Liverpool - Computer Science Dept. (A1002)  
 University of Manchester - Institute of Sciences & Technologies (A1014)  
 University of Manchester - Medical Informatics Group - Dept. of Computer Science (A1019)  
 University of Newcastle upon Tyne - School of Health Care Sciences (A1009)  
 University of Reading, Department of Computer Science (A1027)  
 University of Salford - Dept of Mathematics and Computer Science (A1019)  
 University of Strathclyde - Bioengineering Unit, Glasgow (A1012)  
 University of Strathclyde - Dept. of Computer Science (A1035)  
 University of Sussex - Department of Cognitive and Computing Sciences (A1037)  
 University of Ulster - Institute of Informatics - Dept. of Information Systems (A1008)  
 University of York - Centre for Health Economics (A1016)  
 Varian - TEM Ltd (A1024)

The Victoria University of Manchester - Dpt. of Medical Biophysics (A1018)  
West Midlands Regional Health Authority - NHS-IMC (A1021, A1031)

**European Free Trade Association Countries**

**Finland**

Helsinki City Health Department (A1034)  
Technical Research Centre of Finland - Medical Engineering Laboratory, Tampere  
(A1005, A1016, A1021, A1029)

**Norway**

Norwegian Institute for Hospital Research, Trondheim (A1028)  
Norwegian Telecommunication - Administration Research Dept., Tromsø (A1033)

**Sweden**

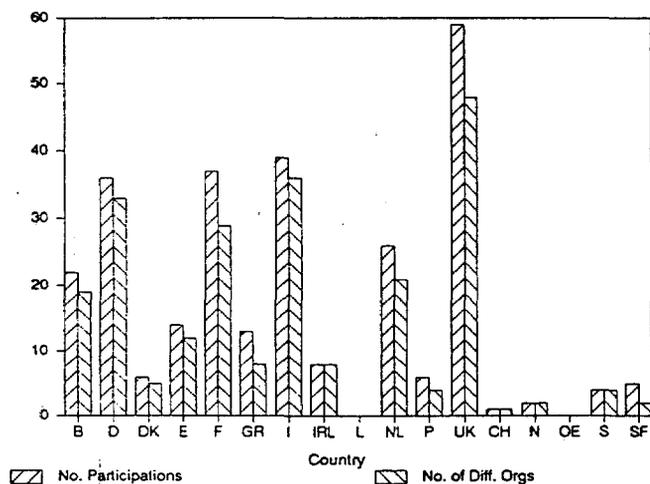
Linköping University - Centre for Medical Technology Assessment (A1016)  
SPRI - Health Economics and Technology Assessment, Stockholm (A1028)  
Uppsala University - Unit F Biomedical Systems Analysis (A1029)  
Swedish Centre for Working Life (A1037)

**Switzerland**

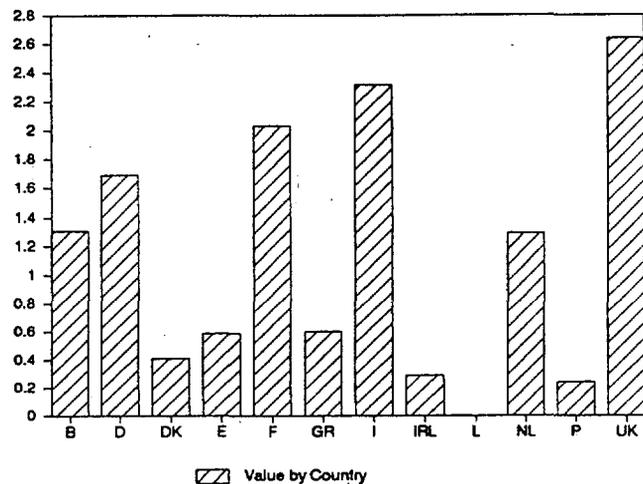
Hôpital Cantonal Universitaire de Genève - Centre d'Informatique hospitalière  
(A1004)

**IX. Statistical Analysis**

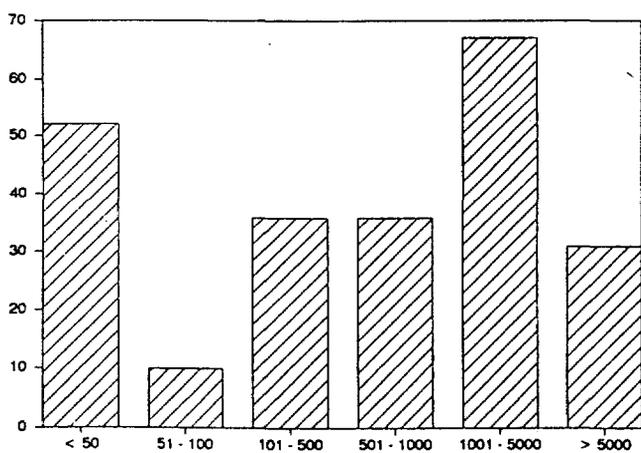
**Country Distribution of Organisations**



**Financial Participation (MECU) in AIM**



**Sizes of organisations**



**Types of Organisations**

