

Evaluation of Istituto Nazionale di Ricerca Metrologica 2006

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Executive Summary

The Evaluation Committee (Comitato di Valutazione, "Committee"), established according to art. 11 of the operative rules (Organisational and operating regulations) has performed the evaluation of the Istituto Nazionale di Ricerca Metrologica, INRiM, for the year 2006, based on the Activity Report 2006 and talks with institute responsables (President, Director general, Department Director, Division Heads, Head of the Laboratory accreditation service).

Based on the annual report of 2006, the Committee has formulated a number of "challenges" that it suggests to be addressed by the Board of Directors.

For INRiM in implementing its operating principles:

- To implement the declared effectiveness and flexibility under the regulatory constraints, which government imposes.
- To acquire capacities in "new" fields of management, such as Human resource management and commercial dissemination of knowledge.

For INRiM in pursuing its successful scientific record are:

- To be able to allocate appropriate resources to new fields within a constant (or declining budget). This involves critical reviews of current activities and reallocate of human resources.
- To review its very wide portfolio of research topics in view of the establishment of a new institute with a new mission.

As a National Metrology Institute:

- It is major challenge to develop its new divisions so that they ensure a positive development of INRiM as a major NMI in the world.

With respect to INRiM's manifold dissemination activities:

- To establish a systematic overview of its dissemination of knowledge and of results and to bring them in line with the mission of the new institute. This could be formulated in a policy document.

In relation to the attraction of funding:

- To establish a clear overview of INRiM's financing and its correlation to the use of resources (both human and economic), and to set targets for INRiM's performance that are realistic. It may be of help to establish a focussed economic reporting system that facilitates the managerial decision-making.

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1 Introduction, Method of work

INRIM became operative on 1 January 2006, its regulations coming into force on 1 January. According to Organization and operation regulations:

- The IEN head of scientific and technical activities and the IMGC director retained responsibility for their respective structures, till the appointment of the INRIM Department Director;
- The IEN and IMGC scientific responsibilities were extended till the appointment of the Department Divisions officers.

As a result, INRIM operation in 2006 was based on the following three first level structures:

- 1) **Department** (comprising Time and frequency metrology, Electrical metrology, Photometry and radiometry, Acoustics and ultrasounds, Quantum devices for metrology, Materials, Applied electromagnetics, Computer vision; Length metrology, Mass metrology, Thermal metrology, Dynamometry, Metrology for chemistry, health and environment, Interdisciplinary metrology);
- 2) **Administration and management** (comprising General secretariat, Asset and cost accounting, Personnel, Remuneration and emoluments, Library, communication, promotion and image, General technical services);

3) Laboratory accreditation service.

At its first meeting held on 16 January 2006 the Board of Directors appointed the Vice-President and the Director General as well as the head of the Laboratory accreditation service. On 31 March 2006 the Board of Directors appointed the Scientific Council. The Director of Department was appointed with a considerable delay, in May 2007. As a consequence, although a number of four Department Divisions were proposed and approved by the end of 2006 (Electromagnetism, Mechanics, Optics, Thermodynamics), the appointment of the Division Officers was only possible at the end of June 2007 and only later still, with the appointment of the Department Council, will normal operation be possible.

Although in 2006 INRiM was not yet organized into Divisions ('Divisioni') as deemed by art. 18 of Organisational and operating regulations, but maintained the organization of the merging Institutes, namely IEN G. Ferraris and IMGC, evaluation has been done with reference to the above mentioned 4 Divisions and the Laboratory accreditation service (which, due to its relevance from institutional, operational and financial standpoints, as deemed by art. 20 of Organisational and operating regulations, has been assessed as a separate entity).

Table 1 from Annual reports 2006 describes the merging of scientific units into four divisions, which constitute the permanent departmental structure of INRIM)

The Committee has taken note of the new structure and it conceives of INRIM as consisting of the four divisions plus accreditation

Department	Scientific unit	Source
Electromagnetism	Electrical metrology (ME)	IEN
	Quantum devices for metrology (DQ)	IEN
	Materials (MA)	IEN
	Applied electromagnetics (EM)	IEN
Mechanics	Computer vision (VA)	IEN
	Length metrology	IMGC
	Mass metrology	IMGC
	Dynamometry	IMGC
Optics	Time and frequency metrology	IEN
	Photometry and radiometry	IEN
Thermodynamics	Thermometry	IMGC
	Acoustics and ultrasounds	IEN
	Metrology for chemistry, health and environment	IEN, IMGC

Table 1 Conversion from scientific units to divisions

Regarding the themes for the this years evaluation, the Committee has decided to focus the assessment on a few key issues, which are deemed to be factors of success, namely the

- Scientific performance as an index of quality and international recognition of metrology research, basic and applied (See section 3).
- Metrology effectiveness as an index of the Institute capability of performing as a National Metrology Institute at the same level of other European and International Institutes (See section 4).
- Knowledge dissemination, as an index of promoting, favouring ad sustaining metrology culture, practice and innovation in Italy (See section 5)

In addition to such factors, the Committee has considered two extraordinary subjects as ability to attract funding and procedures for regulation implementation according to Art. 3 as tools capable of supporting and fostering the three success factors above (See sections 6 and 2, respectively).

Because this year's evaluation report is submitted to the Board of Directors after plans have been made for both 2007 and 2008, and since the year was the first year of INRIM's operation, the report does not contain specific recommendations to the Board of Directors. Rather, the Committee wishes to establish a precedence of reporting based on the feed back to this years report from the Board of Directors.

Instead of recommendations, the Committee has formulated a number of challenges for the Board of Directors, as they appear from the evaluation of 2006.

2 Implementing organizational and operating principles

Since 2006 marks the first year of operation, the Evaluation Committee has made a specific evaluation of the implementation of organisational and operating principles. These are, in accordance with the Organizational and operating regulations, Art. 3:

- a) Flexibility and rapid decision-taking, achieved by delegating functions and roles
- b) Periodical verification of its organisational structures, in order to guarantee a rational use of resources and to ensure consistency with the goals defined in planning documents
- c) Effectiveness and efficiency in the use of its human and technical resources
- d) Assessment of resources and constant monitoring of their effective use
- e) Support and development of technical and scientific training, with particular attention to top level training
- f) Attention to continuous professional updating of its personnel
- g) Exploitation of its historical and museum heritage
- h) Circulation, communication and transfer of the results of the research activities

During 2006, all items of the principles a-h were addressed, and the implementation may be summarised as follows:

- i) As the structure of the organisation was not established yet and the budgets were given from the two budgets of the merging organisations, this point could not be implemented. However, even after its full establishment, INRIM faces a serious challenge in living up to its declared flexibility under the constraints imposed on it from government regulations.
- ii) Periodic evaluation of its structures is set to one year, which seems reasonable.
- iii) Like for clause a), regulatory constraints impose challenges to the execution of effectiveness and efficiency (clause c).
- iv) In its training activities, INRIM focussed on the graduate and Ph. D. levels, as well as specific seminars, and this seems reasonable.
- v) The professional upgrading of personnel appears rather sporadic, it does not seem to be centred on specific individual

needs. As a result, the personnel development including job changes appears difficult.

- vi) INRIM appears to face problems in maintaining its museum activities related to this interesting task.
- vii) Apart from traditional academic communications (see section 3) and transfer of results in terms of publications and teaching, INRIM appears to have a non-systematic approach to “knowledge dissemination” (see section 5). In particular, it has little acquaintance with patenting and start-up companies.

Hence, the major challenges for INRIM in implementing its operating principles appear to be:

- To implement the declared effectiveness and flexibility under the regulatory constraints, which government imposes.
- To acquire capacities in “new” fields of management, such as Human resource management and commercial dissemination of knowledge.

3 The scientific performance of INRIM

As a scientific Institution, INRIM appears to have covered in 2006 a large spectrum of scientific research activities in different fields. The results of these activities are largely based on research performed during previous years by the two merging Institutes. Therefore the present evaluation report of the scientific activity refers only formally to INRIM, but essentially it refers to the two Institutes and it does not take into account how their composite scientific activity merged in a way functional to the mission of INRIM. This will be in the next evaluation reports.

	Department	Electromagneti sm	Me- chan- ics	Optics	Thermo- dynamics
FTE-TI Adept (Department) (TI)	141	49	43	23	26
FTE-TD Adept (Department) (TD)	16	5	3	3	5
Other Adept (Department)	67	22	13	13	19
Total_FTE Adepts (Department)	224	76	59	39	50
Publications in international journals (RI)	146	75	26	25	20
Publications in international journals with IF (RIIF)	121	64	17	21	19
Sum of IF	206	104	25	46	31
Publications in int. journals / FTE Dep. RI/(TI+TD)	0,93	1,39	0,57	0,96	0,64
Publications with IF/FTE Dep. RIIF/(TI+TD)	0,77	1,19	0,37	0,81	0,61
Average IF	1,7	1,62	1,43	2,23	1,62
Scientific Highlights ¹	13	6	0	5	2
Average IF of Highlights	4,49	4,35	0	4,74	4,3
Papers in proceedings of international conferences	74	12	29	22	11
of which: oral presentations	20	6	9	3	2
of which invited talks	5		1	2	2
Other communications to international conferences	131	65	24	21	21
of which: oral presentations	39	19	4	6	10
Of which invited talks	14	5	5	3	1

Table 2. Scientific indicators for INRIM and its four divisions²

Most of the 2006 scientific activities are strongly related to the metrological mission of INRIM, others concern development of instrumentation and/or measurement methods and few consist of the development of competencies and methods, which may prove important to future metrology. A few activities have no immediate link to the mission of INRIM: the Committee appreciates their presence as "curiosity"-driven activities, which are important for a research Institute, but underlines that the number and the resources dedicated to them should not exceed 10-15% of the total. Moreover for the next evaluations, the Committee would appreciate a description of how each activity is related to the mission of the Institute.

For the present evaluation the Committee considers the following principal items:

¹ Publication in international journals with IF higher than 2.5 are considered scientific highlights, independent of the relevance of the content for the INRIM mission.

² Data taken from the 2006 Activity Report (Italian version)

- The total number of publications per adept in journals with Impact Factor (IF), as indicator of the numerousness of the production,
- The average IF of the publications, as indicator of the average relevance of the research,
- The presence of “scientific highlights” singled out on the basis of high IF, as indicator of the presence of high quality research,
- The participation in international conferences and oral presentations at such conferences, as indicator of a presence in the international community.

These indicators will be considered both at the INRIM general level and at the division level.

From the data compiled in the Committee draws the following conclusions.

Numerousness of the scientific production Assuming that INRIM adepts are 50% dedicated to research activities and 50% to other activities, a mark of 1 publication/adept is to be considered a good productivity level. Therefore the average production of 1,27 publication/adept and of 1.03 (publication with IF)/adept is adequate, showing that INRIM is a quite active Institute. The detailed analysis of the numerousness factor of the Divisions shows that the publication level of Thermodynamics is smaller than 1 and should be increased in the future and that attention should be paid to the rather small publication level of Mechanics in journals with IF.

Quality of the scientific production Because many metrology journals of good quality have IF around 1.5 or slightly higher, a good average scientific production should have similar IF. The INRIM mark of 1.73 shows the good average quality of the scientific research performed, which is present in all the Divisions.

Highlights 11% of the INRIM publications are in journals with large IF (higher than 2.5) with a very high average IF of 4.49. Although some highlights appear to be only weakly related to the INRIM mission, this is really a very good performance, which shows the presence in the Institute of high quality scientists with new good ideas, of good laboratories and instrumentation and, in general, of a good level of resources. The absence of Highlights for Mechanics in 2006 may be due to a statistical fluctuation.

Conferences The participation in international conferences seems to be reasonable, with about 1,5 conference every years per adept. The number of oral presentations to international conferences is 29 % of the total contributions, which is considered satisfactory. This depicts an Institute that has, on the average, adequate international scientific connections compared to its scientific activity level, and this is true for all the Divisions.

The challenges for INRIM in pursuing its successful scientific record are:

- To be able to allocate appropriate resources to new fields within a constant (or declining budget). This involves critical reviews of current activities and reallocate of human resources.
- To review its very wide portfolio of research topics in view of the establishment of a new institute with a new mission.

The two challenges are, inevitably related, and they are both related to the issues addressed in section 6.

4 INRIM as National Metrology Institute (NMI)

As the national metrology institute, NMI, of Italy, INRIM has specific tasks that go beyond the usual tasks of a research institute. They are related to the maintenance of national measurement standards and the dissemination of measurements, primarily in Italy, that are traceable to either its national standards or to foreign primary standards for the benefit of trade, health, and the environment, as well as a tool for the promotion of innovation (see section 4.1).

Further to scientific and technical work, organisational work is an important task for an NMI. This is necessary in order to ensure that national realisations of units and scales, and which are maintained by national standards, are globally coordinated. Increasingly, the multitude of units, needed to support a modern society, exceeds what can be maintained at any NMI, and therefore collaboration and coordination of resources play an important role in the international work (see section 4.2).

Finally, the ways in which an NMI performs scientific research and disseminates knowledge are influenced by its role as an NMI. This is described in sections 3 and 5, respectively.

4.1 Maintenance and upgrading of national standards

INRIM maintains National measurement standards in 9 out of 10 subject fields of metrology, as defined by the European Regional Metrology EURAMET, whereas the subject "Ionising Radiation and Radioactivity" is taken care of by the institution INMRI-ENEA.

Maintenance of standards involves taking part in international interlaboratory comparisons. Since 1999, this has been carried out under the aegis of the CIPM-MRA (The Mutual Recognition Arrangement of the Comité International des Poids et Mesures) within the Meter Convention. This is a time-consuming activity, which is necessary in order to verify that INRIM's units are in reality equivalent within specified uncertainties to the units maintained in the rest of the world.

In order to ensure that measurement performed for external users are reproducible, an NMI must maintain a quality assurance system that in sufficient detail described how measurements are carried out. A suitable written standard for this is ISO 17025.

INRIM executes its tasks as an NMI in a way that is fully compatible as being a well respected NMI. This is documented specifically in the Appendix B of the KCDB database operated by the BIPM.

Of course the coverage of standards that INRIM is able to maintain varies from subject field to subject field, and INRIM expresses the concern that it will not be able to both maintain at a satisfactory level its present coverage and at the same time develop new standards to support emerging technologies of importance to Italy.

Since the two former institutes IEN and IMGC were largely complementary as NMI's, the new INRIM appears as a result of a "simple adding together" of its two component; but the new organisation with four divisions has the potential of generating synergy and release capacity for the necessary evolution of scientific metrology in Italy.

- It is major challenge to develop its new divisions so that they ensure a positive development of INRIM as a major NMIs in the world.

4.2 Participation in international organisations

At the European level, INRIM takes active part in all 12 technical committees of EUROMET, and held one chair in 2006. It has played a major role in the European project iMERA that has prepared the way for the new organisation EURAMET e.V. as well as for the European Research Programme under Framework programme 7 of the EU.

At the global level, INRIM is a member of 6 out the 10 consultative committees of the CIPM, and held the presidency of one in 2006. In several of the other CC's it was also active.

5 INRIM's dissemination of results

The economic and social impact of the scientific activities on the evaluation of knowledge dissemination represents a crucial aspect. In order to promote the development of the Italian system components (scientific knowledge transfer, exploitation and diffusion), the INRIM legislative decree n. 28/2004 explicitly deals with scientific and technologic competences' diffusion and transfer. In particular, these activities include: i) knowledge and technology transfer to science, industry and society; ii) development of the calibration laboratories network (accredited as SIT centre); iii) high level scientific and technical services; iv) technical standardization cooperation; v) education and training; vi) technical support to legal, health and environmental metrology (in term of measurement method and traceability).

5.1 Dissemination of competence to the companies

Knowledge dissemination to companies was carried out by INRIM Institute with different activities:

5.1.1 Patents and licenses.

As it appears from Annual Report "Table 2", this is not a very active field for INRIM (only 3 in 2006):

- Patented invention n. TO2006A000213, 21 marzo 2006, "Apparatus for the determination of the ethanol content in liquid and gaseous matters, and associated procedure", M. Rocchia;
- Patent n. MI2004A 001589 "Equipment and procedure for module and phase measurement of the electrical current flowing at least in one conductor" in collaboration with Herholdt Controls S.r.l.;
- Foreign registered Italian patented invention "Spectrophotometer and spectrophotometric procedure based on a cavity resonator Fabry-Perot".

Modern product development relies on a closer collaboration between knowledge centers and private entrepreneurs, but this connection is not well established at INRIM. Among other things, the small number of annual patents may represent a structural data, compared to the patent applications of IEN and IMGC in the years before 2006.

5.1.2 Accreditation and technical metrological services.

The reliability of measurement instrument represents a fundamental prerequisite for all quality systems. In particular, all measurements results should be traceable to the SI. The accreditation activity in 2006 can be summarized by the following data: increase in accredited laboratories (4 new accredited laboratories), accreditation renewal and extension for 33 and 23 laboratories, respectively; 46 surveillance visits; income of 947 k€.

Some ambitious objectives have been attained concerning accreditation for car speed meters, flexible scope (Politecnico di Milano in the field of acceleration measurements) and underwater ultrasound measurements (Istituto Corbino of CNR). Furthermore, in this year the INRIM calibration laboratories issued about 1.500 calibration certificates and other metrological services, as reported in Table 3. As a consequence, about 60.000 calibration SIT and 120.000 simply traceable certificates were issued.

Through accreditation of laboratories, INRIM potentially can disseminate its high technical knowledge to the industrial practitioners of metrology. Although this happens, it appears to happen on a case-by-case and personal basis, and not determined by Institute efforts.

Description	2005	2006
Calibration certificates	1.651	1.474
Test Reports	234	188
Technical Reports	16	38
Total Documents	1.901	1.700
Involved full time equivalent persons (FTE)	27,22	23,42
Income (k€)	2.138	1.681

Table 3. Calibration, measurement and test activities in 2005 and 2006

5.1.3 Scientific metrological services

In 2006 the INRIM drew up 15 new research contracts (in the same year more than 90 research contracts were already activated), among which more than 1/3 drawn up with private companies with k€ 4.006 of total budget (k€ 1.668 financed by Regione Piemonte for research projects funding, k€ 132 for research activities submitted to other Public Bodies, k€ 525 for research activities involving private companies, k€ 1.681 for consulting, calibrations, equipment tests and other activities). Among these, the research contracts drawn up with aerospace industry and mechanical companies are particularly interesting.

5.1.4 Spin-off and technical personnel detachment

An interesting knowledge transfer procedure is that provided in Italy for the Law n. 196, 24-06-1997, (named "Pacchetto TREU"), considering the public research detachment as a way to re-launch the research activity in PMI. In 2006 the INRIM obtained 5 research units with TREU Law, working in measurement instrumentation construction and calibration companies.

Any spin-off is documented in the 2006 and no procedures seem to be available in INRIM to promote spin-off. activities.

Generally, the knowledge transfer activity to the companies does not appear to represent a prior activity at INRIM. As a consequence, such activity still depends on the researchers sensitivity instead of being the consequence of the Institute strategy. Nevertheless, the high scientific and technologic research level together with the need of new funding way determined in the last years an increasing number of research contracts and centers accredited as SIT.

As a consequence, there is a gap between capabilities and results, in terms of patents and spin-off. In order to reduce this gap it is necessary to set up a policy and take measures able to boost patent activity and application of research activity. In the evaluators opinion, it should be verified the interconnection between scientific and industrial metrology. In particular all research results could be evaluated in terms of patentability or know-how for innovation.

5.2 Dissemination of competence in the society and scientific community

As regards the scientific knowledge dissemination, the INRIM Institute pursues such aim with several activities: i) participation in the Standardization, Scientific and Technical Committees; ii) education and training; iii) diffusion of competences to the community (scientific or not); iv) giving support to legal, health and environmental metrology.

Details related to the first three activities are given in Table 4

Description	2005	2006
N. of seminars held by INRIM personal	27	28
Granted patents	2	3
N. of research contract drew up in the year	30	15
Annual incomes (k€)	642	2.296
Active scientific collaborations	210	210
Participation in International scientific and technical organisms	165	170
Participation in National scientific and technical organisms	110	110
N. PhDs courses involving INRIM participation	5	7
PhD thesis discusses in the year	9	8
Master Degree thesis discussed in the year (I lev. + II lev.)	17 + 12	35 + 11
Lessons held by INRIM personnel in specialist and academic courses (h)	557	878
Foreign students and researches stages and stays in INRIM (months-pers.)	27	14,9
Italian students' and researchers' stages and stays in INRIM (person-months).	40	54,5
INRIM personnel stays in (months-pers.) in foreign scientific institutes	33	50
Seminars held in INRIM by external persons.	25	23

Table 4. Dissemination activities in 2005 and 2006.

In particular, the INRIM Institute knowledge transfer methods are:

5.2.1 Participation in the Standardization, Scientific and Technical Committees

The standardization activity is particularly pursued at the INRIM Institute by participating in National (UNI, CEI, CIG, CTI, AICQ, etc.) and International (ISO, IEC, IUPAC, CISPR/A, CIE, CEN, IAU, ITU-R, etc.) standardization committee and also by coordinating some of these committees (see Section 15.3). The participation in metrological and accreditations organisms, beyond other scientific and technical organisms, also represents a particularly qualified and significant activity (see Section 15.1/ 15.2). In 2006 there were 210 active scientific collaborations with research bodies and Universities. The participation in 170 international and 110 national

scientific and technical organisms was also kept activated. Such aspects demonstrate the good relationships of INRIM with national and international institutions, with the collaboration in standardization activities and in the definition of measurement and test protocols.

5.2.2 Education and Training.

Training constitutes an integral part of the activities of INRIM, as it appears from INRIM Annual Report "Table 2". It is also noteworthy that "education and training" is one of key elements of INRIM's vision (see Section 9). The very fruitful relations with different University such as the Polytechnic of Turin together with dedication grants for thesis work at INRIM ensures a high concentration of graduate work at INRIM, compared to most national metrology institutes.

In 2006 master degrees increased of 50% with respect to 2005 (46 total degrees), while the number of PhDs continued to be important (8 theses).

Also training in all its facets is part of INRIM activities. Courses for industrial technicians and teachers, workshops and seminars, summers schools that are organized in collaboration with other bodies, indicate the substantial effort that INRIM puts into training. In 2006 were held 539 h lessons by lecturers in Universities and cultural associations and even 114 h third level courses. It is also interesting that in the activity the INRIM Institute assimilates cultural events to technical training. To such purpose have been held 339 h lessons within internal courses and 225 h lessons within external professional courses.

All this activities reflects the interesting attitude at INRIM that science is part of our cultural heritage not only a modern non-cultural exercise. This attitude has vanished from most national metrology institutes of today's technocratic world.

5.2.3 Dissemination of competence to the scientific community and civil society

Among the expected diffusion activities, particularly interesting are the numerous cultural activities proposed by INRIM, such as:

- i) Guided tours (science day) and multimedial aids (CD-ROM "Il linguaggio delle misure" promoting the diffusion of International System of units) for the high school students
- ii) Events for the diffusion of scientific topics, such as "Il tempo della scienza" (also available at the web address http://www.inrim.it/events/tempo_scienza_06.shtml);
- iii) Scientific seminars held at INRIM by both internal scholars and external institutions;
- iv) Participation in some TV events.

The organization and the participation in scientific initiatives are also notable: EUROMET Mass and related quantities Technical Committee Meeting; EUROMET Ultrasounds Technical Sub-Committee Meeting, 3rd Workshop Advances in Foundation of Quantum Mechanics and Quantum Information with atoms and photons"; Workshop on Crackling Noise, funded by European Science Foundation (ESF); Workshop "Le misure della forza di Casimir: situazione attuale e prospettive future in Italia"; 44th IUPAC General Assembly; 41 IUPAC Chemistry Congress.

5.2.4 Support for legal, health and environmental metrology.

In legal, health and environment fields the society needs correct procedure measurement and reliable calibration facilities. Then INRIM provides some tasks regulated by law, such as the participation in the Legal Governance Committee of MISE (Comitato Centrale Metrico). INRIM drew up a formal agreement with National Research bodies for health ISS (Istituto Superiore di Sanità) and environment APAT (Agenzia per la protezione dell'ambiente e del territorio). Furthermore, the INRIM cooperates with MISE (Economic Development Ministry) to make available measuring techniques and procedures for both the protection of the consumers in commercial exchange and the protection of the population health and of the environment. Finally in most of these areas the INRIM is the authority named to measurement traceability.

In 2006 the INRIM has developed research projects, measurement procedures and specific traceability of measuring instruments in the fields of:

Legal metrology: in this field INRIM has developed a procedure for the calibration of field-gas chromatography, for gas quality measurement, in cooperation with SNAM; also, it has been developed a procedure for speed vehicles measurement for traffic safety purposes, in cooperation with METAS. Finally, 2 laboratories of Local Legal Authorities (CCIAA) have been accredited in water volumes and mass measurements.

Health and environmental metrology (in cooperation with APAT and ISS): in such field the INRIM Institute has carried out research activities aimed to the improvement of the measurement equipments and techniques (e.g. optical alcoholmeter, vehicle emission comparison, traceability of air quality measurements), test campaigns for environmental measurements and realization of standards for traceability (atmospheric pollutant, noise protection, and road lightning). Furthermore a very interesting in progress activity is represented by the project iMERA, three tasks of which are under the INRIM responsibility.

The activities of knowledge diffusion to community and academy can be considered excellent for both quality and quantity. The visibility and proposal capability at international level of INRIM Institute in National and International activities testifies its interaction ability in several metrological sectors and with the community and the scientific academy.

Nevertheless, despite the last years notable efforts, still a sensible gap between the legal, health and environment metrology and the scientific

metrology. As a consequence it should be desirable a detailed program, approved by concerned authorities, aimed to the individuation of the chemical and physical quantities for which a national metrological traceability is needed. The INRIM Institute should then organize the knowledge dissemination activities about International System of Units also for such quantities.

The challenges with respect to INRIM's manifold dissemination activities appears to be:

- To establish a systematic overview of its dissemination of knowledge an results and to bring them in line with the mission of the new institute. This could be formulated in a policy document.

6 Ability to attract funding

Project	Funding Body	2001-2003 average, IEN	2004 IEN+IMGC	2005 IEN+IMGC	2006 INRIM	2007 INRIM	Procedure	EU/IT
Laboratories	MIUR	528	0	0	0 ⁽¹⁾	0	INRIM specific	IT
Other	Regione Piemonte (RP)	0	30 (IEN)	30 (IEN)	30	30	INRIM specific	IT
Internat. cooperation	Public bodies				99 ⁽⁵⁾	29 0	INRIM specific	IT
Sub Total		528	30	30	129	59		IT
Programs	MIUR, ASI, public bodies	489 (PNR tender)	NA ⁽⁴⁾	NA ⁽⁴⁾	125	199	Tenders ⁽⁷⁾	IT
	ESA	293	NA ⁽⁴⁾	NA ⁽⁴⁾	0	0	ESA tender	EU
	EU		NA ⁽⁴⁾	NA ⁽⁴⁾	7	187	EU tender	EU
	Several	65		117			Tender	EU/IT
	Regione Piemonte	0	0	0	546=1638/3 ⁽²⁾	546+537 ⁽⁶⁾ =1083	Tender	IT
Research contracts	Several	483	NA	NA	426	470	Private agreement	I/ foreign
Programs and contracts-Sub Total		1330	931	1459	1104	1929		
Expected Total					2295 ⁽³⁾	2265 ⁽³⁾		
Calibrations	Several	1584 (IEN+IMGC)	1942	2139	1681	1853	Institutional	EU/IT
Accreditations	Several	1016 (idem)	809	923	903	800	Institutional	EU/IT
Sub Total service	Several	2600	2751	3062	2584	2653	Institutional	EU/IT
Overall Total		4458	3712	4451	3817	4641		

(1) Additional funds of 1925 kEuros provided by MIUR, and reported in 2006 documents, are reserved to safety accomplishments in INRIM buildings, and therefore dropped from research funds.

(2) The expected income of 1638 kEuro from Regione Piemonte has been treated as a triennial competence, according to INRIM president's audit, which looks in agreement with a detailed estimation of 2006 competence undertaken in Section 6.4.

(3) The rows assumes the triennial income from Regione Piemonte (RP) may become an annual competence as envisaged by triennial plans.

(4) NA=Not available. They are cumulated in the 'several' items, since details are not available (see Section 6.4).

(5) Data are provided by INRIM accounting officers. Funding procedure is not clear: agreement or tender?

(6) The 2007 regional programs cover one-year budget (accounting officer's information).

(7) Funding procedure of the 2006-2007 'national Programs' is not clear : agreement or tender?

Table 5. Research and institutional funding. Financial data are given in kEuro and must be interpreted as 'competence funds' made available in 2006 by contract signature. Activity reports and triennial plans are just concerned with 'competence funding' and not cash flow.

Assessment of funding ability is subdivided into

1) Capacity to access funds for research projects announced both nationally and internationally and to attract financial and/or instrumental resources from research contracts and partnerships with enterprises and public bodies

2) Comparison of the funding ability with other metrology and research institutes on a per-capita basis.

3) Monitoring of research funding by INRiM research units as shown in the 2006 activity report (doc. 1).

Assessment has been done per Institute and not per Division, as they did not exist in 2006.

6.1 Funding capacity

Table 5 shows INRiM funds subdivided into

1) INRiM specific funds, as those obtained in the past from Italian University and Research Ministry (MIUR) or recently from Regione Piemonte.

2) Program funds awarded in response to national or international tenders (ESA=European Space Agency, ASI= National Space Agency, PNR=National Research Plan).

3) Contractual funds as those achieved by private agreements with national/international industries and public bodies.

4) Institutional funds from calibration and accreditation activities are also reported.

Source documents are the triennial CIV report (doc 5) and the 2005/2006 activity reports (docs from 1 to 4). The key rows of Table 5 are shown in *italic*. Data related to 2007 have been added in **Table 5** to confirm expectations expressed in the evaluation.

Assessment is not straightforward due to transition from two separate institutes (IEN and IMGC) into a unique one. As a matter of fact, the planned re-organization into a single research department and 4 divisions only occurred in 2007. For such reasons, 2006 evaluation should be kept with caution; it may be considered as a zero point in view of future assessments.

A second difficulty derives from accounting rules, which are based on annual competence implying a multiannual contract signed in 2006 shall provide 'competence' funds only to 2006. According to INRiM management, revision of this practice has been undertaken since 2008. A rather significant case is the budget awarded by Regione Piemonte (RP), which corresponds to triennial programs in the average. The budget has been completely referred to 2006 in INRiM reports (docs 1 and 4), while only a third part, roughly, should pertain to 2006, as reported in **Table 5**.

A third difficulty concerns funding procedures: funding shall be neatly separated into (i) awarded funds in response to a tender (national/foreign) (ii) agreements/contracts with private /public bodies, (iii) liberalities, (iv) institutional services, (v) INRiM-specific MIUR funding. Notwithstanding such difficulties, taking into account that both Institutes had the same mission, and that cooperation existed before unification, evaluation may be tempted. As a key remark, one can hardly say INRiM

funding ability has evolved along a neat positive trend. It suffices to compare IEN average funding in the triennial 2001-2003 with the total funding of IEN+IMGC in 2004-2005 and with INRiM 2006 funding. The latter look less than the triennial average of the sole IEN from 2001 to 2003. Even worse, such a negative trend occurred while specific funding by the Italian University and Research Ministry (MIUR) was completely cancelled. Reasons can not be easily derived from reports nor from staff hearing. On the contrary, if one assumes 2006 to be INRiM zero point, such reasons do not even deserve to be investigated, but such a cloudy snapshot (see also the per-capita comparison with other Institutes) should lead INRiM management to dedicate substantial effort in this respect. Luckily, positive indications became manifest in 2006 report as explained below and are confirmed by 2007 data.

What emerges as a worthy pledge for the future is the budget awarded in response to Regione Piemonte (RP) tenders. The hope is that INRiM shall repeat a similar exploit in next years thus converting the actual triennial budget to become annual as the row 'expected' in **Table 5** assumes. Expectation in this sense emerges from triennial plan documents (docs 6, page 21, and 7), where the 2006 triennial budget has been repeated as annual from 2007 to 2010, and the 2007 competence in **Table 5**.

Note however, the 2006 program-funding exploit is paralleled by steady if not decreasing research contracts (a small increase has been forecasted in the triennial plan). Hopes and recommendations for a positive trend were already expressed in the 2001-2003 IEN evaluation. Such hopes are repeated here. May RP-funded research fill the gap between basic research and technology transfer to industry, thus fostering industry/society-oriented research, as entailed by art 3, 1-d of the instituting law?

Finally, what appears to be steady, although subject to not negligible oscillations (very likely coming from external sources) is the institutional funding from calibration and accreditation activities. They look a solid and worthy source doubling the 2005/2006 research income as shown in **Table 5**.

6.2 Funding ability comparison

Body	Program and contracts		Calibration + accreditation		Research /technical staff	Comments
	k€	k€ per staff	k€	k€ per staff		
IEN+IMGC (2005)	1459	14,2	2139+923	30,9	103 /99	
INRiM (2006)	1203	12,1	1681+903	26,6	99 / 97	Triennial RP budget/3
INRiM (expected)	2295	23,2			99	Triennial RP budget included
INRiM (2007)	1908	19,7	1853+800	27,1	97/98	
PoliTo (2005)	32734	24,6	NA	NA	1331	Ph.D students/research fellows excluded
PTB (2005) (doc 10)	10700	21,0	8971	10,1	510 /888	Civil servants /employees
PTB (2006) (doc 11)	13700	26,6	9879	11,4	515 /863	
DFM (2005) (doc 8)	513	39,5	142+35	59,0	13/3	Academic /Technicians
DFM (2006) (doc 9)	615	47,3	140+38	59,3	13/3	

Table 6. Funding – total and per scientific staff

"Per staff" funding has been obtained by considering the total scientific staff and not full-time-equivalent (FTE) data, so as to allow comparison with other Institutes. Specifically 'program and contracts' were referred to research staff, whereas 'calibration + accreditation' to technical staff. It

may be of interest to compare INRiM with other metrology institutes and academic institutions like Politecnico di Torino. Incidentally, academic data halts at 2005, implying INRiM is up-to-date. Per-staff assessment might partly compensate uncertainties in the absolute funding analysis in Section 6.1. As in the past, the benchmark Institutes are a larger one as the German PTB and a smaller as the Danish DFM.

Per-capita data in Table 6 confirms INRiM weak funding from research programs and contracts, which is contrasted by the strength of calibration/accreditation income. Ceteris paribus, only repeating the 2006 budget awarded by Regione Piemonte each year, INRiM may expect to align with PTB and academic rates. As already mentioned, this is the expectation of Triennial Plans (docs 6 and 7). A positive trend 2006-2007 emerges from Table 6, where also 2007 data have been reported.

As already noted, institutional funding, including calibration and accreditation, appears a very solid source, although mere 'institutional' (or service) according to INRiM management, which unfortunately does not lead to industrial contracts and cooperation. The actual picture seems the following: national industry and public bodies mostly aim to certificates. Industry contracts enter through a different path. Such a dyscrasia, very likely common to worldwide metrology, looks misaligned with the instituting law where only technology transfer activities are mentioned in the art. 3.1-d. Distinction is instead done in the triennial plan 2007-2009 (doc 6) where technology transfer is separated from technical services. As a recommendation, neat and feasible technology development procedures should be studied, planned, monitored from basic research to industry prototypes. Regione-Piemonte applied research programs look addressing similar goals.

6.3 Funding partition and monitoring

Type	Partition	Detailed funds (tentative) [kEuro]	Official funds [kEuro]	Percentage (+)
Research contracts	Italian Industries	765		30%
	Public bodies	240		10%
	Foreign bodies	90		4%
	Subtotal	1095	525	44%
Research programs	EU	80		2%
	ESA	133		4%
	MIUR	195		5%
	Subtotal	408	132	11%
Regional Funds		439	546	45%
Total		1942	1203	100%
(+) the subtotal percentages refer to the 4 th column (official data); the detailed item percentage has been obtained from the 3 rd column; for instance, the 30% in the 2 nd line derives from $(765/1095) \times 100 = 30$.				

Table 7. Tentative funding subdivision from 2006 activity report

An effort has been made to collect and group funding-data provided at pages 120 to 125 of the 2006 activity report (Italian version, doc 1). No advise from INRiM was requested on the purpose. The original goal was to

try a detailed partition of the official data into industrial, public and international funding. Actually, the reported financial and temporal data of each signed contract and program look rather poor from a quantitative standpoint. Very often funding is missing, or no reference is given to financial year. Some past funding is reported without explicit reasons. Therefore, collection and partition is forcedly dominated by significant uncertainty. As a result, the total funding showed in Table 3 (3rd column) looks rather different from official data, which may raise the question about meaning and usefulness of the detailed report. As a consequence the resulting partition, which was the original goal, becomes highly questionable, but in absence of better information it has been scaled to official data as in **Table 7** (percentage column). In other words, the percentage of each subtotal refers to the 4th column, whereas the percentage of the detailed items which are missing in the 4th column, are derived from the 3rd column.

One may argue INRiM staff had acknowledged any request of help; furthermore, building elements of **Table 7** are not provided for brevity's sake. Nevertheless, the exercise is believed to have some significance since shows the accounting results which might be obtained at a first sight, although care has been taken in deriving them.

Note that funding from research contracts and programs double more than the official total, implying very likely detailed data refer to multiannual contracts. The opposite applies to Regione Piemonte programs, which, in absence of explicit information, were always considered triennial and then 1/3 scaled.

Whichever be the right scale factor to be applied to detailed funds (3rd column in **Table 7**), weakness in international funding clearly stems, the total percentage being lower than 10%. As a first recommendation, international funds should be kept as higher quality with respect to national (competitive or not), as they usually arise from very competitive conditions.

A further recommendation may be raised to INRiM management to facilitate funds accounting and monitoring by the research staff itself at least at Division level through appropriate IT procedures.

6.4 Conclusions and recommendations

INRiM life starts with a weak funding ability especially at international level. This is accompanied by discontinuous and unpredictable Institutional funding (see Triennial Plans and **Table 5**), only capable, rebus sic stantibus, of guaranteeing laboratory and large equipment to stay aligned to international standards. Funds awarded by Regione Piemonte in 2006 on a local competitive basis, if repeated in next years (what seems perceivable from 2007 data) may at least align INRiM per capita rates to leader Institutes as PTB, and thus start, hopefully, a virtuous cycle, where industry and international funding may benefit. Although no specific assessment has been made on procedures, organization and tools employed for fund-

ing, their detailed monitoring by the former IEN+IMGC units in the 2006 report looks rather uncertain, which raises some concerns about research micro-organization. What instead appears solid and strong is the calibration/accreditation service, which unfortunately only develops on a mere institutional basis instead of becoming a first stage toward technology transfer. Needless to say, last weakness is not imputable to INRiM but instead to national regulations and central authority directions.

The challenge in relation to the attraction of funding for INRiM when the initial period of establishment is:

- To establish a clear overview of INRiM's financing and its correlation to the use of resources (both human and economic), and to set targets for INRiM's performance that are realistic. It may be of help to establish a focussed economic reporting system that facilitates the managerial decision-making.

7 Summary

The year 2006 was a very special year for INRIM. After several years of discussions, and one year under preliminary operation, a combined metrology institute in Italy, based on the former IEN and IMGC, was constituted. Naturally, the practical merging of the two institutes that had similar missions but different constitutions and cultures were not fully implemented, but the annual report for 2006 summarises retrospectively, how INRIM will be permanently organised.

In this respect, the Evaluation Committee finds the achievements of INRIM for 2006 very successfully.

In view of the above, the Committee has not made any firm conclusions or recommendations. The purpose of this year's report is to establish a framework for the evaluation of INRIM for the coming period.

In reviewing the performance for 2006, the Committee has treated the organisation of INRIM as consisting of five entities, namely four divisions, namely:

- Electromagnetism,
- Mechanics,
- Optics,
- Thermodynamics

as well as

- Laboratory Accreditation Service.

The findings are organised according to

- Implementing organizational and operating principles
- The scientific performance of INRIM
- INRIM as a National Metrology Institute (NMI)
- INRIM's dissemination of results
- Ability to attract funding

8 References

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- 10) PTB annual report 2005.
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