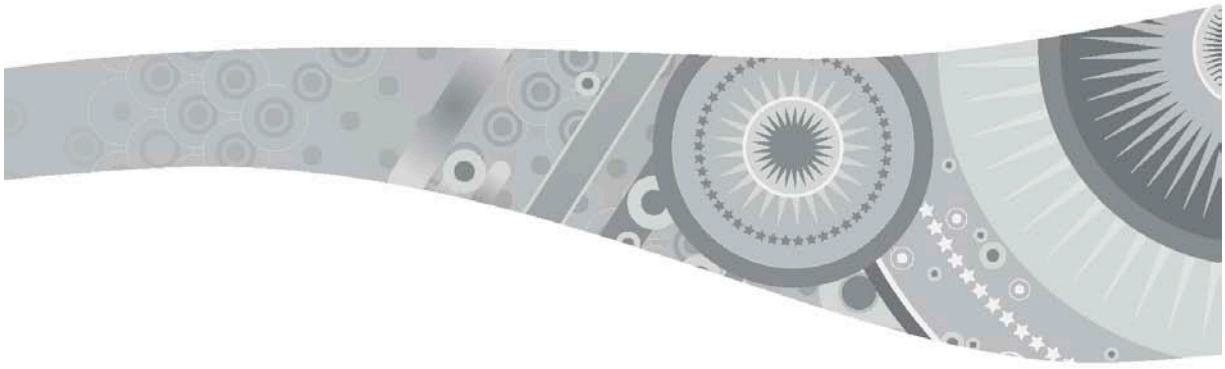
ISTITUTO ITALIANO
DI TECNOLOGIA



GUIDELINES for EVALUATION

Notes from the Scientific Director
for the Strategic Committee and the Board of the Foundation

THE SECOND FIVE YEARS OF IIT

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OBJECTIVES OF THIS DOCUMENT:

This paper briefly discusses some issues, which are strategic for the second five years of the IIT, for a successful and sustainable consolidation of its position both nationally and internationally. In particular:

- □ Implementation of evaluation procedures
- □ Synchronisation of the evaluation procedures with the most important management milestones of the Institute (budget forecasting, budget reviews, staff evaluation for bonuses etc.)
- □ Technology Transfer Strategy
- □ Realistic forecast of fund raising

EVALUATION

1. Standard evaluation indicators in connection with the peculiarities of IIT:

a) The performance indicators of a scientific research institute are of two types:

- *quantitative* (Impact factor - IF, Citation Index - CI, h-factor, number of patents, Spin-Offs, International Events, attractiveness for foreigners, fund raising capacity, licensing of IP).

- *qualitative* (leadership skills, management capability, international acknowledgement and reputation, facility/lab organisation and management, qualification of the young people, placing on the market of young post Ph.D., training, communication etc...).

The former are derived from parameters available on the Web of Science (or equivalent database) or based on financial/management parameters. The latter are mainly related to a subjective assessment, usually delegated to external experts. There is therefore a need, common to all scientific institutions, to combine an evaluation using an algorithm (by objective parameters) with one of individual type, typically obtained from a panel of external experts and on-site visits with interviews.

b) A critical aspect of the scientific evaluation of a multidisciplinary institute like the IIT is the fact that the performance indicators above mentioned do not have the same weight in different areas (platforms). For example, for neuroscience, IF and CI are by far more

significant parameters than industrial fund raising or licensing and patenting. Diametrically opposite considerations apply to robotics. Therefore, it is not possible to elaborate universal algorithms and evaluation schemes. There is thus the need to introduce appropriate "weight functions" to adjust the value of both quantitative and qualitative indicators to the peculiarities of the different platforms. This in fact is equivalent, on the one hand, to tracing the principles and guidelines of assessment common to all platforms, and on the other, to developing a capacity to adapt these criteria to the different disciplines.

From the points raised it is clear therefore that assessment is a complex process that must take account of the institute's target and that must have *a strong subjective component (panel evaluation) grafted on an objective basis, customised to the field of research.* The evaluation process should therefore consist of a series of steps:

1. Identification of items of general interest to the foundation (system of objectives), and their weight functions by thematic area.
2. Identification of objective algorithms (if any) customised to the different thematic areas.
3. Identification of the panel of mixed, external experts, who are able to assess not only scientific aspects but are also able to harmonise points 1 and 2 even with subjective assessments (e.g. leadership skills or the potential value of young recruits).

In this sense, the role of the Technical Scientific Committee (TSC) is fundamental both as advisor in the set up of the mid and long term goals, as well as a driver of the assessment. The TSC establishes the external evaluation panels for the assessment, guides their activities, and helps in the implementation of reports and suggestions that emerge from the on-site visits.

2. Proposal for an evaluation method

On the basis of the points above, it is therefore necessary to proceed with the construction of a methodology for assessment, shared by the bodies of the Foundation and the scientific component (directors of departments and centers), that amalgamates the objective and subjective indicators and their relative weight functions for the various thematic areas. From this must stem the guidelines that the evaluation panel should follow in the years ahead. Based on established international practice the evaluation panel should be proposed by the Technical Scientific Committee (TSC) and appointed by the Executive Committee. The panel should be made up of both members of the TSC and of outside experts chosen from the international community, selected *ad hoc* and from time to time, with interdisciplinary profiles suitable for assessment of all aspects of the Institute activities.

The evaluation will assess the scientific and technical staff in its entirety, with specific attention:
on an annual basis to the determination of the variable part of salary for team leaders, senior scientists, research directors, technicians and administrative staff;

on a base of several years (every two-three years in start-up, every three four years in full scale operation) to the strategy and international positioning of the research units (Departments and Laboratories of the Network).

As discussed in the previous section, the assessment must take account both of scientific results and achievement of the expected scientific objectives, as well as the capacity of fund raising and technology transfer and leadership skills.
The research directors should be evaluated not only for scientific and technological excellence and fund raising but also for their ability to manage and guide their scientific infrastructure and to develop an interdisciplinary approach.
The administrative staff and management should be evaluated for their ability to create an environment that, compatibly with regulations and laws, would allow researchers to develop their research quickly and effectively.

Assessment on an annual basis

On an annual basis, the assessment is done through the preparation of a self-appraisal by each staff member, which shows all the quantitative and qualitative indicators for the activity of the previous year. The self appraisal is delivered to the staff members immediate superior (e.g. senior scientists for team leaders, director for the senior scientist) who in turn will draw up an individual assessment report in which, quantitative, qualitative parameters and the staff members objectives achievement will be evaluated. The MBO (Money by Objective) proposed percentage for the past year shall also be indicated in the individual report.

The research directors deliver their self appraisal to the TSC chairman. The evaluation will be carried out by all the members of the TSC.
All assessment forms and MBO proposals are also examined by the S.D.

The scientific director prepares the annual evaluation report for the Scientific Council and the Board of Trustees.

Assessment on a multi-year basis

The general assessment of the research structures instead is carried out on the basis of two or three years during the start-up phase and four-five years later. It is conducted by a panel of experts appointed by the Technical Scientific Committee for the on-site visit. The panel must evaluate both the quantitative and qualitative aspects properly weighted, as described in Section 1, it should interview the researchers to assess the real excellence and leadership skills and to assess the international scientific positioning, the vision and the scientific strategy for each IIT structure.

3. Synchronisation of assessment with the budget

Assessment has a key role in building the budget. The budget is a tool to direct management, through the choices of resources allocation to priority destinations, as well as an important yardstick in the process of accountability. The budget must be the result of a scientific programming, which in turn is the result of an evaluation of the activities and a strategic decision about what should be done, what should be discarded and what should be enhanced or strengthened. Thus, given the strategy adopted by the IIT Strategic Plan (top-down) the budget construction must be a bottom-up process, with detailed verification steps, synchronised with the assessment process and must arise from a development strategy and not be a merely administrative process.

For purely indicative purposes, the management sequence of the Foundation and the consequent involvement of the different organs might be as follows:

YEAR 0
September-October: Strategic Plan updating for the following year and definition of the relevant objectives for the MBO system purposes.

October – December: Budget drafting and approval by the Executive Committee.

YEAR +1
January: approval of the Budget by the Board of the Foundation.

January-March: assessment

- *annual* for staff members, based on quantitative and qualitative indicators measured within the IIT structure by the Scientific Director with the TSC support,
- *multi-year* on the basis of the on-site visits coordinated by the TSC.

June: check on the activities state of progress, budget review approved by the Committee, informative note to the Board.

September-October: updating of the Strategic Plan for the following year and check/redefinition of the relevant objectives for the MBO system.

October – December: budget drafting with adoption of the indications emerged from the assessment and approval by the Executive Committee.

4. Technology Transfer

The Technology Transfer (TT) activities remain a key aim of the IIT activity, therefore they represent an important yardstick of its success evaluation. However, it is necessary to analyse the opportunities and the possibilities offered by domestic and international markets to envisage from the beginning what might be a reasonable expectation of success (revenues) in TT. To this aim it must first be remembered that 70% of the SMEs which constitutes the industrial backbone of our country is broadly speaking a user of medium-low technology and in the rare cases of high-tech activities it has a limited investment power. Large domestic firms (including multinationals with an Italian centre of gravity) invest percentages varying between 10 and 15%in R & D, with a predominance of the D part rather than R. Furthermore, in most cases they resort to more public support via Italian law 297, *PON* (National Operative Programmes) or *Industria 2015* to which IIT cannot have access (or can access only in part), effectively making them an unattractive partner regardless of their quality. In this context, the presence of IIT centres in the South of Italy, or the participation of IIT on national and district structures, which have the right to access programme agreements with the regions, may play an important role. In any case, these possibilities are merely marginal and geographically localised.

From the international point of view, although IIT begins to be attractive as a partner for high-tech companies, it is necessary to consider the difficulty due to the young reputation of the

institute and to the competition coming from other well established research giants (e.g. Frahunofer, Max Planck, MIT, Weizmann etc.).

It is therefore absolutely essential to be completely aware that TT cannot be and will never become the main source of revenue of the IIT (just as it is not for the MIT or Weizmann, see benchmark in the appendix). It is rather from an integrated strategy of TT, which combines several actions, which the complete success of the IIT might originate:

- *Consulting services and/or jobs for companies*: This is a typology of TT that is generally based on small sized projects, consulting services and feasibility studies for SMEs and enterprises. The type of project is annual, aimed at the study of problems of technological and/or manufacturing, the innovative content rather small in view of resolving problems with short-term effects. Usually it does not have strong I.P. implications and has low costs. However, it requires a concentration of resources in the short term (especially staff will be distracted from the activities of institutional research on which it is assessed) and it is dispersed on large and very diverse issues. An institute like the IIT is already subject to numerous and frequent requests, potentially at odds with the recommendations of the Board concerning thresholds for small projects. It is therefore reasonable to assume that this type of projects should involve the IIT marginally and that it should always be carefully selected and screened.

- *Spin-offs and exploitation of internal I. P.* This is the most well known and discussed type of TT. At this moment the foundation has three ideas for spin-offs for which it is developing business plans together with the policies and management regulations. It is known that even in the more advanced realities of the world, spin-offs have a very high failure rate and rarely lead to significant financial results. In Italy the main problems concern the start-up phase, which almost always needs seed funds in the first two or three years, and the management of relationships with researchers who become entrepreneurs (IP, control bodies and the role of the Institute, potential conflicts of interest etc.). In this regard the establishment of a company seeded from the IIT might be worth considering for the future. It would be endowed with a start-up investment fund (seed fund typical size of 1 million euros per project, for the initial phase of the spin-off) with functions of "starter" of initiatives, possibly involving business angels, banks, savings management funds etc. External funding agencies would take part in the initiative with their capital while the IIT would give the company patents, designs and inventions (skills). The company mission would be manifold: (i) development of both applications on its own and with products together with synergistic industrial partners (possibly with the creation of new special purpose bodies), (ii) being a vector for innovation in Italy for the introduction of innovative methods in the existing industrial system, (iii) operating as a branch of IIT on the market, possibly responding to the needs of SMEs (see point 1) by reducing the tasks of the research institution.

- *Joint labs with large enterprises* This would be an action of medium-long term partnership with larger companies that could invest staff and resources in R&D. Researchers from the company and the IIT work in the same environment, with shared targets and an agreed road map. These activities require adequate logistical solutions, large laboratories and very advanced management of I.P. Generally speaking, the programmes to be developed must be sufficiently long-term to interest the research institution and highly target-

oriented to be of interest to the company. The mixed team creates interdisciplinary professionals in great demand, and if well managed gives excellent results both to the research institute, which can aim its activities at real projects in technology, and to the company which can develop processes, ideas and products that could not otherwise be developed internally. The possibility of establishing joint labs also maximises itself by offering expertise and infrastructures on different thematic platforms, and network structures in more premises, as proposed in the new strategic plan. A typical I.P. management scheme envisages joint ownership of patents, an exclusive license for the industry in areas of reference for its core-business, and an opportunity for the institute to exploit the inventions in applications other than the core business of the partner company (possibly giving it a right of first option).

Beyond the general nature of the term, Technology Transfer is based on scientific excellence (which remains the main objective of the IIT) and on new products and new research ideas, and takes time, seriousness and credibility (see benchmarks in the Appendix, Figure 4). The measures briefly described must be implemented in parallel, especially at a time of general crisis in which the already low propensity for risk of our companies is exacerbated by market conditions.

From the point of view of assessment it must be clear that these results are a combination of a growing reputation and international visibility along with a well-organised national and international network of relations with companies, which develops through a constant work of scientific quality and seriousness of the institute. This takes time, like any other process of confidence building in the international market and cannot be improvised. Therefore, the role of evaluation is that of encouraging actions that go in this direction and to stop everything that is not functional for this difficult and challenging process.

5. Guideline proposals for a Technology Transfer strategy for IIT

It is necessary to set up an operational plan that:

a. identifies the areas of technology and products of primary interest, depending on the stage of development of IIT in each scientific discipline;
b. identifies the target market of companies that might become partners of the IIT;
c. establishes a systematic plan of action towards target companies;
d. sets out in sufficient detail and depth, the most suitable modalities of Technology Transfer than can be created compared to the areas and targeted businesses.

The first step towards setting up the operational plan is to create a structure dedicated to technology transfer within the IIT Foundation. This structure must progressively incorporate:

- □ the currently existing patent office (3 units of which two senior and one junior);
- □ two senior profiles for scouting with and within companies (one in the wetware area and another in hardware);
- □ a legal expert on IP and contracts;
- □ a financial expert for the management /preparation of business plans and relationships with external funders.

It is reasonable to assume that this structure can be completed within the next 12/18 months.

6. Fund raising capacity

While being another important objective parameter of the appraisal process, the ability to attract funding is "environment-dependent" and as such requires a conscious capacity discernment on the part of the evaluator. At present, the IIT can procure funds for research through the following channels:

- European projects
- private funds, grants and Industrial Technology Transfer
- public funds via State tenders
- other options (donations, foundations, local authorities etc.)

For European projects the IIT is absolutely state of the art with a high success rate, superior to almost all other European institutions. However, as we know, European projects do not finance infrastructures and equipment but only research and personnel costs. So they cannot in any shape or form be considered as a primary source of income (average size less than a million Euros in three years).

For private funds the considerations of the previous point are valid so it is unthinkable in the short term to have an IIT substantially supported by industrial funds. For public funds the IIT has a competitive disadvantage upstream, since due to its legal nature it is prevented from participating in most of the ministry's calls to tender (MIUR, FIRB, PRIN, authority tenders etc. that also have low budget and periodicity is not guaranteed). The other options in Italy are marginal both for social and fiscal reasons.

Therefore, it is clear that for the purposes of a meaningful and high-level assessment, the weight of the "fund raising capability" parameter should be appropriately weighted by the factor of "actual fund raising opportunities". Needless to say that such assessments cannot be based on simple algorithms, but must go through a complete evaluation by an expert and high-profile panel of independent third parties, but not necessarily consisting of only foreigners.

It is reasonable to deem that a fund raising capacity between 20% and 30% of the budget allocation of a department (staff, consumables, durables, travel, services) should be considered an excellent performance for the IIT, which is comparable to the best international technology institutes (see Appendix).

7. IIT Indicators and Strategic Objectives

From all the foregoing discussion it appears that the system of evaluation is closely related to the definition of both qualitative and quantitative goals that are clearly defined and measurable, albeit with the necessary flexibility linked to the non-deterministic nature of the activities which a research institute carries out. In this sense we can propose the following qualitative and quantitative objectives for the Institute activities :

Quality objectives

1) SCIENTIFIC VISIBILITY: internationalisation of IIT, measurable through the construction of international, bi/multilateral, industrial and project based agreements The world of science and technology only accepts first-tier partners, therefore important partnerships are good indicators of correct technical and scientific choices and of credibility in the medium and long term.

2) SCIENTIFIC ASSESSMENT: external panels for the assessment of (short-term, fixed frequency) both the quality of researchers and the general activities of IIT, with constant attention to the international state of the art.

3) PUBLIC PERCEPTION: this is a random but also very crucial indicator. For example: public awareness of IIT, relations with the ministries, relationships with other research bodies, ability to innovate and operate in the context of research minimizing antibodies and conflicts but preserving the quality and the prerogatives of the foundation, independence from politics and high-level communication.
4) MANAGEMENT SKILLS: administrative and management efficiency, problem-solving approach to bureaucratic problems, speed and fairness of the procedures.

5) HUMAN RESOURCE MANAGEMENT: procedures for high-level hiring, career paths for researchers, an international staff, IIT researchers' satisfaction and sense of belonging.

6) IIT INTERNATIONAL POSITIONING: to date, in the five-year period of reference 2005-2009 for the start up and 2009-2011 for the new strategic plan, substantial resources have been invested (or will be invested in accordance with the programme) on seven platforms:

- Robotics
- Neuroscience
- Drug Discovery Development and Diagnostics (D4)
- Environment Health and Safety (EHS)
- Smart Materials
- Portable Energy
- Computation

forming multinational teams of scientists in research units of the highest national level, spread throughout Italy (called IIT@seat). The attached table summarizes the research units involved on each platform, and the total budget and the staff allocated for each platform at the national level on a five-year period of reference

	Robotics	Neuro	D4	EHS	Smart Materials	Energy	Computation	
RBCS – Sandini	X	X			X		X	
ADVR – Caldwell TERA-Fontaine	X X						 X	
NBT Benfenati	X	X		X	X			
NanoPhys Diaspro			X	X	X	X	X	
Nanochem Manna			X	X	X	X	X	
NanoFab Difabrizio			X	X	X	X	X	
D3 Piomelli			X				X	
IIT@UniParma		X						
IIT@UniLE	X			X	X	X	X	
IIT@NEST-Pi			X	X		X	X	
IIT@PoliMi					X	X		
IIT@IFOM-Mi			X	X			X	
IIT@SSSA-Pi	X				X			
IIT@UniNa			X	X	X		X	
IIT@PoliTo	X				X	X		
IIT@UniTn		X						
								Total
Total budget MEU	65	53	56	37	46	40	13	310
Total people	261	157	128	87	118	108	38	897

The contributions of the various departments/facilities of the Central Research Lab in Morego are shown in green on the different platforms of the strategic plan 2005-2008 and on the new strategic plan 2009-2011. The budget and personnel refer to the period 2005-2010 (2007-2012 for the D4 platform).
The contributions of the different centres of the IIT network are shown in red on the different platforms of the strategic plan 2009-2011. The forecast for budget and personnel refers to the financial plan approved for 2009-2013.

Considering such investments, it is therefore essential to foresee what the positioning of IIT could be internationally in the technical and scientific fields represented by the different platforms.

- **Robotics has successfully demonstrated how with a massive and targeted investment, such as that undertaken at the central laboratory in Morego, Italy has brought itself to the level of the top 5 in the world, with a large margin for growth and consolidation. It is reasonable to assume that the main objective of the robotics platform will be the continued growth of iCub as "open source hardware" used by a growing number of laboratories around the world, for the development of a biomimetic humanoid.**

- The identification of macro goals for neuroscience is more complicated. This platform has a year's delay from robotics. The first on-site visit of the Scientific and Technical Committee panel is envisaged for the summer of 2010.
- The pharmacological platform came into function in April 2010 and aims to develop a scientific programme on new generation neuro-pharmaceuticals and pain killers in close collaboration with venture capital suppliers and pharmaceutical industries.
- The new platforms of the 2009-2011 Plan, , aim to consolidate the interdisciplinary approach of the IIT, which has a visible and obvious target in the system integration of iCub, but also to develop some innovative technology on which the international competition is very strong. In particular:

    - Energy: development of low cost, portable energy sources with high efficiency, such as plastic solar cells with a cost target of 50 euro cents/W and 10% efficiency, highly efficient energy harvesting, new nano-structured electrodes for fuel cells and catalysis.
    - Smart Materials: development of nano-composite organic and inorganic materials with engineered physical, chemical and mechanical properties and responsive surfaces for applications ranging from transport to prostheses.
    - EHS: assessment of the toxicity of nano-materials in view of the future standards of safety certification of nano-materials envisaged by the governments of countries with high technological development over the next 10 years.
    - Computation: as transverse service and development platform of the multi-scale computational methods necessary for the design of the complex systems needed for other platforms.

It is obvious that in the coming months of 2011 the IIT should proceed with the identification of general long-term goals such as:

- the international positioning of the IIT by area of scientific research (which role of leadership do we intend to pursue and at what level on the international stage?)
- IIT capacity to produce human resources of "world class";

and midterm goals that could instead be:

- the general scientific visibility of the IIT
- systematic scientific evaluation in accordance with international standards of the activities and its staff.

Quantitative Indicators

1) GROWTH OF THE IIT BRAND: performance of the IIT network at the national and international level, (measurable with publications, patents, contracts, impact factor, citation index and fund raising).

2) FUNDING (national, international, public and private grants), bearing in mind the considerations of sections 5 and 7.

3) TECHNOLOGY TRANSFER: set up of a high-level system of technology transfer, setting up of spin-offs, licensing and royalties. Main actions of technology transfer:

- Transfer of products of IIT research to the clinical world from D4, EHS, Neuro
- Transfer of products of IIT research to the pharmacological and diagnostics industry from D4 and EHS
- Transfer of products of IIT research to manufacturing and high tech industries (transport, ICT, electronics etc) from Energy, Smart Materials, Computation and Robotics
- Creation of Spin-offs
- Divulgation
- Creation of joint laboratories with companies

Appendix 1

Benchmark data on some important European and American Research Institutes.

GOVERNANCE

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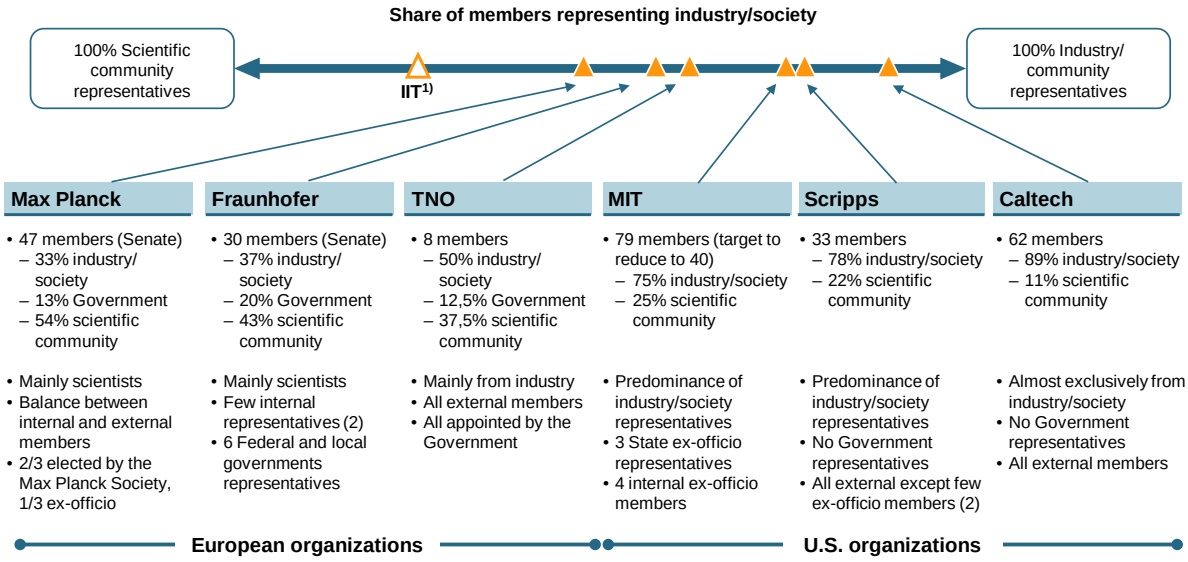
Governing boards' composition shows a presence of (external) scientific representatives that hardly exceeds half of members

Board composition

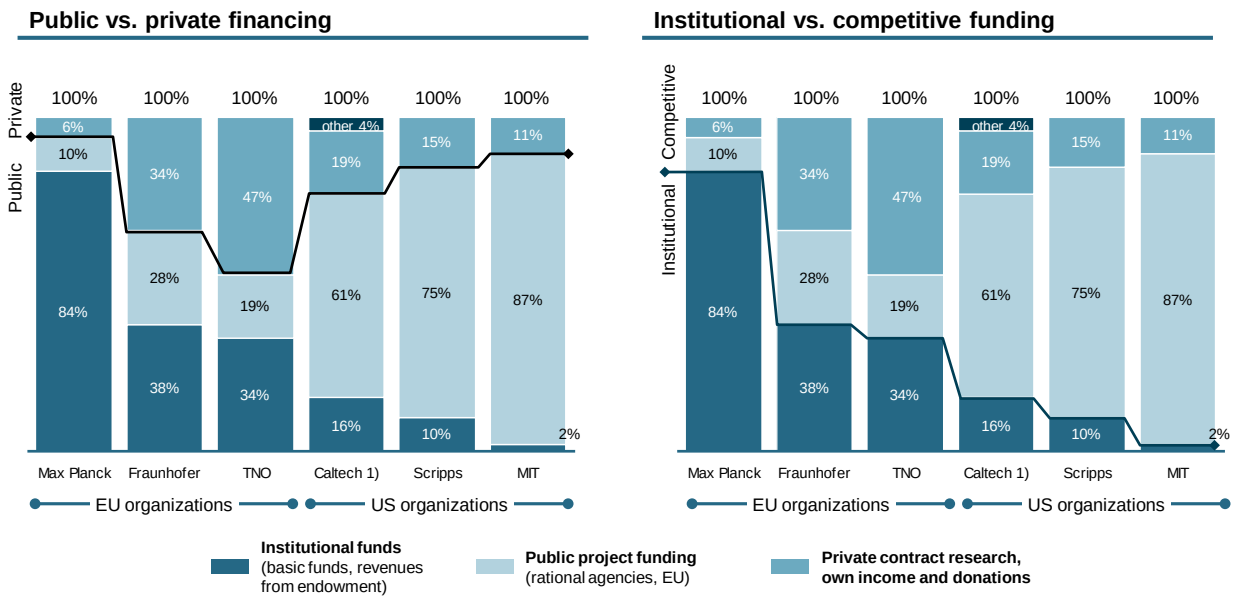


1) Present Board composition

All institutions rely heavily on public funds, increasingly granted competitively to specific research programs

Funding sources: detail by research organization

BACKUP



1) Assumptions: net of tuition and students financial aid; return on endowment assumed at the average value of the past years (23%); donations allocated to education and research based on the students to scientific staff ratio

The main information deduced from this benchmark is:

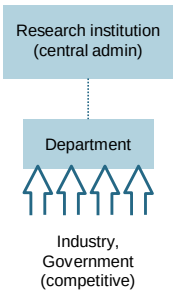
1) The public component is substantially prevalent compared to the private one.
2) The public competitive component is substantially predominant compared to the funds available, but in all countries there is sureness and repetitiveness of tenders and calls for proposal.

American and European institutions have different funding models, which explain most of their organizational differences

Funding models

US "bottom-up" model: competitive grants

(e.g. Caltech, MIT, Scripps)



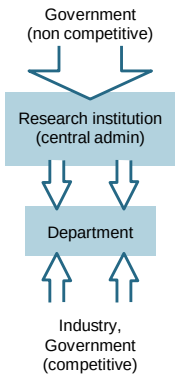
- **Funding model**
  - no institutional funds –public funds are allocated as competitive grants to project proposals
  - single departments bid for grants, mainly from the Government agencies

Impact on research organizations

- Little/no involvement of the central administration in research planning (no research funds distributed centrally)
- Highly competitive environment: researchers only rely upon the sponsorships they raise from the market
- Maximum level of financial and scientific autonomy: departments are normally financially independent and manage their own funds
- Some disadvantages: a considerable share of professor time is spent to prepare applications

EU "top-down" model: institutional funding

(e.g. Fraunhofer, Max Planck, TNO)



- **Funding model**
  - considerable share of institutional funds –research organizations are assigned public funds that they can autonomously allocate
  - departments receive funds from the central administration

Impact on research organizations

- Strong involvement of the central administration in research planning
- Less competitive environment: researchers rely upon the funds they receive centrally along with the sponsorships they raise from the market
- Lower level of autonomy: departments are financially dependent from their organization

Additional data for the Weizmann Institute in Israel

An important goal of the Weizmann Institute is the conversion of research findings and academic knowledge accumulated by its scientists into practical applications for the improvement of health and the standard of living. Thus, the Institute encourages cooperation with commercial entities to promote high-tech and bio-tech industry, especially in Israel.

Relationships between its scientists and industrial or business entities are governed by the Weizmann Rules of Intellectual Property and Conflict of Interest. Marketing and commercialization of all Intellectual Property is accomplished by Yeda Research and Development Co. Ltd, the Institute's commercial arm.

Revenues (US Dollars)	**X 1000**	**%**
Appropriations and grants from the Government of Israel	74.3	36.0
Donations and legacies	47.1	23.0
Revenues from research	52.3	25.6
Financial income and investments	15.3	7.4
Institute share of **royalties** from Yeda	10.8	5.3
Other revenues	5.4	2.7
Total	**205.3**	**100.0**