



Istituto Nazionale di Fisica Nucleare
Coordination for External Training
and Technology Transfer

Fundamental research and technology transfer activity at I.N.F.N. - L.N.F. : a preliminary sample

Presented

by

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**on behalf of the Committee of National Technology
transfer and external training (TTFE of the I.N.F.N).**

I.N.F.N.- L.N.F.

(Laboratori Nazionali di Frascati)

Summary

1) Interaction models

2) Methods of investigation:

- a) sample selection
- b) data definition
- c) company registry
- d) size & type of relationship

3) Data analysis

4) COMEB company : a “*representative model*” of the INFN Technology Transfer Activity

Fundamental Research and Technology Transfer Activity at the INFN

Abstract

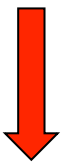
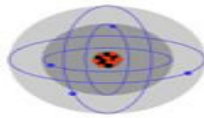
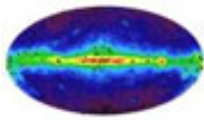
The fundamental research of the I.N.F.N. (Istituto Nazionale di Fisica Nucleare) requires innovative technologies to generate development and making the institution competitive. In addition to scientific research, the I.N.F.N. also generates various kinds of economic and innovation benefits to industrial companies in manufacturing devices for the scientific activities.

Therefore the collaboration with companies has become an essential aspect. In order to consolidate the connections with the industrial companies the I.N.F.N. has constituted a dedicated team to organize actions on each area of Italy.

In particular, in this presentation we report the results in terms of spillover effects (economic impact, new market, employment growth, new competence, growth image) obtained by industrial companies working with the I.N.F.N.-L.N.F. (Istituto Nazionale di Fisica Nucleare – Laboratori Nazionali di Frascati) scientific activities

I.N.F.N. research activities

- ✓ The **I.N.F.N.** - National Institute of Nuclear Physics - is an organization dedicated to the study of the fundamental constituents of matter, and conducts experimental research in the fields of **particle physics, astroparticle, sub-nuclear and nuclear physics, theoretical physics and technology research.**
- ✓ Fundamental research in these areas requires the use of cutting-edge technologies and instrumentation, which the INFN develops both in its own laboratories and in collaboration with the world of industry.
- ✓ These activities are conducted in close collaboration with the academic world.



**Particle
Physics**

**Astroparticle
Physics**

**Nuclear
Physics**

**Theoretical
Physics**

**Technology
Research**

Survey methodology

✓ Selection of the sample: 80 companies random and “selected”

1. From a list of suppliers, made available by the administrative departments of the single structures, we selected firstly those companies with which INFN had **substantial or continuous** economic relationship.
3. A further selection of the sample was made by choosing **randomly** the companies and also by considering those, whose relationship with INFN, **was already known to the interviewer**.

✓ Definition of business areas: categories

1. Type of business;
3. Amount and type of financial relationship of the company with INFN;
5. Parameters for assessing the impact on business.

INFN business with the companies in the frame of the technology transfer is split as:

Supply: order of goods already available by the company or that are standard products of the company itself.

Job order: production and supply of goods upon design and technical assistance of the INFN; production and supply of goods that comply with the experience of the firm.

In both cases the company is fully responsible of the job. The final product is innovative with respect to company know-how.

R&D: commission the company to develop, in close collaboration with INFN, technologies and goods that can be realized by the firm. The company is only responsible of the job execution

Definition of database fields (for the data-base creation) : I

Company registry consists in :

✓ **Name;**

✓ **Region Membership;**

✓ **Type of production:**

1)Electronics-customer (computers, electron. boards & components, printed boards, power supplies ,...);

2)Materials (composite material, supercond. cables & wires);

3)Mechanics (mech. products and instrum., precision mechanics, struct. metalworks);

4)Medical (medical accelerators, dosimetry instrum., hadrontherapy instrum., diagnostics);

5)Nanostructures-vacuum (vacuum technology & instrum.; crystal production);

6)Specialized instrumentations (detectors, magnets, RF systems, nuclear instrum., Laser)

✓ **Number of employees;**

✓ **Average annual turnover.**

Data-base fields : II

Amount and type of financial relationship of the company with the INFN :

- ✓ **INFN average annual turnover for the supplies ;**
- ✓ **Type of relationship:**
 - **Supply;**
 - **Job order;**
 - **R&D.**
- ✓ **Percentage of annual turnover from INFN**

Parameters for the impact assessment :

- ✓ **Development of a product successively marketed:**
yes/ no
- ✓ **Hiring of new personnel;**
- ✓ **Company image outcome:**
 - **None**
 - **Excellent references**
 - **Know-how expansion**
 - **Market expansion**

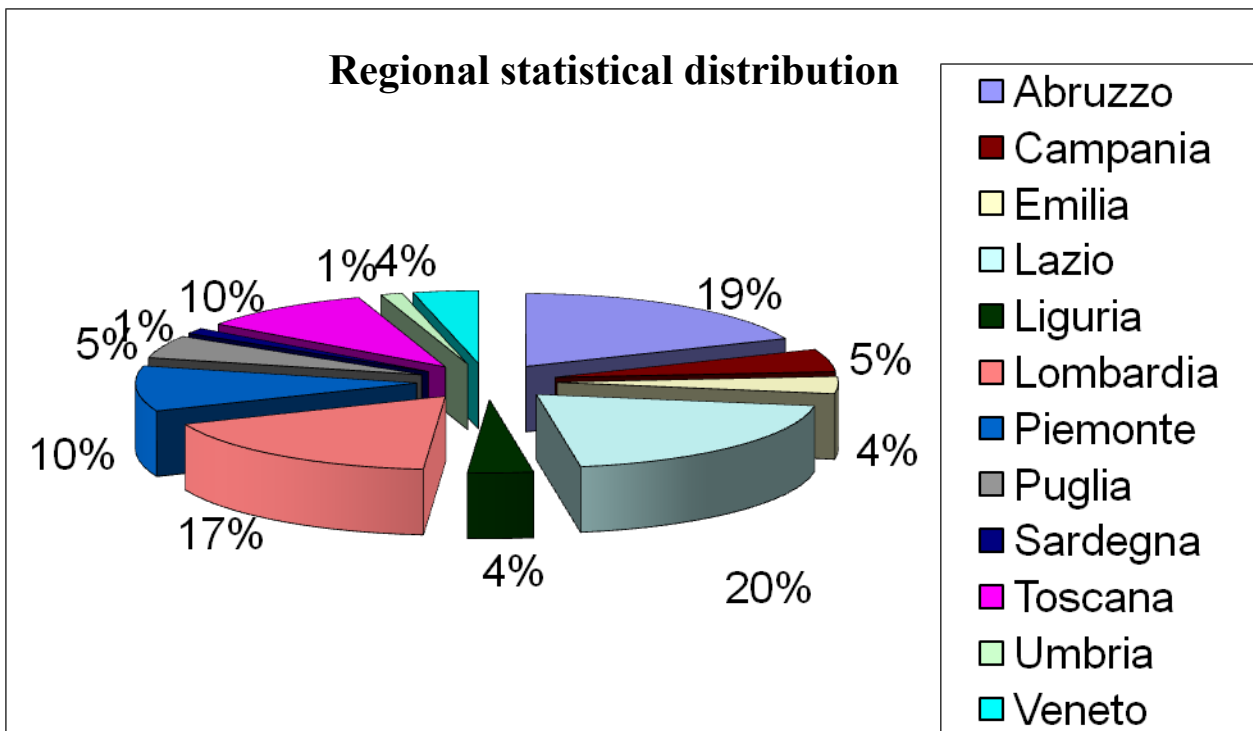
Guidelines of Technology Transfer from INFN to Industry



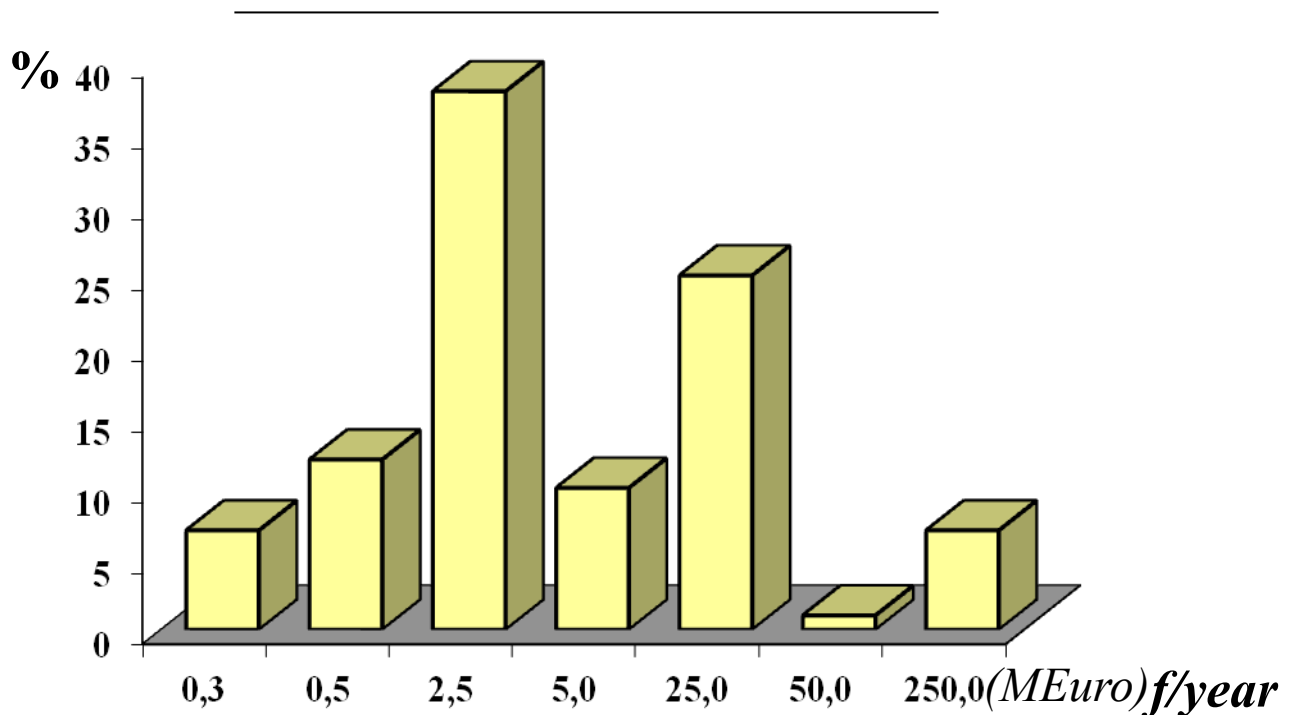
Data analysis: statistical distribution of the fields (80 companies statistic)

Distribution of the membership regions of the interviewed companies

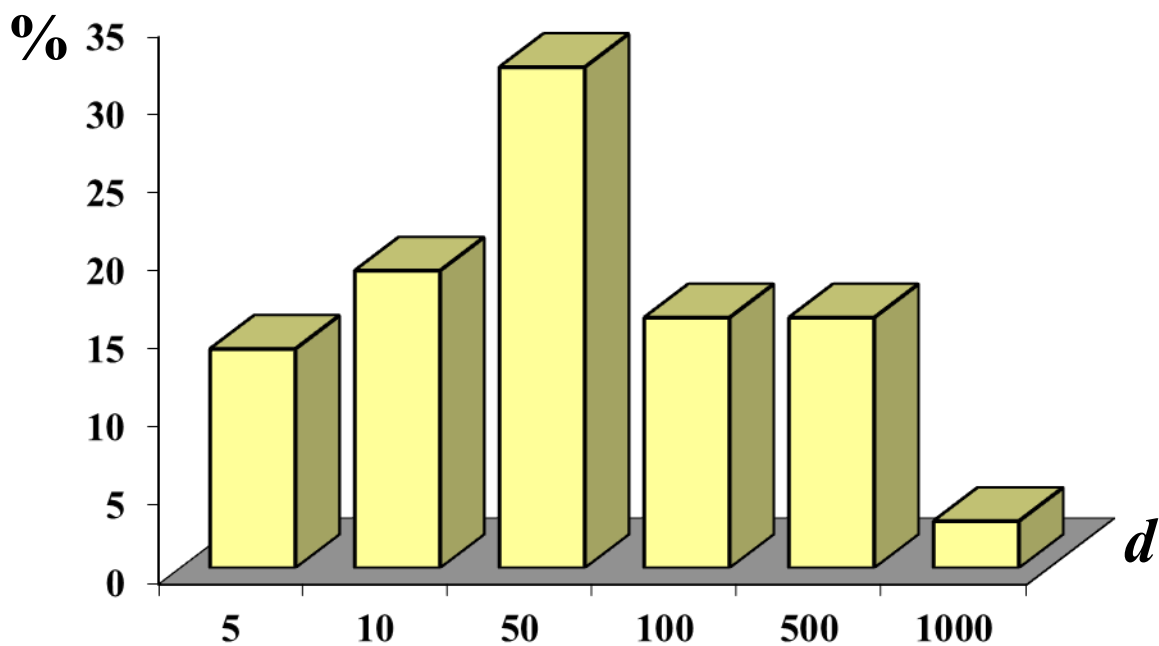
Region	%
North	41
Centre	53
South + Islands	6



Companies size distribution



Companies distribution (%) according to average annual turnover $f/year$.



Companies distribution (%) according to the number of employees d .

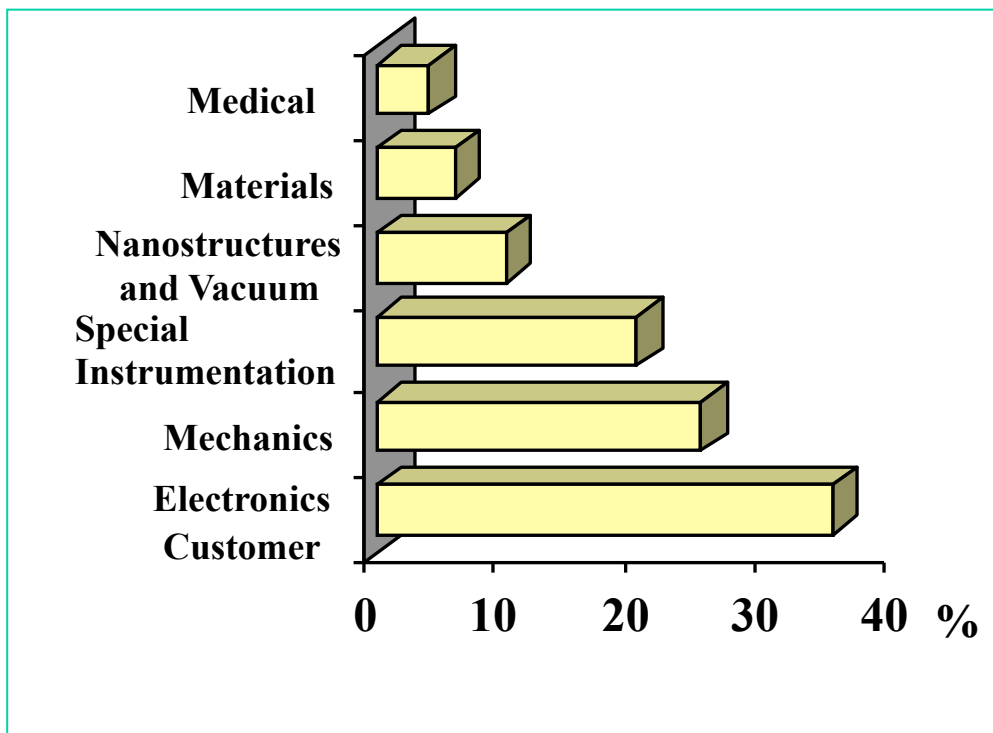
Companies data

Companies distribution per size: small, medium, big industry.

Company	a) Average annual turnover		b) N. of employees	
	MEuro/year	%	Employees	%
Small	0 - 5	68	1 - 99	81
Medium	5 - 25	24	100 - 499	16
Big	> 25	8	> 500	3

For INFN is convenient to work with small companies for:

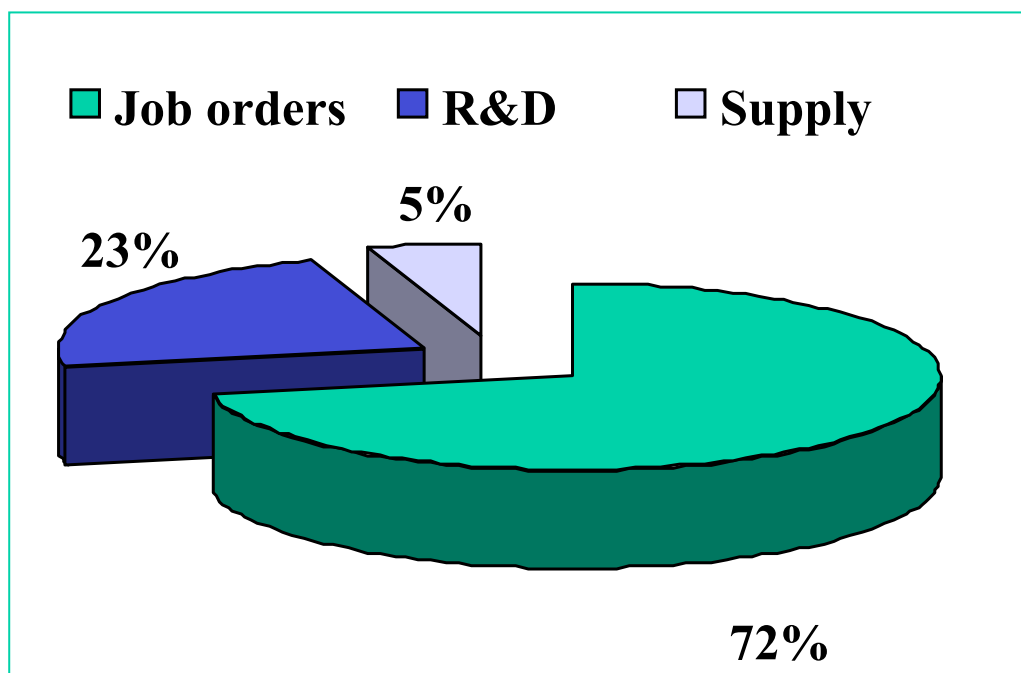
- a) Economic reasons and a better products quality;
- b) Small company has a better ability to adapt the demands of the INFN (small company is more flexible or less rigid with respect to the big one).



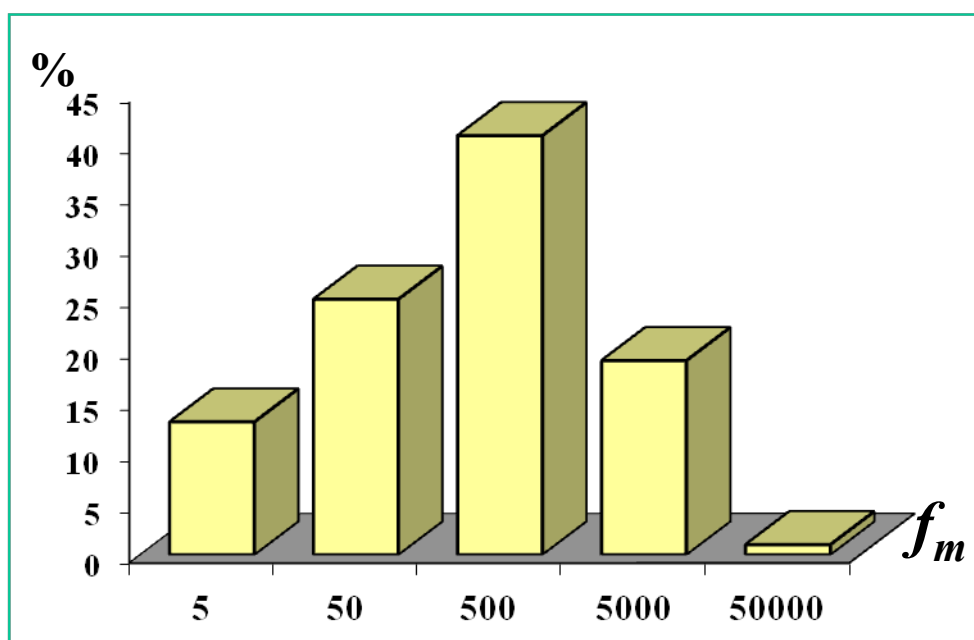
Distribution of the product categories handled by the companies interviewed.

Electronic, Mechanics and Special Instrumentations represent the 80% of the market that is accessed by INFN.

INFN/Companies Relationship

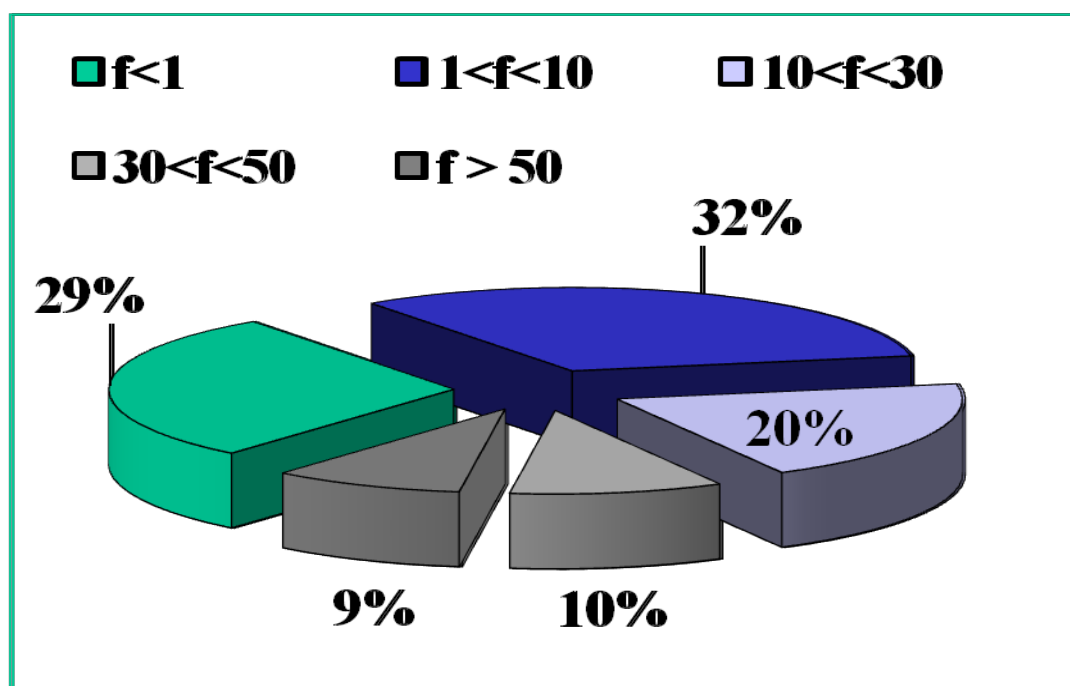


Distribution (%) of the relationship type among INFN and the companies interviewed



Companies distribution according to the average annual turnover f_m (in kEuro) from INFN (for engagement with the INFN).

Annual turnover of the sample firms with INFN: percentage of total



Companies distribution according to percentage of the turnover f (MEuro) for commitments with INFN, with respect to the company total turnover.

Note that:

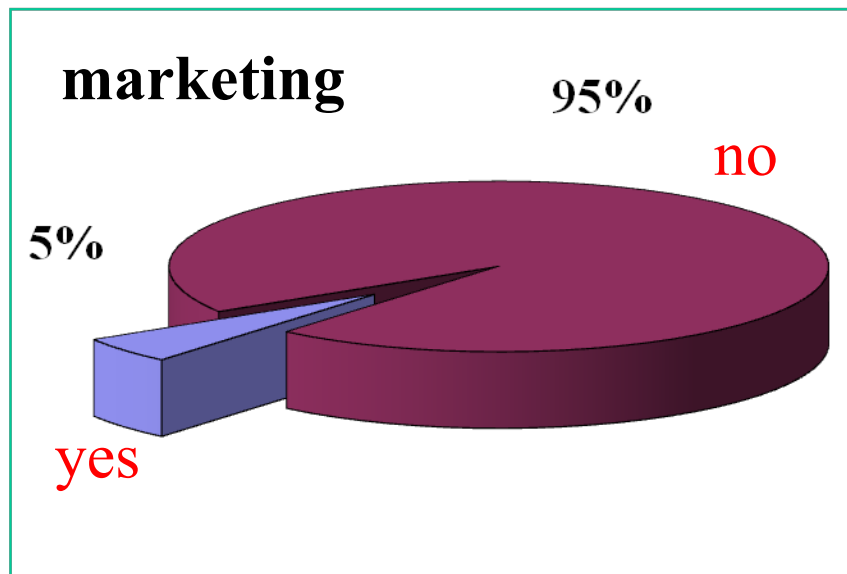
for 9% of the firms, the turnover with INFN represents **more than 50%** of the company total budget;

for the 30%, the turnover with INFN is **“important”** and represents more **than 10%** of the company total budget;

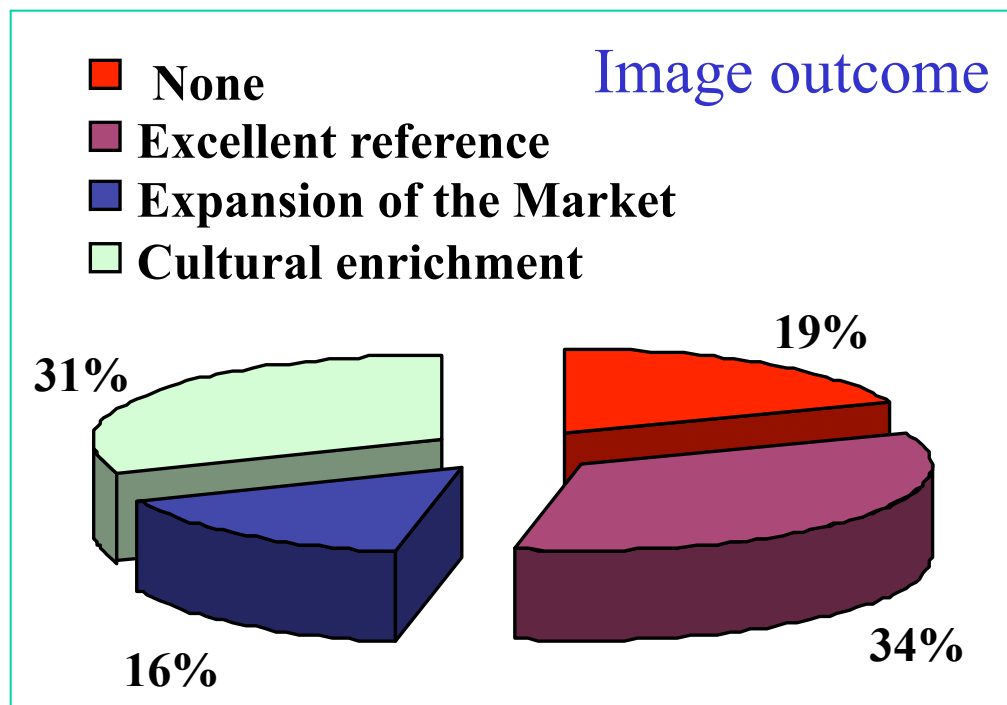
for the 32%, the turnover with INFN is **“standard”** and represents less **than 10%** of the company total budget;

for the 29%, the turnover with INFN is **“negligible”** and represents less **than 1%** of the company total budget;

Impact of INFN on sample firms

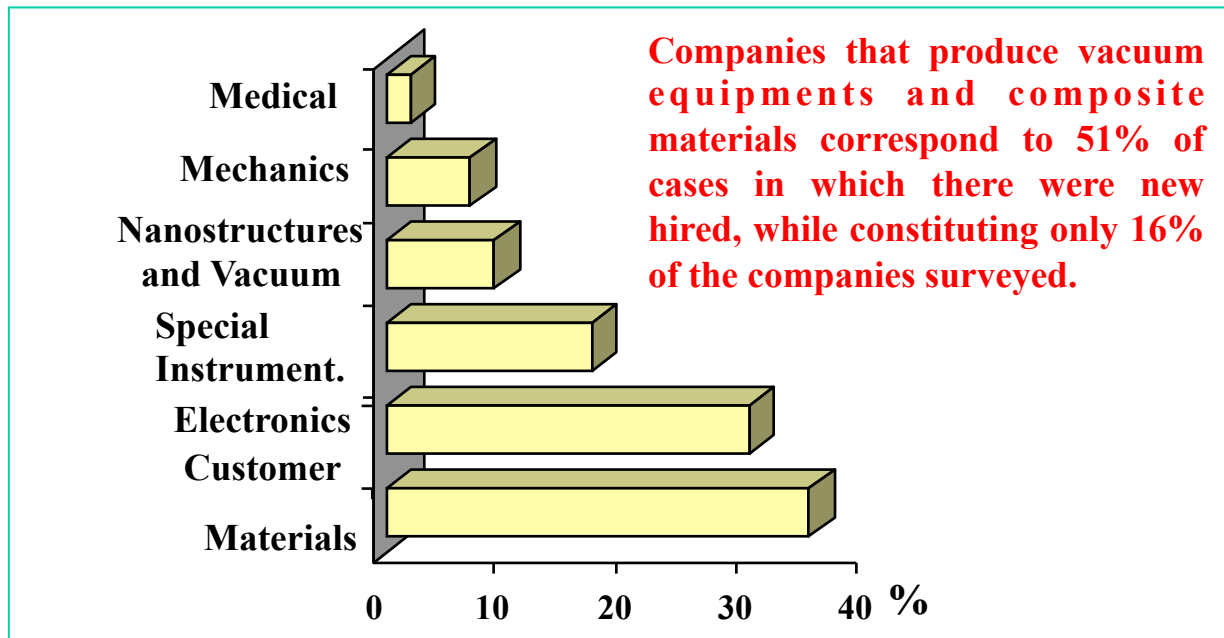


Companies distribution who marketed the products made in close collaboration with INFN.

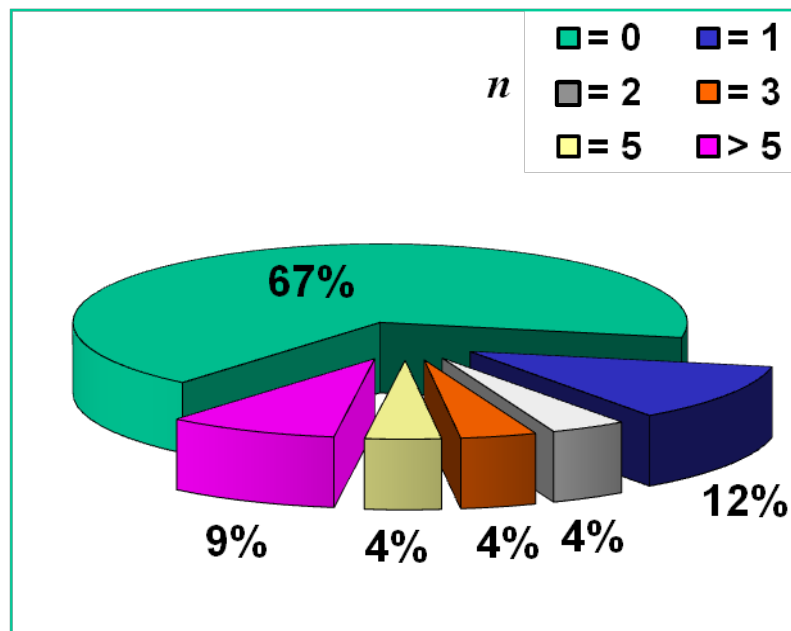


Distribution of the image spillover among the interviewed firms

New Hires (as a result of commitments with INFN)

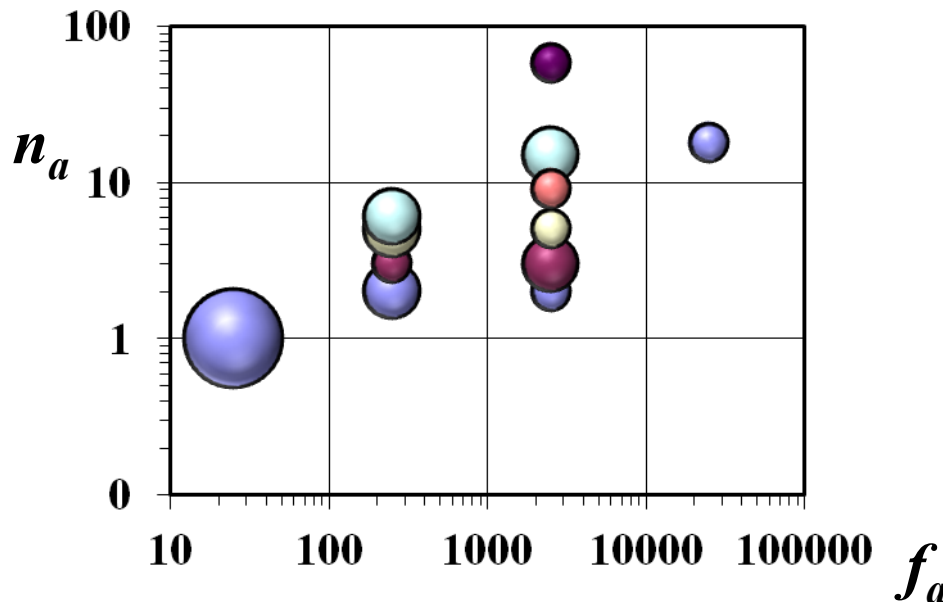


Distribution of the number of new employees as a result of commitments with INFN by category of product sold.



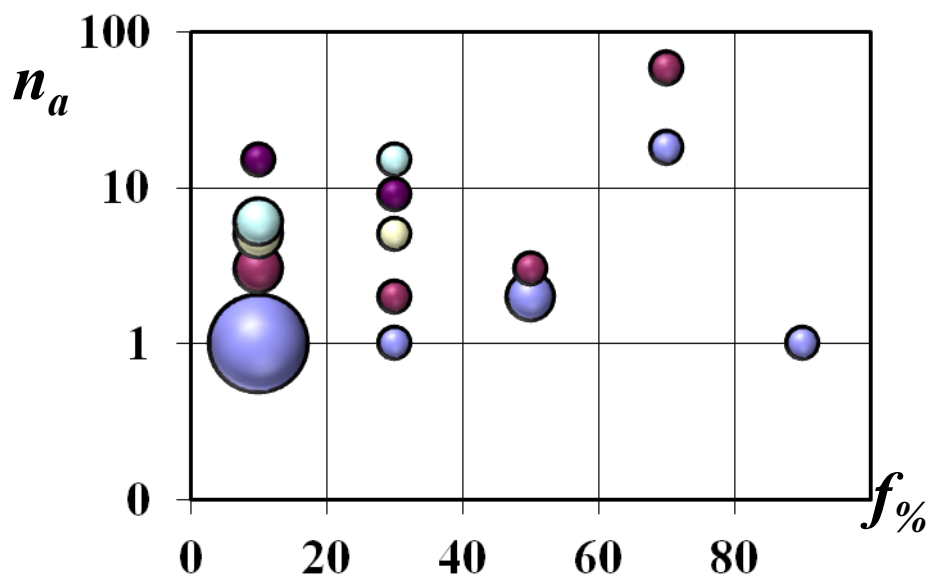
Statistical distribution of the firms according to the number n of new employees, hired as a result of commitments with INFN

Correlations: new employees vs turnover with INFN



Correlation between the number of new hires and the annual turnover f_a (k€) with INFN.

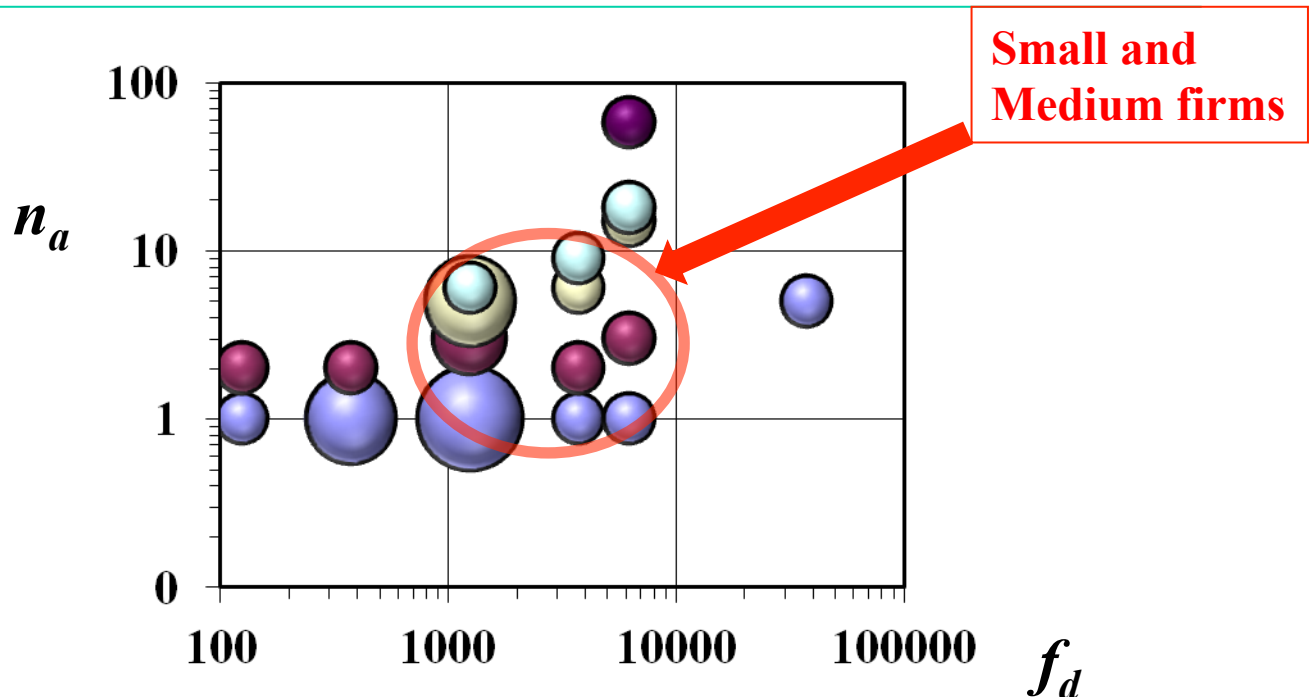
A close correlation between new hiring and turnover with INFN is clearly shown.



Graph of correlation between new employees n_a and percentage of turnover from INFN $f\%$.

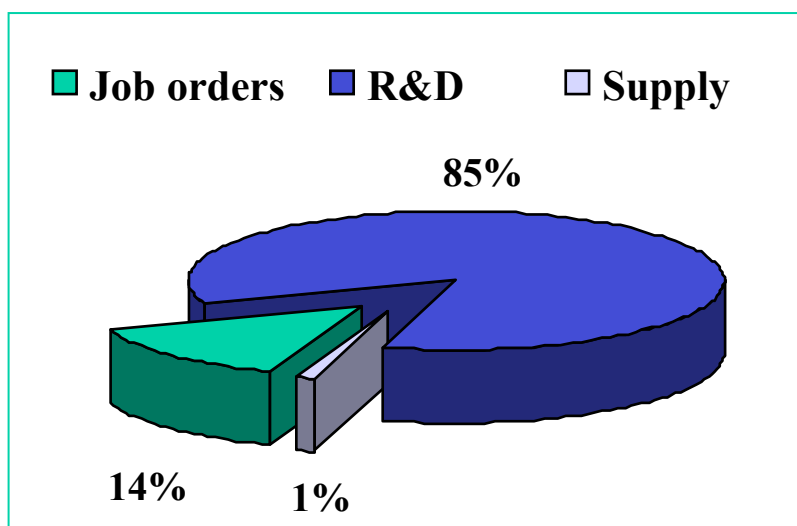
This correlation is poor and it has to be improved !!! !!!

Correlations: new employees vs size of the firm and type of business



Correlation between number of new hires n_a and annual turnover f_d (in k€) of the company.

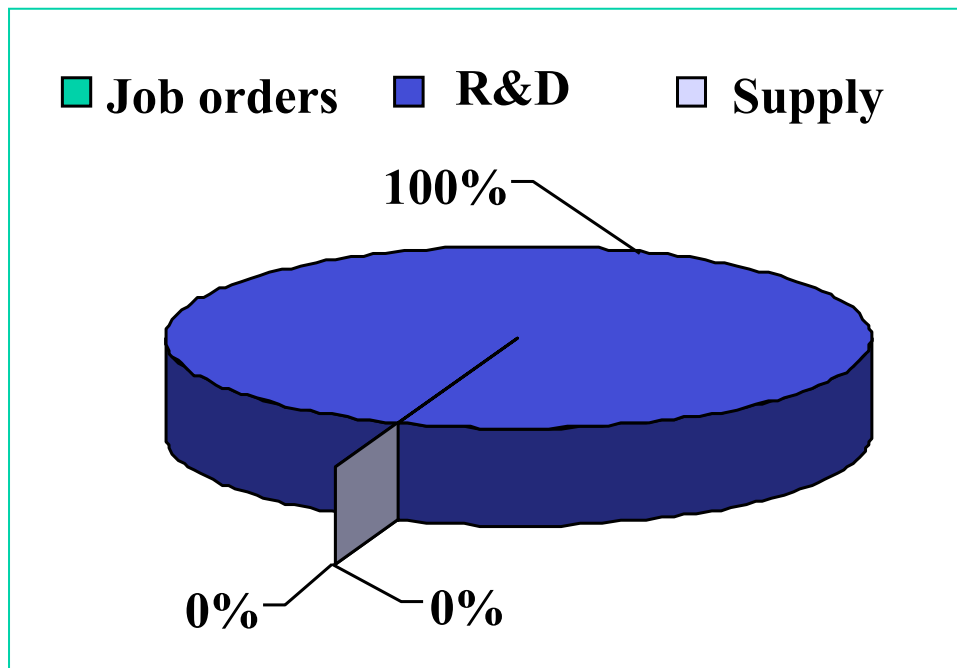
A greater impact occurs for small and medium companies.



Distribution of new hires according to the type of business.

**The 85% of new hiring is due to R&D activity
in close collaboration with INFN !!!!**

Impact of INFN on the firms



Distribution of marketing cases as function of the type of business among INFN and companies.
Marketing of products is due to the R&D relationship in close collaboration with INFN : limited to 5%

81 % positive impact
(16% is market expansion)
19% no image outcome

for 9% of the firms, the turnover with INFN is “vital” (> 50% of the total);
for the 30%, the turnover with INFN is “important” (> 10% of the total);
for the 32%, the turnover with INFN is “standard” (< 10 % of the total);
for the 29%, the turnover with INFN is “negligible” (< 1% of the total).

33% of firms has hired new personnel



<http://www.comeb.it/>

CO.ME.B is a “*representative model*” of the INFN Technology Transfer Activity

CO.ME.B. was founded in 2005 by Mauro and Roberto Bonifazi, and now has 8 employees.

Profile of CO.ME.B

CO.ME.B is a high-tech company specializing in precision mechanical construction, with particular regard to scientific research.

CO.ME.B has established itself as a landmark company in Central Italy thanks to the special attention that it dedicates to the needs of each individual customer.

CO.ME.B provides subcontract mechanical work, designing and realizing everything from single components to complete machines. Its products are used in all industrial and scientific sectors and CO.ME.B has a proven track record in the aerospace industries and archaeological research.



<http://www.comeb.it/>

Satisfying the needs of industry and the world of research requires a high degree of flexibility. **CO.ME.B is capable of meeting the diverse needs of its customers**, spanning a wide range of sectors with the most appropriate approach and materials.

Highlights of activities

1) Design and production of systems and components for the aerospace industry.

- Automatic Machine for ultrasonic inspection of the USA Presidential Helicopter central rotor.



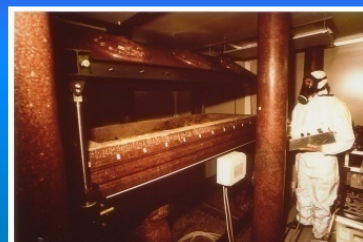
2) Design and production of UHV (Ultra High Vacuum) equipment and components for industrial applications and scientific research.

Emittance-meter



3) Design and production of equipment for archaeological research.

Minimal Opening
of the King Federico
II sarcophagus





<http://www.comeb.it/>

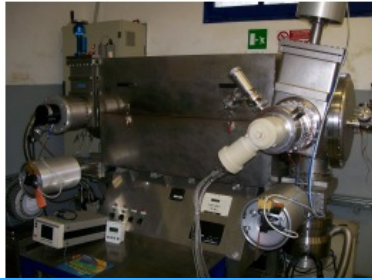
A company's customers are its greatest asset and a guarantee of its commitment. CO.ME.B enjoys the trust of important research institutions and large public and private companies

Some of our Customers

ACRONYM	NAME
INFN	National Institute of Nuclear Physics
CERN	European Organization for Nuclear Research
ENEA	Institution for New technologies, Energy and the Environment
CNAO	National Centre of Oncological Hadrotherapy
P.S.I.	Paul Scherrer Institute
ELETTRA	Free Electron Laser for Multidisciplinary Investigations
FONDAZIONE TERA	Fondation of Technologies related to Biomedical Physics
LA SAPIENZA	University of Rome
INAF	Astro Physics National Institute
INSEAN	National Institute for Studies and Experience of Naval Architecture
	Ministry for Cultural Heritage and Environmental
ICR	Central Institute for Restoration Capitoline Museums



Equipments available for the activities on RF accelerating structures **(with no public funding)**



**UHV
baking
system**



Manufacture: COMEB SrL

Cost: 350,000.00 Euro (investment 200,000.00)

Works required: Out-gassing process in vacuum (at 650°C and <math><5E-8</math> mbar for 15days) for the X-band structures of ELETTRA and PSI.

Results achieved: operation at 650/700°C at about

Acquired know-how: Experience in the field of vacuum heat treatment; acknowledgement of successful execution from CERN, ELETTRA, PSI; further works of out-gassing treatments in the near future for the above Institutions and the INFN.

Equipments:

3 turbo molecular pumps of 4500 l/s total

2 ionic pumps of 800 l/s total

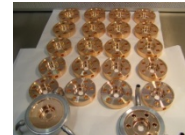
1 criogenic pump of 1500 l/s

1 Mass spectrometer

1 Automatic current generator in case of blackout of the main network



Ultra precise lathe machine (with no public funding)



C-Band



X-Band

**3 GHz RF Deflector for
(Frascati, Psi, and Elettra)
Frascati RF gun etc.**

Manufacturer: SCHAUBLIN (Switzerland)

Cost: 100,000.00 Euro (initial) plus costs for research and development of special tools

Works in progress: X-band structures for INFN and CERN; C-band for INFN.

Performances achieved: Operates at +/- 0.002mm with surface roughness of about 0.02 Ra.

Outcomes: CERN and INFN acknowledge the excellent execution of the work.

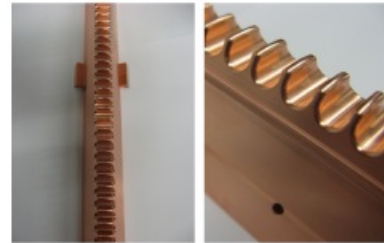
More efforts are required to be more involved in the construction of the S, C and X band accelerating structures.



Machine Operating in 5 axes (with no public funding)
(Mikron_UCP600_vario.pdf)



**Cern
PETS**



Manufacturer: MIKRON AGIE (Svizzera)

Cost: 300,000.00 Euro

Works in progress: Two X-band structures (Two Test Modules type 0) for CERN.

Performances achieved: Operates at +/- 0.005mm with surface roughness of about 0.1 Ra.

Outcomes: CERN acknowledges the excellent execution of the work;

More efforts are required to be more involved in the construction of the S, C and X band accelerating structures.

Conclusions

- ✓ INFN can have a cultural impact on companies even in cases of non-high-level commitments and for a considerable proportion of the firms contacted.
- ✓ Increase of the personnel (**33 %**) according to the industrial effort.
- ✓ Marketing of the products (**5%**).
- ✓ Deep interaction with small and medium firms.
- ✓ Some companies have grown, following the regular relationship with INFN (**Spin –off**).
- ✓ In the 85% of the cases, the firms have increased the number of employees: **Expansion.**
- ✓ **All of these despite the total lack of a strategy promotion of Technology Transfer and without disregarding the needs of economy and transparency of supply.**

What to do ?

- ✓ Collect a sample of statistically significant companies and analyze better the sample.
- ✓ Analyze the existing know-how and the already successful T.T. cases.
- ✓ WEB access to the database and standardization of the analysis methods.
- ✓ ...

But ...

All this requires resources
(**Man Power** and **Financing**).

???