



National Institute for Nuclear Physics



National Committee for Technology Transfer

**Impact of INFN research activity
on Italian industry**

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Introduction

The Istituto Nazionale di Fisica Nucleare (INFN) promotes, co-ordinates and carries out basic research in nuclear physics, elementary particles and their basic interactions [1].

Basic research needs high technology to be carried out and, at the same time, it contributes to high technology development. This is why the relationship between INFN and industry is very important. On the one hand the collaboration with high qualified partners allows INFN to be competitive in the realization of complex instruments used in international collaborations; on the other it allows INFN to transfer its know-how to industries letting them become more innovative on the international market.

A first analysis was made by the Technology Transfer Unit activity in order to evaluate INFN's economic and occupational impact on Italian industries that contributed to the realization of INFN Scientific Projects [2]. The present work concerns a new investigation based on a larger sample of industries and on a refined method of analysis [3]. It's clear that INFN's general impact on national industry is not relevant at all. What this analysis aims at is to point out any positive effects and implications due to the relationship between a research institute and a sample of industries. Such considerations suggest that however marginal INFN impact on the big industry is, its relationship with small and medium companies is privileged and constructive.

Model of interaction

The relationship of the supply between INFN and Italian industries is characterized by the nature of the products supplied as well as by the distribution of responsibilities among industries and INFN researchers. We can make out four different typologies of interaction:

- Acquisition of goods and services having no high technology characteristics, which we henceforward indicate as *supply*.
- Acquisition of goods and services characterized by high technology content, which we henceforward indicate as *high tech supply*.
- The industry can grant the demanded characteristics of the product being in charge of the project and realization phase. Although the final product is not available in the industry catalogue it represents an *innovative* application of the industry *know-how*. Such a relationship with industries is henceforward indicated as *commission*.
- Industry know-how cannot grant the demanded characteristics of the product. Its realization needs a phase of research and development, which is carried out together with INFN researchers, whereas the industry is completely responsible for the phase of production. Such a relationship with industries is henceforward indicated as *development*.

Description of the interactive model

The starting idea we are supporting by this analysis is that the more industries interact with INFN the more positive is industry feedback. If we are expecting a positive feedback on the industry image as well as an increase of the industry market in case of *supply*, different are our expectations in case of *development*. The latter actually requires several, precise and different phases in the realization of the apparatus. Such phases need the involvement of INFN researchers to be carried out, especially when the project, the development and the set up of the apparatus is concerned. It is therefore highly probable that from such a close interaction technology and know-how transfer occurs.

Methods of analysis

Data were collected by means of telephone interviews given by the people in charge of the companies to the members of INFN Technology Transfer unit.



Selection of the sample companies

The selected providers were 3344, which is equal to about 120 GL of INFN amount of expenses. The number of industries taken into account was later reduced 337 since we considered only those whose economical relationship with INFN amounted to at least 50 ML. A questionnaire was given to the 337 sample industries. The sum of money related to them amounts to about 71.8 GL. Those that answered the questions were 227, which is equal to 67% of the sample.

Definition of database fields

Interviews were aimed at collecting data according to a common fixed scheme. The collected information allowed the creation of a database. Fields were divided in the following categories:

1. Corporate name
Trade name, address, telephone number, e-mail, contact person, telephone number, e-mail, product typology and its application, product certificate, number of employees and yearly average budget
2. Typology of financial relationship between INFN and industry
The amount of company average budget per year due to INFN request of supply, type of relationship: supply, high tech supply, commission and development and ratio between the average budget due to INFN and the total amount of company budget.
3. Parameters of evaluation
Feedback on company image, company feedback on the ability to penetrate the market, opening to new markets, company feedback on project and production ability, new staff recruited as a result of commitments with INFN: number of new employees and number of employees hired in high tech field, realization of products later marketed and success of the marketed products.

Database Analysis

The analysis of the collected data consists of two phases: creation of statistical distribution of database records and studying mutual relationships between INFN parameters of impact and typology and the relevance of INFN's relationship with industry.

The first phase of analysis draws a picture of the sample industries that were interviewed and allows us to measure INFN impact on industry in terms of technology transfer. This measurement is based on the incidence of evaluation parameters introduced above. The second point of analysis allows us to verify the conjectured models of interaction between INFN and industry.

1. Field distribution graphics

Geographical distribution and impact on the territory

Table 1 shows the territorial distribution of both the 337 industries and 16 INFN units taken as a

Geographical Area	Companies		INFN Structures	
	Number	%	Number	%
North	182	54	7	44
Centre	103	31	6	38
South and Islands	52	15	3	18
TOTAL	337		16	

Table 1. Territorial distribution of interviewed industries and INFN units.

sample. The table points out that the geographical distribution of industries is closely related to the distribution of INFN units. A larger number of industries concentrates in the north, which depends on the fact that in that area, more than elsewhere, there are companies able to provide high technology goods.

Table 2 shows the geographical distribution of both industries budget and of the 16 INFN units total amount of expenses. The 46% of expenses related to INFN units placed in the centre, is to be ascribed to the presence of Frascati and Gran Sasso National Laboratories. In this case the



relationship between the geographical distribution of companies budget and INFN expenses appears to be weaker.

Analysing tables 1 and 2 it is clear that although a larger number of companies and a larger amount of expenses focus on the northern area, INFN unites weigh heavily on the territory that is in the area where they are established. A detailed data analysis shows that:

Geographical Area	Companies		INFN Structures	
	Budget (GL)	%	Expenses (GL)	%
North	41.6	58	25.5	35
Centre	19.8	27	33.0	46
South and Islands	10.4	15	13.3	19
TOTAL	71.8		71.8	

Table 2. Territorial distribution of industry budget and INFN amount of expenses.

- 48% of INFN units total amount of money, about 36 GL, is spent in the local area that is in the area where INFN unites are established.
- Considering that the expenses in supply are higher (74%) than those made in High Tech supply (55%) and in commission (24%), it is confirmed what was previously stated: companies able to supply high technology goods are mainly established in the north.
- Expenses related to the "development" category amount to 34%. This means that with regard to this category INFN unites tend to collaborate with industries established in the local territory.

Distribution of corporate data

Figure 1 shows the statistical distribution of the industry average budget per year (sample of 210 industries). Figure 2 displays the statistical distribution that regards the number of industry employees (sample of 226 industries). Both distributions provide a guideline to the size of industries.

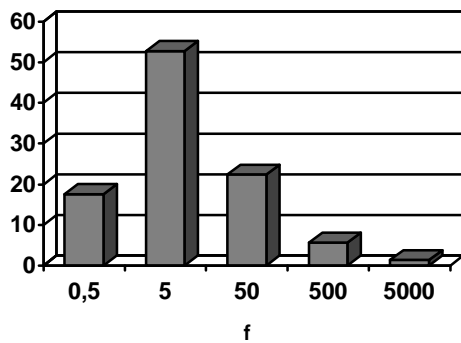


Figure 1. Percentage distribution of industries connected to their average budget per year **f** (in GL).

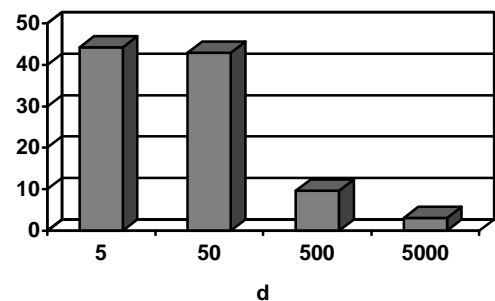


Figure 2. Percentage distribution of industries related to the number of employees **d**.

The same data are analysed in table 3 according to a more concise classification: small, medium and big industries. Data points out the relevant part played by small companies, followed by the medium ones. The bigger companies play a smaller role, 4% with regard to employees and 12% with regard to their budget. Such a data allows us to state that INFN prefers to collaborate with small and medium companies, giving them an

Industry	Budget per year		Number of employees	
	GL	%	Employees	%
Small	0 – 10	71	1- 99	87
Medium	10 – 50	17	100 - 499	9
Big	>50	12	> 500	4

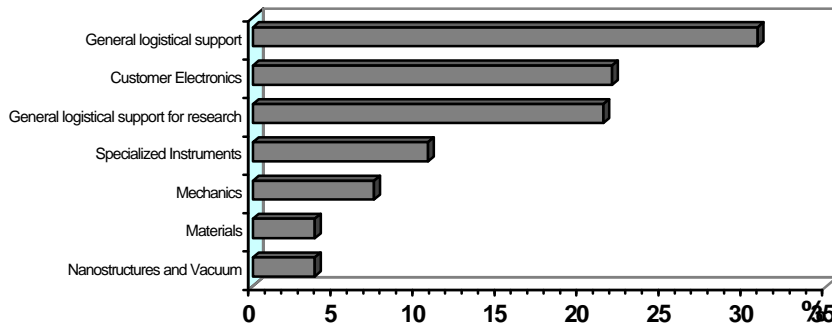
Table 3. Distribution of industries based on the size.



important contribution to develop their know-how. We believe that such a privileged relationship with small and medium companies depends on the following reasons:

- INFN takes economic and qualitative advantage of supply by medium-small industries;
- Medium-small industries can adapt easier to INFN necessities than big ones.

Figure 3 shows the percentage distribution of companies based on the type of goods they sell. The



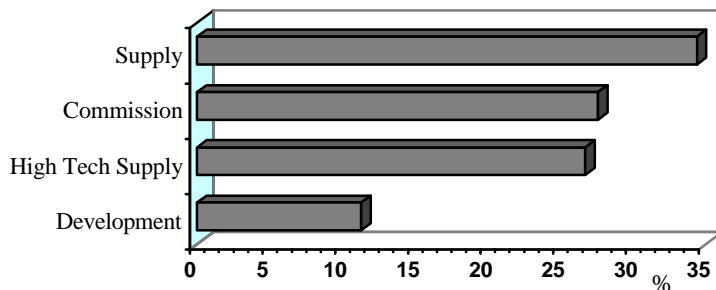
“General logistical support” category represents both in terms of industries and amount of expenses a third of the market, which INFN deals with. The 60% of the market is represented by the category of logistical support for Research, Electronics and specialized instruments, both in

Figure 3. Percentage distribution of industries related to the market-classification

terms of companies and amount of expenses. Companies dealing with compound equipments, vacuum apparatus and mechanics (about 10%) play a quantitative lower role.

Relationship typology between industries and INFN

The distribution of the relationship between the 337 sample industries and INFN is presented in Figure 4 according to the categories previously described. Data points out that: about 40% of industries, which is equal to about



45% of the amount of expenses (32GL), collaborate with our Institute in order to produce innovative products; as far as the definition of innovative products is concerned, INFN Researchers’ contribution is very relevant for about the 10% of companies, which is equal to about 15% of the amount of expenses (10 GL); only a third part of industries supply products that don’t have a high technological content.

Figure 4. Percentage distribution based on the relationship typology of the sample industries.



Figure 5 displays the distribution of industries based on the relevance of their yearly financial relationship with INFN. In terms of percentage we can observe that:

- The budget due to INFN orders is an *essential* element for the 7% of companies since it amounts to more than 50% of their yearly budget;
- The 14% of companies owes more than 10% of their yearly budget to INFN orders, which certainly represents an *important* entrance for them;
- The trade relationship with INFN is *standard* for the 53% of the companies, since it is lower than 10% of their yearly budget;
- Trade relationship could be considered *unimportant* as far as companies' yearly budget due to INFN orders amounts to 1%. This is true for the 26% of companies.

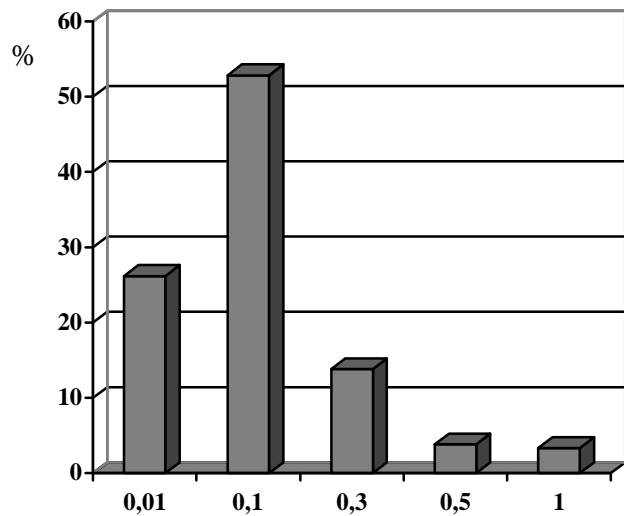


Figure 5. Industries percentage distribution based on the ratio between the budget due to INFN orders and their yearly budget (a sample of 210 industries has been examined).

Such elements show that in many cases (more than 10%) industries' activity is devoted to the realization of INFN products, a phenomenon known as *spin-off*. It will be interesting to verify if afterwards such companies will autonomously be able to develop products and put them on the market.

Parameters for the evaluation of companies' impact

Feedback on companies' image

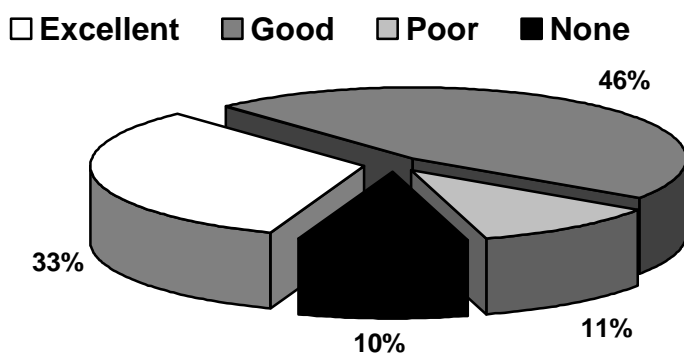


Figure 6. Percentage distribution of answers on the companies' image feedback.

Figure 6 refers to the percentage distribution of the answers given by companies on the possible feedback on companies' image due to their relationship with INFN. It is clear that 79% of companies state a positive feedback on image (either excellent or good). Such a percentage is approximately constant compared to the nature of interaction with INFN. In fact,

the value for Development is 92%, for High Tech Supply is 73% and finally for Supply is 77%. These data show that the closer the relationship with INFN, the more significant is the feedback on image declared by companies.



Company feedback on the ability to penetrate the market

Figure 7 shows the positive answers (Excellent or Good) with regard to the companies' ability to penetrate the market in consequence of their contacts with INFN, according to the type of relationship. In this case one can point out how close is the relationship between a positive answer and the collaboration with INFN. Approximately 60% of companies belonging to the Development category declare a positive answer, against 36% of companies from the Supply category.

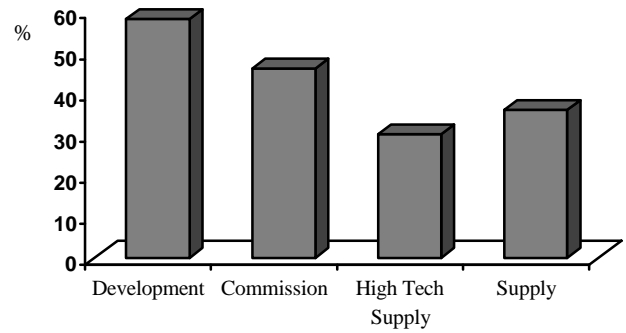


Figure 7. Distribution of positive answers with respects to companies' feedback on ability of penetrating the market, according to the type of contact with INFN

Opening to new markets

Considerations similar to those just presented in the previous paragraph can be formulated while dealing with the possibility of acquiring new markets, declared by companies. Figure 8 illustrates how the positive answers are distributed following the type of contact.

About 47% of companies from the category Development state a positive feedback with respect to opening to new markets, while only 19% of those belonging to the Supply category give the same answer.

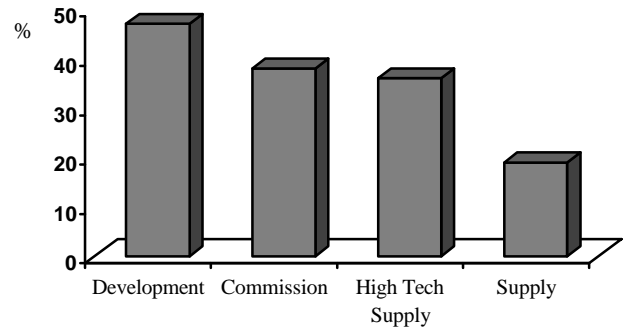


Figure 8. Distribution of positive answers on the acquisition of new markets according to the type of contact.

Company feedback on project and production ability

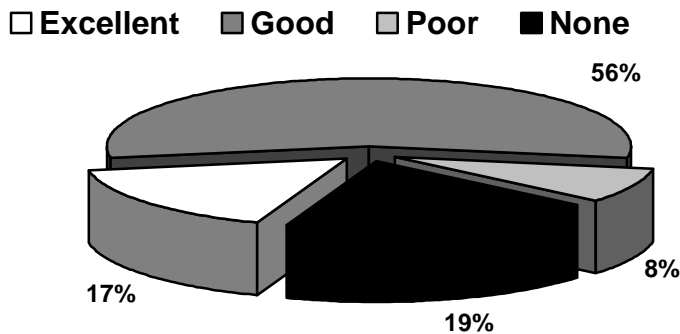


Figure 9. Distribution of answers with respect to project and production ability. Development category.

Figure 9 illustrates the distribution of answers by companies belonging to the Development category to improve their project and production ability. A relevant number of companies (73%) that closely collaborated to the production of innovative apparatus declare a positive feedback on their project and production capacity. Companies belonging to the category Commission state the same only in 56% of cases, particularly for the production side.



New staff recruited as a result of commitments with INFN

The data concerning the hiring of personnel, after undertaking commitments with INFN indicates that in 22% of cases the companies increased the number of employees, which in 2% of cases was increased by more than 5 units. Figure 10 refers to companies belonging to the category Development, which hired new staff to meet the commitments with INFN. In this case we can see that the 39% of industries engaged new employees and that in the 8% of cases the number of new employees is over 5.

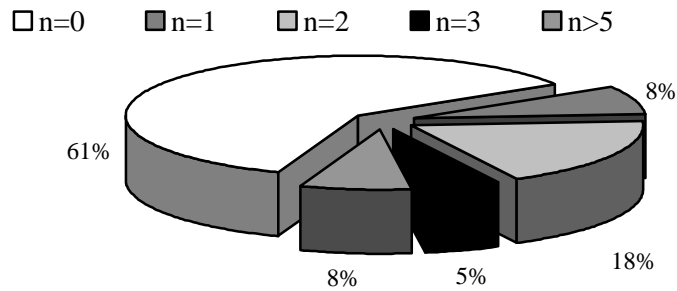


Figure 10. Statistical Distribution of companies belonging to the category Development, according to *n*, number of new employees, hired to fulfil their commitments with INFN.

Figure 11 shows the number of new employees as well as that of new employees engaged in High Tech field, connected to the relationship typology between industries and INFN. It should be noted that 68% of new staff refers to qualified personnel and that 41% of new staff is concerned with companies that closely collaborate with INFN (Development category), even though they only represent 11% of the sample.

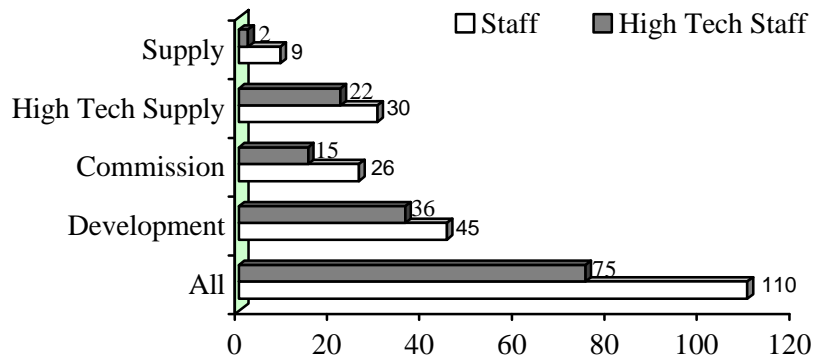


Figure 11. Distribution of new staff and new High Tech staff according to the typology of relationship.

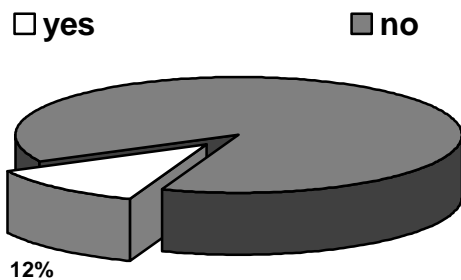


Figure 12. Distribution of companies whose products realized in collaboration with INFN came on the market.

Realization of a product later marketed

Figure 12 presents the distribution of the industries whose products realized in collaboration with INFN, came on the market. 12% of the companies answered positively. Such a percentage isn't high in absolute terms, nevertheless it represents an important result because it refers to those companies to which the relationship with INFN caused a qualitative growth. 62% of commercialised products were developed in collaboration with INFN. 19% of those cases, as stated by companies belonging to Supply and High Tech Supply categories,



refer to particular products especially realized to meet specific needs of INFN and which were later marketed.

Finally, Figure 13 shows how the success of marketed products is distributed. The graphic refers to 62% of products, while the remaining 38% still has to be marketed. The figure shows that only 6% of companies that commercialised the product give a negative answer on the success of the product.

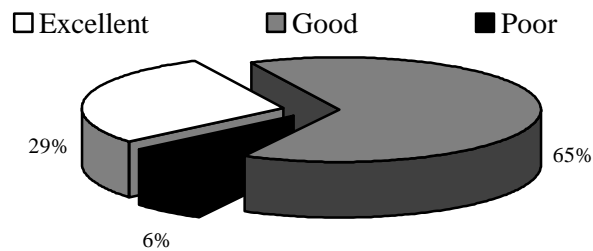


Figure 13. Success of marketed product.

Conclusions

From the results of the analysis we can draw the following conclusions:

- INFN weighs heavily on the territory;
- INFN interaction with industry is relevant towards small and medium companies;
- INFN impact on industry is also visible when a small amount of money is involved and ordinary items on catalogue are required;
- The extent of INFN impact on companies can be measured by the increase of companies' staff, of their ability to produce new items and by the improvement of their project and production skills. It's a matter of fact that 22% of the interviewed companies proportionally increased the number of their employees with respect to INFN financial commitment. Besides 12% of the companies commercialised new products following a close collaboration with INFN.
- Some industries are commercial spin-offs from INFN research work;
- 44% of industries took advantage of their relationship with INFN, in terms of number of employees. This is the case of the relationship typology we classified as *development*. Such a result confirms the starting point of our analysis: the more INFN researchers collaborate with industry at the definition and realization of products, the more technological transfer succeeds.

The results of this analysis show that the technology and knowledge transfer naturally arise from INFN ordinary research activity. Should therefore INFN carry out a policy aimed at promoting technology transfer, in the framework of its mission, an important contribution would be given to the development and innovation of our industries. It would make them become more competitive on the market conveying, at the same time, the idea that basic research is a great resource for the country.

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See: <http://server11.infn.it/ctt/Documenti/documentazione.htm>
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