A REVIEW OF TECHNOLOGY TRANSFER AT CERN

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Abstract

The technology transfer structure, policy and activities at CERN are reviewed. The technology transfer process is discussed: technology identification, intellectual property protection, prototype developments, transfer of know-how and products licensing. The current status of technology transfer activities at CERN is described and results are presented. The main domains of technology transfer at CERN are also mentioned.

1 INTRODUCTION

Since its creation in 1953 CERN has had a long tradition of Technology Transfer (TT), mainly through people, purchasing and collaboration agreements. In 1986 an internal committee analysed in depth the relations between CERN and industry and the Finance Committee accepted the development conception in 1988 [1]. By March 1999 the CERN Member States[1] had asked to introduce a pro-active technology transfer policy [2] "to make known and available to third parties, under agreed conditions, technical developments achieved in fulfilling the laboratory's mission in fundamental research". In 2000 a new division was put in place at CERN: the Education and Technology Transfer (ETT) Division. The main TT structure within ETT Division is the TT group. It works in collaboration with a Technology Advisory Board (TAB)[2], which monitors and evaluates TT and advises the Director-General when an important strategic decision needs to be taken. Internal and external TT networks[3] facilitate the diffusion and outreach of CERN technologies. By March 2002 the delegations from CERN Member States had welcomed the initial results from the current TT policy [3], a summary of which is presented in this paper.

[1] At present CERN Member States are Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom. Israel, Japan, the Russian Federation, the United States of America, Turkey, the European Commission and Unesco have observer status.

[2] TAB is composed of TT experts from inside and outside CERN.

[3] The external network includes one TT Officer per Member State and the internal network one representative per CERN division.

2 CERN TECHNOLOGIES

The identification, accessibility and clear description of the technology domains at CERN are the starting point of any TT process. Therefore, an important priority of the CERN TT activities is the collection of data on technological solutions in the fields of CERN technologies and their description in the TT database[4]: a user-friendly and comprehensive database for external and internal use as well as an effective working tool for TT Officers. This work is ongoing (Fig. 1).

Figure 1: Example of a technology description in the technology transfer database

At present 160 individual technology solutions have been identified and described in the TT database. This will continue to be developed particularly with LHC-related technologies. The distribution by technology domain in the database is given in Fig. 2.

The current database allows for the tracking of any ongoing TT activity and contains the history of the various cases treated from a technical, financial and administrative point of view. It allows the monitoring of the information on CERN technologies, projects, patents, licences and collaborative development agreements.

In addition to its standard features it allows data navigation, event advertising and on-line video demonstration of selected technologies.

[4] The TT database Web address is http://www.cern.ch/TTdatabase

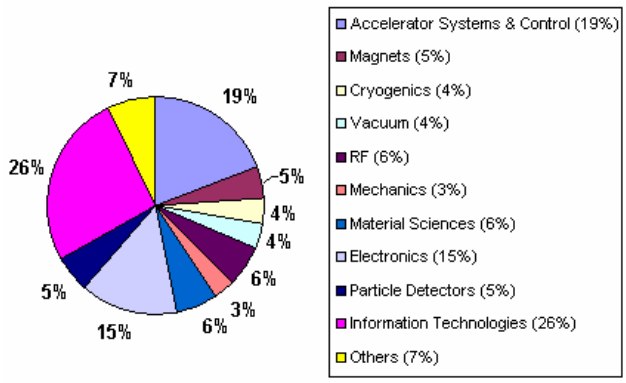

Figure 2: Distribution of technologies listed in the technology transfer database

3 TECHNOLOGY DEVELOPMENT AND RELATED ISSUES

Figure 3 outlines how the technologies are transferred to industry. During this process, the various steps involve transfer either of know-how or of patented and non-patented technologies, which is achieved through agreements, open sourcing/copyrighting, patents or licensing. In order to carry out this technology transfer efficiently, collaboration agreements are established at an early stage to clarify Intellectual Property (IP) rights issues. Later, exploitation agreements are laid down with industry before licensing the technologies/know-how. In particular when start-ups are created, IP needs to be clearly defined at the outset.

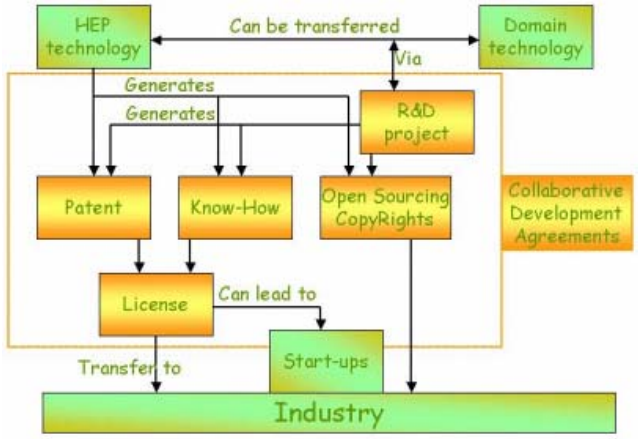

Figure 3: Technology transfer process

The three phases of technology development (R&D, realization and exploitation) are illustrated in Fig. 4. Resources from particle physics normally fund the R&D phase for the purposes of High Energy Physics (HEP) developments. In the realization phase, for developing TT projects in domains outside of HEP, complementary resources from other external sources, including those provided by ETT Division, are necessary. Until recently, resources provided by ETT Division came only from the CERN TT budget, but now additional resources can be generated by TT activities for re-injection into specific projects and for product development. It should be noted that this process can sometimes require substantial funding, particularly for developing prototypes. Currently these can only be obtained from external funding agencies or with the help of industry. In some cases funding from the European Union is envisaged.

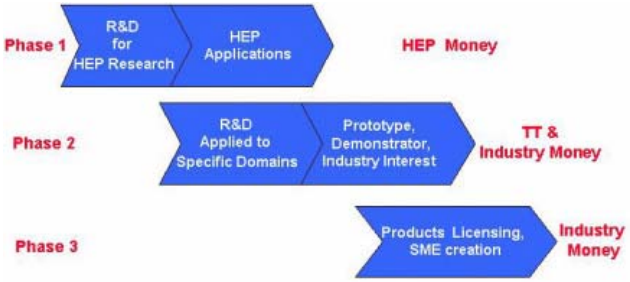

Figure 4: Stages in the development of technologies and projects (venture capital funds included in industry money)

The exploitation phase gives rise to products or the creation of Small and Medium Enterprises (SMEs), which have to be exclusively funded by industry, and therefore require the establishment of appropriate agreements (to cover IP, additional R&D and licensing) with CERN.

The 54 TT cases treated by CERN since the beginning of 2001 have been analysed according to Fig. 4 and the analysis is illustrated in Fig. 5. All except four cases, which are still in the development stage, have found application in HEP. However, it should be noted that a significant percentage (30%) has resulted in product/SME creation.

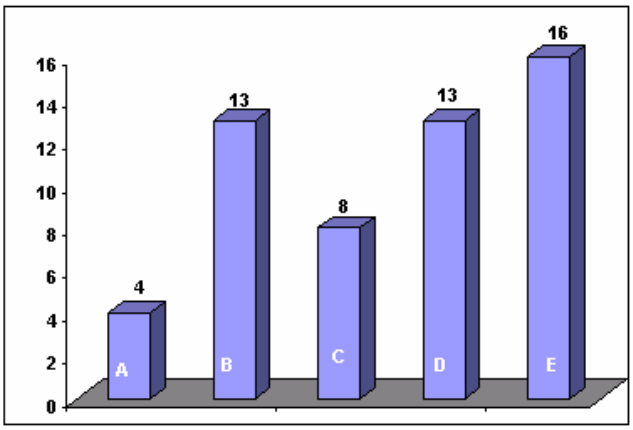

Figure 5: Present status of the 54 technology transfer cases: (A) R&D for HEP research; (B) HEP applications; (C) R&D applied to specific domains; (D) industry interest (prototype, demonstrator, licence); (E) products, SME creation.

It should be emphasized that CERN has particular skills in combining a wide range of technologies in order to

develop comprehensive and powerful solutions. CERN know-how can make an important contribution in several domains, in particular information technology, materials technology, electronics, medical imaging, hadron therapy, and energy (both solar and nuclear).

4 TECHNOLOGY TRANSFER MECHANISMS AT CERN AND FIRST RESULTS

CERN has pursued a TT policy built on multiple platforms: those of collaborative projects with outside bodies; of the establishment of start-up companies; of delivering patents, standards, publications and services; of technology through partnership and purchasing. These mechanisms are outlined in the following sections.

4.1 Collaborative Agreements, Services & Consultancy

In the past two years CERN has adopted a policy of establishing collaborative agreements with industries, institutions and individuals in exploitation areas related to developments in accelerators, magnets, cryogenics, vacuum, RF, mechanics and material sciences. CERN personnel involved in these collaborations are made aware of IP protection issues through the TT group in ETT Division and during the last year there has been strong evidence that this method of TT is beginning to pay dividends throughout CERN. There are three main types of agreement relating to the issue of Intellectual Property Rights (IPR): licences of technology or know-how, collaboration agreements and consultancy agreements. Both licences and consultancy agreements are particular forms of collaboration agreements, which concern the exploitation of CERN know-how. Licences are usually given on a non-exclusive basis although in some special cases, after consultation with TAB, exclusivity can be granted. During 2001 the number of licences resulting from collaboration agreements increased significantly compared with 1999 and 2000.

CERN is also occasionally requested to provide its unique services and know-how to other research institutes or industry, services that cannot be provided by European industry. However, under special conditions, these services can be extended to non-European collaborating countries. In both cases, the IP protection has to be properly dealt with and is again handled in ETT Division. Consultancy takes place when CERN is requested to provide specialized advice and to transfer the know-how and unique experience of some of its staff. This again takes place through a collaborative agreement with the requesting body, covering the IP issues as well as the cost of the consultancy. As in all the other mechanisms of TT, CERN requires recognition as the source of the know-how transferred.

4.2 Patents

A novel patenting policy has been followed at CERN in order to optimize the transfer of technologies and to keep patent-filing costs under control. The CERN patent portfolio currently counts in total about 20 patents. In general, the careful handling of the patenting process has allowed the patent costs to remain almost unchanged year-on-year.

4.3 Standardization, Publications, Schools and Conferences

Through the establishment of standards, CERN can make an impact in domains other than HEP. Thus a dedicated effort from the laboratory in this field, and its willingness to act as a test-bed, should be pursued as support for making European industries competitive. One of the best examples of standardization is the use of Fieldbuses [4] and Ethernet [5] networks in industrial control applications.

CERN continues to produce a large number of technology preprints, many of which are accepted for publication in the most important journals or in international conference proceedings. Table 1 (from Ref. [3]) shows the distribution of published papers for the past three years in six areas of technology.

Table 1: CERN publications from 1998 to 2000 across technology domains: (DD) detectors and experimental techniques; (EE) accelerators and storage rings; (FF) health physics and general safety; (GG) computing; (LL) engineering; and (MM) information transfer and management.

Year	DD	EE	FF	GG	LL	MM	Total
2000	651	250	12	18	145	13	1089
1999	518	310	22	10	178	17	1055
1998	403	141	37	25	86	8	700

CERN continues to support TT through the CERN Accelerator School (CAS), the CERN Summer School of Computing and the European School for Medical Physics, as well as through international conferences such as Cryogenics in Science and Industry, Superconductivity, Vacuum Systems, Electrical Power Technology, Control Systems, Detectors and Electronics, and Magnet Technology which have been organized by CERN and its collaborating institutes for many years. In addition, CERN contributes to many conferences and workshops particularly in information technology, particle accelerators for medicine and industry, nuclear science, medical imaging and hadron therapy.

4.4 Technology Transfer Projects and Start-ups

Some of the research projects undertaken by CERN have industrial applications in non-HEP areas, though originating from prior work in the HEP domain. ETT Division has hitherto played a role in funding some of these projects in order to bridge the gap between the R&D and the exploitation. The TT group has already started to contribute some seed money to selected developments towards non-HEP applications.

In 2000 CERN introduced a policy to support start-up creation. However, when launching a start-up company, it is not intended to create an incubator on the CERN site but to use the existing incubators in the Member States. Up to now there have been five start-up cases: three in the information technology domain, one in an application to pharmacology, and one in microelectronics. In order to establish the best practice in the promotion of start-ups from public research institutes, CERN is participating in the EXSIF project (EXpertise on Setting up Innovative Firms) [6] supported by the European Commission under the Fifth Framework Programme. The first objective of EXSIF is to improve the competence of the partners in their support of innovative business creation. This is done by sharing good practice and by pooling the expertise of the EXSIF members. A second objective is the validation of this shared expertise using real cases of new business creation. The EXSIF study is ongoing and will deliver a final report in 2002.

4.5 Technology Transfer Through Partnership

CERN has already gained some experience with 'technology partnerships', aiming at substantial applications of particle physics technology developments for non-particle physics requirements and uses. The first examples of such partnerships are the CERN Grid initiatives (e.g. the DataGrid [7], DATATAG [8], GRIDStart [9] and, recently, the MammoGrid), developing a technology for the LHC computing needs and for applications in other sciences and for industrial uses. At present CERN or particle physics institutes in Member States and non-Member States are leading a variety of international projects in this field with very substantial contributions from the European Union and a number of other funding agencies. These contributions are not directly seen as particle physics funding. The participation of CERN and particle physics institutes is, however, regarded as important for the success of the projects.

4.6 Technology Transfer Through People

Emphasis continues to be placed on TT through people especially as the percentage of visiting staff at CERN is rising. CERN prides itself on being an institution which can pass on its technologies by hosting scientists, engineers and students through its many and varied schemes (Associateships, Fellowships, Doctoral and Technical studentships). Many Member States have, in addition, established special schemes (such as the current Portuguese and Spanish schemes) to provide the mechanism for engineers and applied physicists from those countries to be trained at CERN in specific technology domains. Some countries have doubled their existing programmes to promote TT through people, and others are now considering the possibility to promote such programmes on a pilot basis.

In summary, to demonstrate the application of HEP technology in other fields with industrial interest, some of the most relevant TT results since 1999 are listed below:

- 18 licences,
- 50 collaboration agreements,
- 5 start-ups and
- 11 TT projects.

4.7 Evolution of Resources Generated by Technology Transfer Activities

Increased effort and closer contact with industry during 2001 has been rewarded by higher revenue. The cost of the patent portfolio, the expenditure on TT development projects and the operational cost of TT activities have reached close to break-even in 2001. Regarding the revenue, this beneficial effect is likely to increase during 2002. Further revenues are also expected from royalties, especially from agreements already negotiated and signed.

4.8 The Future for Technology Transfer at CERN

The CERN TT unit intends to continue with its present two main lines of action:

- to identify and evaluate useful technologies and to facilitate their transfer;
- to support TT projects derived from HEP technologies and to promote specific transfers for useful applications outside of particle physics.

To facilitate this it is imperative that IP and IPR issues be included in every collaborative development agreement. This is particularly important when industry is directly involved and especially when technology demonstrators need to be developed: industry normally requires that IP be protected in view of subsequent possible market opportunities.

The role of patents is seen as particularly important and the CERN patent portfolio will be regularly reviewed. The policy, which has been followed, is to file patents when they are deemed promising from a marketing point of view, and to extend them only when a market opportunity really appears. It is important to oppose patents from non-particle-physics sources claiming rights of particle physics technologies to protect the HEP community and the interests of the Member States, as and when necessary.

CERN intends to make the access to licences equally open to all its Member States. Requests for licensing, however, normally come from specific sources in individual Member States and there is a limited window of 'time to market'. Therefore the external network of TT experts in Member States will be informed of intentions to license technologies. CERN proposes to use the external network to promote technologies and patents to technology brokers. CERN will also pursue a policy for start-up creation.

TT through people is another priority for the TT community at CERN. Although difficult to quantify, the transfer of know-how from ex-CERN employees to industry is seen as one of the most effective means of feeding CERN-generated knowledge through to its Member States. In addition, CERN supply contracts can generate potential further business for industry. The actual, quantified benefits to industry are again difficult to evaluate.

CERN partnership will be promoted since it involves highly visible applications of particle physics technologies outside the field and in areas where such contributions are welcome. The collaborative development of complex technologies gives CERN Member State institutes the possibility to participate.

5 ACKNOWLEDGEMENTS

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6 REFERENCES

[1] Technology Transfer from Particle Physics. The CERN experience 1974–1997*, O. Barbalat. Report, BLIT/97–1, July 1997 (1997).*

[2] *Technology Transfer Policy at CERN*, Report, CERN/FC/4126 (1999).

[3] *Technology Transfer at CERN Status & Policy*, Report, CERN/FC/4533 (2002).

[4] Fieldbus Standard EN 50170 (http://www.fieldbus.org).

[5] Ethernet Standard IEEE 802.3 (http://grouper.ieee.org/groups/802/3/).

[6] EXSIF – an EU-funded project on new business creation (http://oraweb03.cern.ch:9000/pls/exsif/display.main).

[7] DataGrid – an EU Fifth Framework Grid flagship project (http://www.eu-dataGrid.org/).

[8] DATATAG – Research and Technological Development for a Transatlantic Grid. IST-2001-32459 (http://datatag.web.cern.ch/datatag/).

[9] GRIDStart – Grid Dissemination, Standards, Applications, Roadmap and Training.