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UFFICIO FEDERALE DELLA FORMAZIONE PROFESSIONALE E DELLA TECNOLOGIA **UFFT**

# Evaluation of the Commission for Technology and Innovation

Report 'Self Evaluation'



Commission for  
Technology and  
Innovation

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## List of Abbreviations

AR&D	Applied Research and Development
BRI	Business Research Institute (of the Swiss Federal Institute of Technology/Zurich)
CIM	Computer Integrated Manufacturing
CPSR	Commission for the Promotion of Scientific Research (KWF)
CTI	Commission for Technology and Innovation (KTI)
DEA	Federal Department of Economic Affairs (EVD)
DHA	Federal Department of Home Affairs (EDI)
EPFL	Swiss Federal Institute of Technology/Lausanne (Ecole Polytechnique Fédérale des Lausanne / Eidgenössische Technische Hochschule Lausanne)
ERT	Education, Research, Technology
ESA	European Space Agency
ETHZ	Swiss Federal Institute of Technology/Zurich (Eidgenössische Technische Hochschule Zürich)
EU	European Union
EUREKA	European-wide Network for Industrial R&D
FES	Federal Office for Education and Science (BBW)
FHSG	Federal Law on Universities of Applied Sciences (Bundesgesetz über die Fachhochschulen)
FMTL	Federal Material Testing Laboratory (EMPA)
ICT	Information and Communication Technologies
IMP	Institute for Mechatronic Production Systems and Precision Machining
IMS	Intelligent Manufacturing Systems
IPR	Intellectual Property Rights
MCHF	Million Swiss Francs
MedTech	MedTech Initiative (R&D program for the Swiss Medical Technology Industry)
NIS	National Innovation System
NPC	National Project Co-ordinator
OECD	Organization for Economic Co-operation and Development
OPET	Federal Office for Professional Education and Technology (BBT)
R&D	Research and Development
ROI	Return on Investment

SAEFL	Swiss Agency for the Environment, Forests and Landscape (BUWAL)
SATS	Swiss Academy of Technical Science (SATW)
SCEM	Swiss Center for Electronics and Microtechnology SA (CSEM)
seco	State Secretariat for Economic Affairs (seco)
SFOE	Swiss Federal Office of Energy (BFE)
SNSF	Swiss National Science Foundation (SNF)
SME	Small and Medium-sized Enterprises
SPP	Swiss Priority Programmes of the SNSF
SSA	Swiss Science Agency (GWF)
SSO	Swiss Space Office
SSTC	Swiss Science and Technology Council
TOP NANO 21	Technology-oriented Program for Nano-Technology
USG	Federal Law on Environment Protection (Umweltschutzgesetz)
WZMO	CTI Project Cooperation for the Promotion of Machine Tools (KTI-Projektprojektverbund Werkzeugmaschinen)

## Executive Summary

This report on the self-evaluation of CTI is oriented towards the questions posed in the individual mandate for the evaluation of CTI and summarizes these in four key questions. The structure of the report uses them as a foundation, and the assessment of CTI is based upon them. Key questions I and II are considered together in the evaluation as are Key Questions III and IV.

Key Question I: What is the role of CTI as a core player in an econo-political innovation policy in the Swiss system of promoting innovation, as well as science and technology transfer (National Innovation System)?

Key Question II: How is the strategic alignment of CTI to be assessed in terms of instructions and mission?

Following its assessment in terms of these two key questions, CTI comes to the following conclusions: CTI is fulfilling its mission to enhance the innovation capability of industries in Switzerland. As a result of the breadth of the measures and the effects of its innovation policy, CTI is a central instrument of economic policy available to the Confederation in the support of the National Innovation System (NIS) of Switzerland. The core business and specific promotional initiatives and programs of CTI establish a coordinated and effective aggregate package. A cluster-based policy is however only rudimentary recognizable. The role, strategy and promotional activities of CTI are consistent with the liberal economic policy in Switzerland. The mission has been successfully accomplished to date, but is now running into danger from the increasingly stringent resource availability.

Key Question III: What is the assessment of the functioning and work ethic of CTI?

Key Question IV: How is the collaboration and coordination when interacting with other organizations in the domain of innovation promotion at national and international level to be assessed?

Based on these key questions, CTI makes the following assessment: The organization and mode of operation of CTI are compatible with the mission and strategy of CTI. The challenges of the future can only be met by an increasing professionalism in the entire organization. At the national level, the cooperation and coordination with other organizations is good. It should, however, be improved particularly with respect to the Swiss National Science Foundation (SNSF). At the international level, there is a real need for debate on a massive build-up of the CTI presence in European institutions for promoting innovation.

Based on these assessments, CTI has formulated the following recommendations to improve its operations as well as to augment the innovation dynamic in the National Innovation System of Switzerland.

- Recommendation 1: Taking into account an improvement in its own operations and considering the coordination of all institutions active in areas of education, research and technology policy in Switzerland, CTI sees an urgent need for a policy dialog on a coherent and mutually coordinated innovation policy.
- Recommendation 2: CTI sees an urgent need for additional financial support for its operations to insure that it can continue to completely fulfill its mission of promoting innovative processes in Switzerland, and, further, is enabled to do so in the future under its rapidly broadening areas of responsibility resulting from new technologies and a stronger international alignment.
- Recommendation 3: In view of the necessity of having to convert into practice an innovation-oriented policy which is both up-to-date and corresponds to the 'good practices' of other OECD countries, CTI sees cluster-based policies as a worthwhile extension of its facilities primarily in the arena of technology-specific networking and technology monitoring.
- Recommendation 4: The objective of the activities in CTI is to enhance the capacity for industrial innovation in the Confederation. Consequently, CTI is the prime instrument for the innovation oriented policy of the Federal Government. Further, the institutional embedding of CTI within DEA and OPET must be retained. A centralizing of the management of the entire promotion of research for Switzerland (a fusion of the SNSF and CTI agencies) is to be rejected.



- Recommendation 5: Set against a backdrop of an improved coordination of agreement on innovative policy, CTI sees an extremely great need for a coordination of projects at the interface with the SNSF and, thus, at the interface between fundamental and applied research. A strengthened coordination based on an expert group is required which, whilst still respecting the current institutional independence and affiliation, can take decisions in a pragmatic and non-bureaucratic manner in the best interest of those companies capable of innovation, yet supporting and not obstructing their innovation processes.
- Recommendation 6: In view of the global challenge in the innovation and re-location competitions, CTI must enhance and build-up its operations in all significant institutions such as the EU, OECD and those promotional programs applying to Europe as a whole.
- Recommendation 7: With regard to an improved collaboration between private industry and the Universities, CTI must pay more attention to the topic of intellectual property to secure incentives for the project partners in a collaboration. In this respect, it should be noted that industrial companies will only invest financially in a partnership together with public research facilities if they can anticipate proportional and, in terms of their ownership rights, guaranteed future profits.
- Recommendation 8: Set against a backdrop of a general increase in interest, on the one hand, in the analysis of the effectiveness of the promotional measures stemming from innovation policy, and as an internal quality assurance check on the other, CTI must improve and build up its methodical and conceptual facilities for assessing the effectiveness of the measures taken. In particular, continuous data recording and qualitative studies on the effectiveness and usefulness to the project partners of the various projects and programs belong within such an analysis.
- Recommendation 9: The relevance of the CTI activities in the Swiss economy is rising rapidly as the importance of innovative competition increases. This needs to be considered by CTI in terms of its communication policy. It must take a more offensive stance in achieving greater recognition in Switzerland and abroad and become more involved in discussions on innovation policy in Switzerland. In its members and experts, CTI has available a great potential which should be used more fully in view of the significance of innovation policy for Switzerland.

## Content of the Mandate for the Evaluation, and Structure of the Self-Evaluation Report

### General Mandate

The present report concerning the self-evaluation of CTI was authorized by the Chairpersons of the Federal Department of Home Affairs (DHA) and the Federal Department of Economic Affairs (DEA). It forms part of a joint evaluation of the two agencies for promoting research: the Swiss National Science Foundation (SNSF) and the Commission for Technology and Innovation (CTI). The basis for the study lies within the mandate framework issued April 15, 2001.

The objective of the evaluation, incorporating the results of the evaluations of SNSF and CTI, is to provide the Confederation with a continuous upgrading of its stimulation activity in the field of research, thereby strengthening the **capacity and operations of the Science and Innovation System** in Switzerland.

Following the general mandate, the evaluation should provide answers to the following questions:

- How can the role and contribution of SNSF as well as CTI within the Swiss system be assessed in terms of stimulating science and research, development, and technology and innovation (including science and technology transfer)?
- How can the international involvement of the activities of SNSF and CTI be assessed, in particular considering Swiss involvement in international programs and activities?
- How is the strategic alignment of SNSF as well as CTI to be assessed in this context?

Required is a **situation analysis** of the current status and the performance capability of SNSF and CTI, together with concrete **proposals** to enhance their efficiency and performance or, alternatively, to optimize the present systems used for promoting research, etc. In considering the instruments, organization, and decisional processes, their **suitability** and **operating mode** are to be considered within the individual evaluations.

The **evaluation procedure** laid down in the framework of the general mandate anticipates a **two-step process**. First, both organizations are offered the opportunity for a **self-evaluation**. The report from each organization then serves in the second step as the basis for an international **peer review** which, in addition to an examination and commentary, anticipates the opportunity for posing questions and paying visits. The individual mandates of the two organizations SNSF and CTI serve to insure the precision of the evaluations. The following is a summarized final report carried out under the authority of the Swiss Science and Technology Council (SSTC). The individual mandates of the two organizations SNSF and CTI serve to insure the precision of the evaluations.

### Individual Mandate for CTI Evaluation

The DHA and DEA have pointed out that the economic success of Switzerland depends critically on smoothly functioning interactions between the various players taking part in the **National Innovation System** (NIS). CTI in its capacity as the federal instrument for **Technology and Innovation Policy** in Switzerland has the responsibility of promoting the conversion of new knowledge and new technologies via innovations. In this field of activities, CTI serves as the **interface between science and industry**.

The specific mandate for the evaluation of CTI lists the following facets:

- role
- strategy
- structure
- process of decision-making
- achievements

of CTI to be subject to analysis and evaluation.

The evaluation of CTI will ensue with due consideration for the **Message for the promotion of Education, Research and Technology** (ERT Message) for the period 2004-2007. The expected deliverables are the assessment and evaluation of the CTI operations as well as explicit recommendations for improving the operations from the viewpoint of the econo-political innovation policy of Switzerland.

Consequently, positional statements on specific partial topics are expected which, per the evaluation charge in the CTI mandate, are summarized as **Key Questions** in the CTI self-evaluation report:

1. General Mission, compatibility with the fundamentals of a liberal economic policy, strategic alignment of CTI
  - What is the role of CTI as a core player in an econo-political innovation policy in the Swiss system of promoting innovation, as well as science and technology transfer (National Innovation System)? The question also to be dealt with at this point is whether the role and strategy of CTI correspond to the fundamentals of a liberal economic policy. (**Key Question I**)
  - How is the strategic alignment of CTI to be assessed in terms of instructions and mission? (**Key Question II**)
2. Organization, Decision-making Process, and Tasks of CTI
  - What is the assessment of the functioning and work ethic of CTI? (**Key Question III**)
  - How is the collaboration, and coordination with other organizations in the domain of innovation promotion at national and international level to be assessed? (**Key Question IV**)

### **Context and Structure of the Report**

CTI appreciates this opportunity to present its strategy and promotional activities, and for a critical review of these matters with its peers. In the present report CTI wishes to provide the experts of the peer review board with a comprehensive insight into its operations and activities. This report thus constitutes a constructive contribution to a fruitful and efficient evaluation of CTI leading to a further enhancement of the overall Swiss innovation system. The structure of the report has been designed by CTI to permit the questions posed in the general and individual mandates for the self-evaluation to be addressed in a consequent manner. The analysis follows the requirements laid down in the general mandate in selecting as working base the concept set, inter alia, by the Swiss **National Innovation System**. In this report CTI features as the central federal instrument of an innovation-oriented economic policy which promotes the application of new knowledge and new technologies, and acts as point of contact between science and industry together with the Federal Office for Professional Education and Technology (OPET).

In its self-evaluation, CTI has taken into account that its strategies and measures have to correspond with the spectrum of **competition in global innovation** and **international re-location** options. This mission of CTI, the promotion of the process of innovation in Swiss industry, can only be accomplished by setting the innovation-specific interests of industry as center point. The basic thinking presented above form the framework in which the present arguments are set. The strategy, organization and mode of operation of CTI should be judged in terms of the above-cited key questions against the backdrop formed by the innovation policy demands of the National Innovation System, the development in innovation competition and success factors of actively innovative companies.

The report is structured as follows: First, the profile and characteristics are presented. Then CTI is considered in the light of global innovation and re-location competition and, finally, its role and position within by the Swiss National Innovation System are described. Against this backdrop, the mission and strategy of CTI are assessed in considering the question of a liberal economic policy (**Key Questions I and II**). Further, the organization, mode of operation, together with the international activities and cooperation of CTI are evaluated using **Key Questions III and IV** as point of reference. Finally, some suggestions in the form of **recommendations** are submitted in the closing section of the report to enhance the performance capability and effectiveness of CTI within the Swiss National Innovation System.

## 1. CTI introduces itself

### 1.1. Profile of CTI

The Commission for Technology and Innovation (CTI) was founded in 1943 as an instrument for crisis management and to promote employment.<sup>1</sup> Its original title was the Commission for the Promotion of Scientific Research (CPSR) which was changed to the present title in 1996. The mission of CTI, the support of the process of innovation in industry, should thereby be made apparent.

**Historical**

CTI is a permanent commission of the DEA comprising 27 members. About 60% of the members occupy leading positions in private industry whereas 40% are scientists from the Universities who have industrial experience. There are also representatives sitting on the commission from other government agencies with whom CTI collaborates: the Swiss Agency for the Environment, Forests and Landscape (SAEFL) and the Swiss Federal Office for Energy (SFOE). In addition, a further 23 people from the business world work on a mandate basis as permanent experts with the teams for promotional topics (termed Initiatives) and programs.

**The CTI profile**

The CTI Commission is a militia-style organization, i.e., the members work with CTI as a part-time activity external to their professional situation. The members are elected by invitation, and make available their expertise to CTI, but do not represent pressure groups. Consequently, the commission exercises a great deal of freedom in reaching decisions.

The most significant 'capital' within CTI is the combined expertise of the members and permanent experts together with their world-wide network of contacts. The effectiveness of CTI goes beyond simply supplying financial support; it results more from being a group of some 50 people fulfilling a collective mission, without personal gain, making themselves available to public service to complete a defined task.

**The knowledge incorporated by the CTI members and experts is its most significant 'capital' investment**

In nominating members, CTI places considerable value on the ground rule of 'separation of referees from the players', i.e., CTI members may not assess project proposals in which they are themselves involved. Members are elected by the Head of the DEA for a period of four years, with two additional four year service periods as an option. The president of the Commission is the director of the Federal Office for Professional Education and Technology (OPET) which is a section of the Federal Department of Economic Affairs (DEA). The General Secretariat of CTI and the administrative aspects of its promotional activities are compensated financially by OPET. The General Secretariat of CTI is integrated in the innovation section of OPET.

CTI is an advisory body. The definitive powers of decision for awarding federal funding rest with the Federal Administration or Executive. Specifically, the decision on projects requesting up to one million Swiss Francs (CHF) is made by the director of OPET, between 1 - 3 million CHF by the Head of DEA and the decision on projects requesting funding beyond 3 million CHF is made by the Federal Council.<sup>2</sup>

CTI has been the official federal agency for promoting application-oriented, industry-related research and development (R&D) at national and international level since January 1, 2000.<sup>3</sup> In addition to its own promotional initiatives and programs,

**Agency of the Confederation for the promotion of applied R&D**

CTI is also responsible for the promotional initiatives and programs in applied research which are founded on other federal ordinances such as the Energy Act<sup>4</sup> or the Research Advancement Act.<sup>5</sup> The responsibilities extend to cover industry-oriented research programs of other federal departments. Further, CTI carries the operational responsibility for industrially-oriented programs from the Board of the Swiss Federal Institutes of Technology. Consequently, following agreement with that Board, CTI carries through the technology-oriented program 'The Nanometer in the World of science and Technology of the 21<sup>st</sup> Century' (TOP NANO 21).

At international level, CTI is responsible for participation in the European research initiative Eureka, the world-wide research program in Intelligent Manufacturing Systems IMS. Further, CTI participates on the Swiss Space Office (SSO), the Swiss representation in the European Space Agency (ESA).

The authorized block credits in millions of Swiss Francs administered by CTI for the period 2000-2003 in the various initiatives and programs are listed in Table 1. The CTI business is differentiated in 'core business' and special initiatives and programs. The core business especially promoting SME individual R&D projects with participation of SMEs. Both parts of the CTI work are complementary.

<b>CTI promotional areas and programs</b>	<b>Authorized credits for the ERT for the finance period 2000-2003 in MCHF</b>
CTI core business - priority orientation towards SME; including standard CTI projects with the Universities of Applied Sciences	99.7
CTI - Universities of Applied Sciences - project-oriented capability development at the Universities of Applied Sciences	80
Top Nano 21 (ETH Board Budget)	(62)
EUREKA	40
CTI Start-Up! Initiative	30
Action program Softnet	30
Initiative MedTech	20
Build up of application-oriented research in education	10
IMS	10
Energy technology (Budget of SFOE)	(10.5)
Others	0.3
Total (without budget of TOP NANO 21 and budget of SFOE)	320

**Table 1: CTI promotional areas and programs in 2000-2003**

## **1.2. Financing of CTI**

The promotional activities of CTI are financed via block credits which are granted by the Federal Parliament for four year periods as based on the corresponding

**Financing via block credits**

Message issued by the Federal Council (the Executive). The specific objectives and the thematic focal points, termed initiatives, for the corresponding block credit period are defined in that Message. The current period 2000-2003 is covered by the Message dated on Nov. 25, 1998. An award of 320 MCHF was sanctioned by the Federal Parliament for the operations of CTI for 2000-2003.

The preparation of the Message for the Promotion of Education, Research and Technology (ERT) for the period 2004-2007 are currently in hand and are expected to be debated by Parliament at the end of 2003. A significant increase in support for the period 2004-2007 is being requested.

**Preparations for a new ERT Commission are in progress**

### **1.3. Performance Record of CTI**

Computer-based editing of its data bank was started by CTI in 1986. Statistics are available from that time which illustrate the progression of the number of proposals received, projects granted, the total volume of R&D support in MCHF, together with the amount of financial support furnished by the government. The progression of these statistics is shown in Fig. 1.

The following developments really stand out: In the last 15 years the number of project proposals received by CTI has increased by a factor of more than seven. The number of projects which has been subsidized in this period between 1986 and 2000 has risen by a factor of somewhat more than four. The split between the number of proposals submitted and the number of projects subsidized continues to increase. As a result of the rapid increase in the number applications submitted, the proportion of rejected proposals has risen to over 40 percent.

**The split between the numbers of project applications made, and those subsidized, continues to expand**

A further increase from the current number of 700 proposals per year is anticipated, with the increase estimated to be over 1,000 annually by 2007. In particular, the Universities of Applied Sciences are going to build up their activities strongly in applied R&D; in this respect, the increased financial support being made available to them has also to be taken into account (viz. revision of the Law on the Universities of Applied Sciences, FHSG).

With the increase in the number of projects subsidized, the volume of R&D generated has more or less quadrupled from just under 50 MCHF to over 200 MCHF. Of this, the federal contribution of about 80 MCHF provided via CTI corresponds to about 40 percent of the total R&D volume. This means that private industry is providing more than its share to CTI projects.

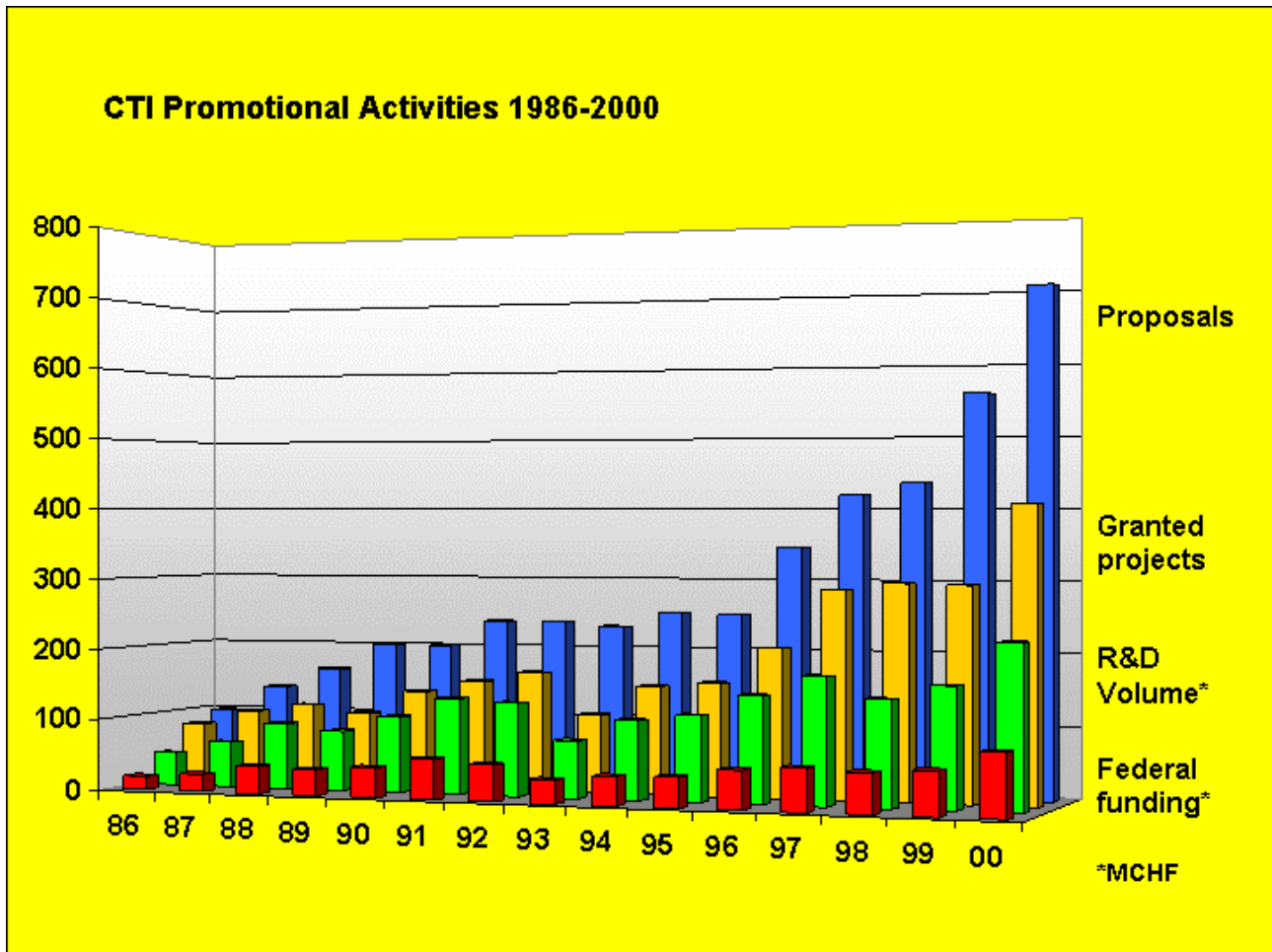


Figure 1: Development of CTI promotional activity in the period 1986-2000

The point-of-view is often expressed that it is only the Universities of Applied Sciences that CTI takes into consideration as partners in the public research sector. This error may well originate in the general publicity surrounding the initiative carried out by CTI of supporting the newly-founded Universities of Applied Sciences as centers of excellence in applied research, and thus as attractive partners for industry. Consequently, the reality fades into the background that it is with research laboratories of the two Federal Institutes of Technology in Zurich and Lausanne that CTI has signed the majority of project partnerships in the period 1986-2000. With over 600 projects each, the two Institutes of Technology are the major clients amongst the Universities, as seen in Fig. 2. This is similarly apparent from the financial support rendered to them with a ratio of about 3/4 to the Federal Institutes and the Cantonal Universities, and 1/4 going to the Universities of Applied Sciences.

All Colleges can be project partners with CTI



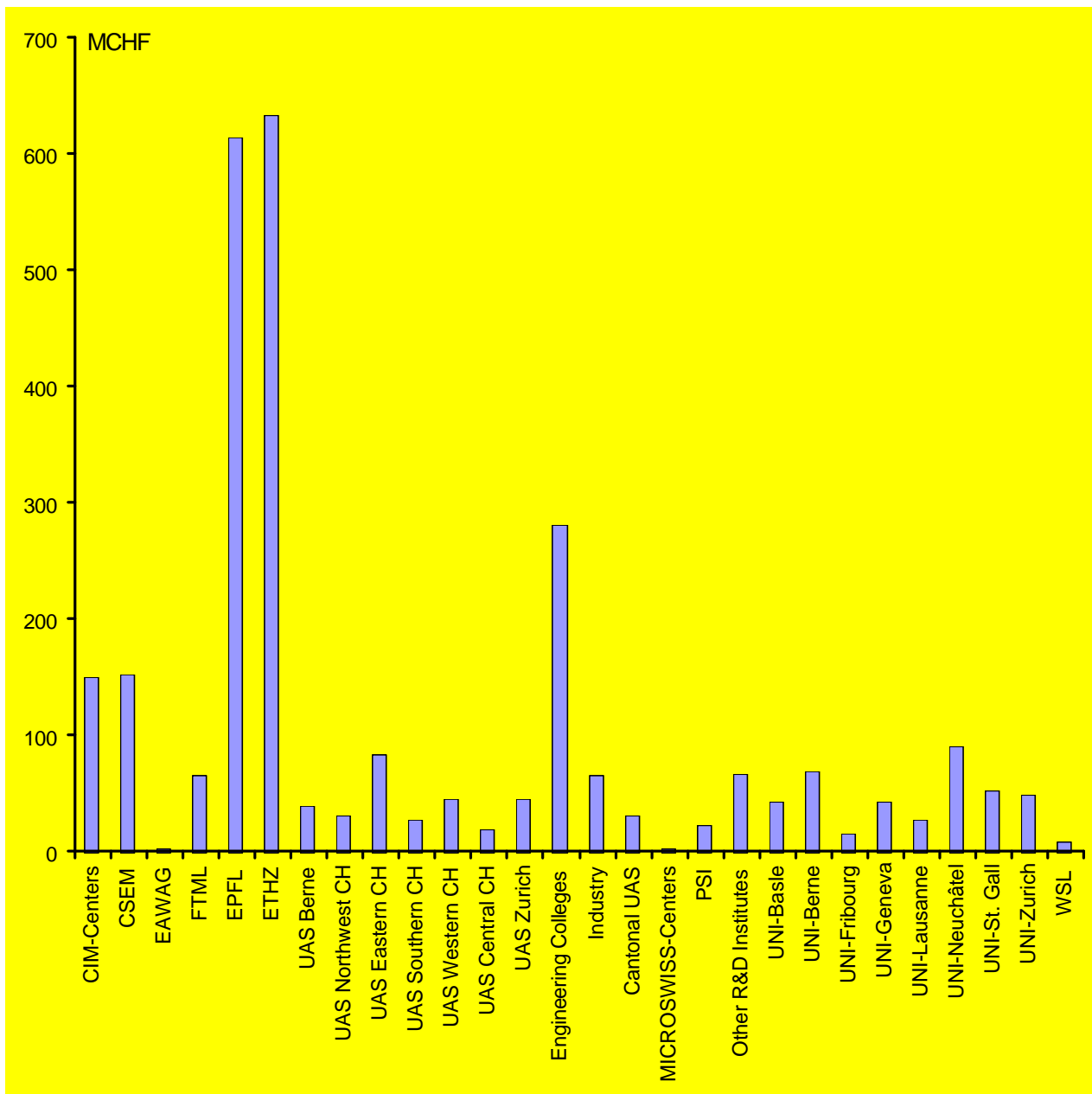


Figure 2: Distribution of granted projects by public R&D-partners, 1986-2000

Turning to the aspect of industrial partners, Fig. 3 makes it clear the SMEs comprise the majority of partners from private industry. Projects without any financial support from private industry are practically non-existent. It is equally clear that private industry contributes more than half of the research moneys to the projects. This applies equally to major industries as well as the SMEs.

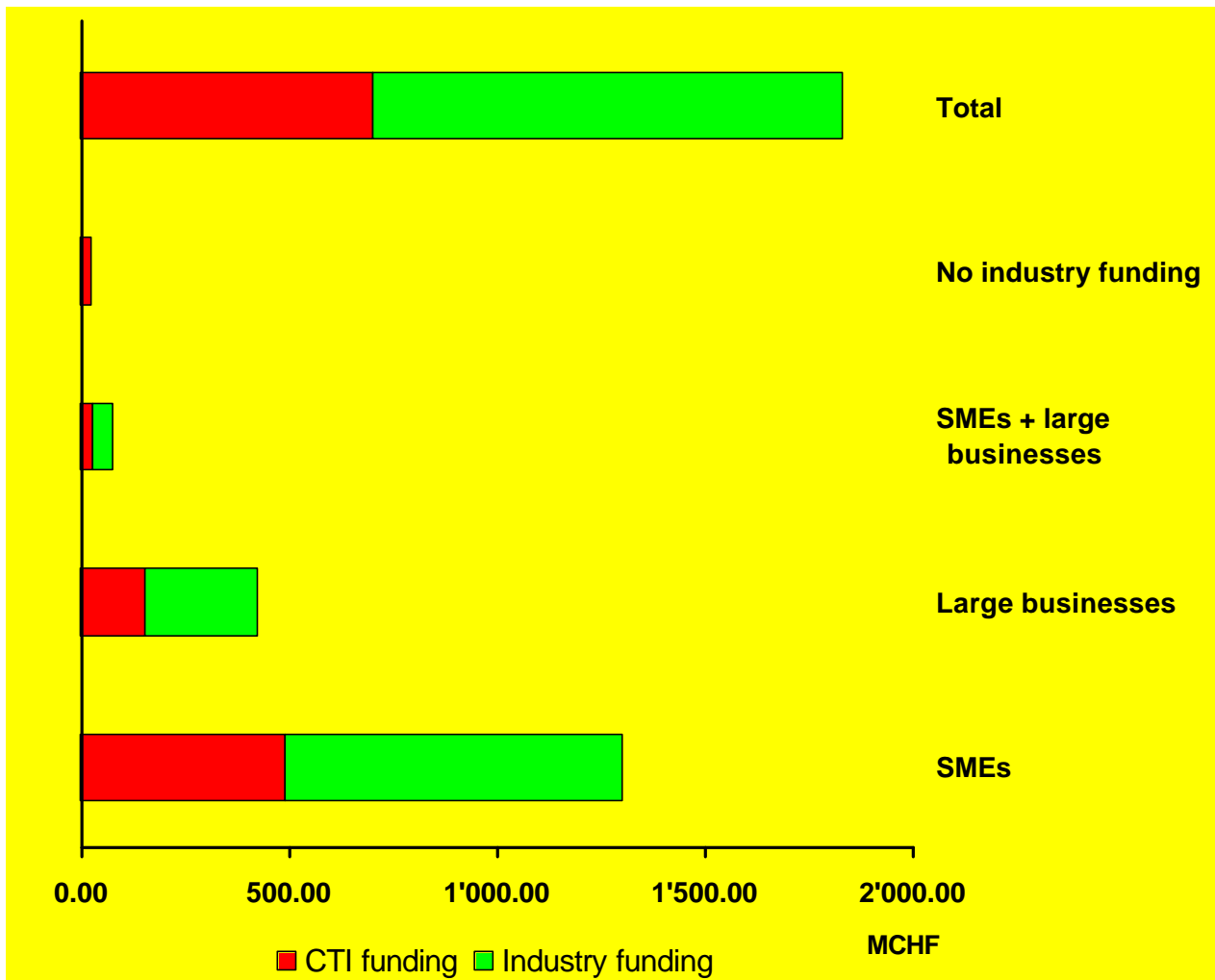


Figure 3: CTI project funding by the size of businesses

Considering the disciplines supported by CTI projects, Fig. 4 shows that there is an emphasis in promoting informatics and software, respectively. These are followed by machinery/equipment and materials. The technology portfolio supported by CTI is thus - with the exception of informatics - primarily in those research areas where Switzerland is traditionally strong.

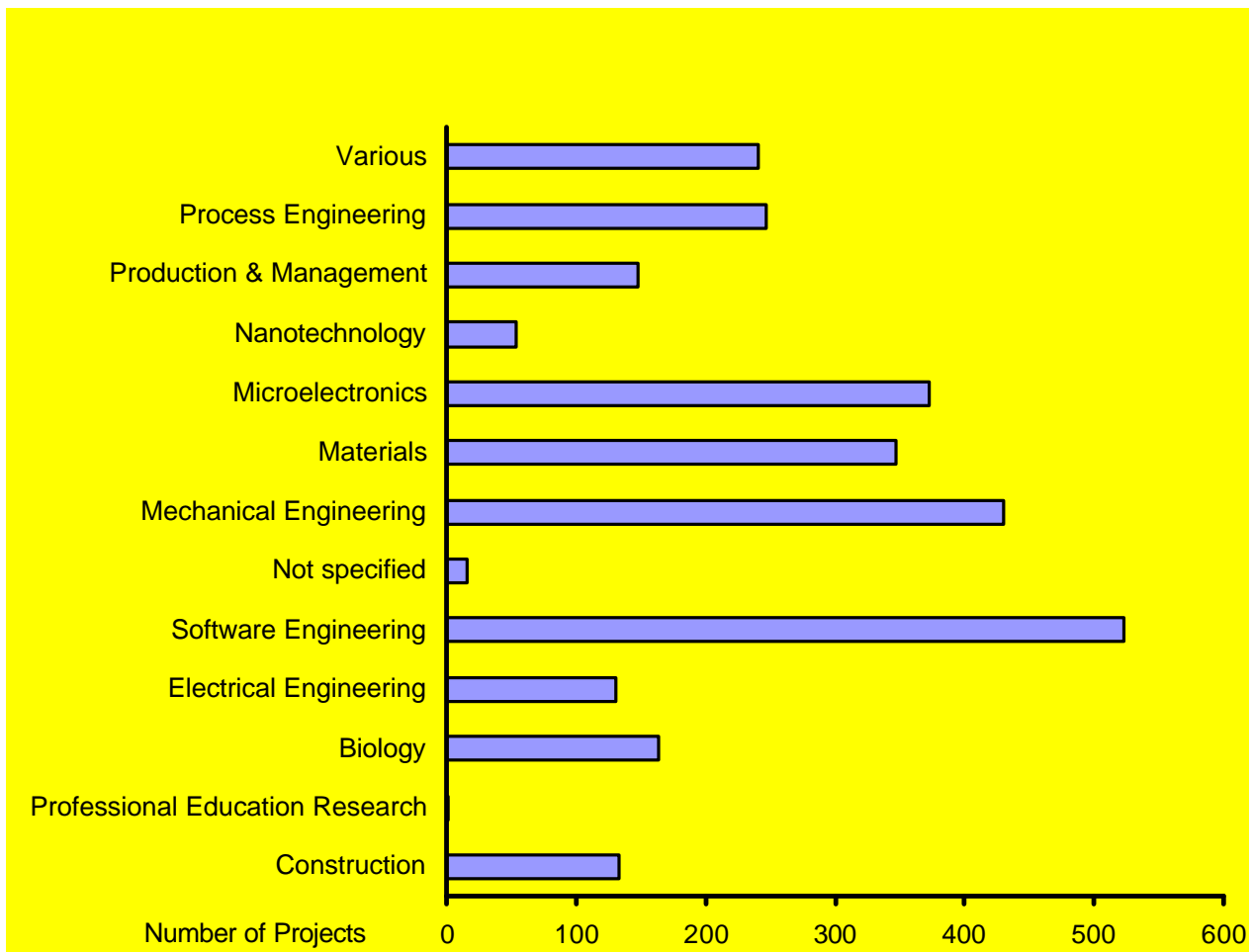


Figure 4: CTI projects by scientific disciplines, 1986-2000

Subsidiary statistics data are available for the period 1995-2000: more than 1,700 collaborative projects involving the Universities<sup>6</sup> and industrial companies have been supported on the recommendations of CTI. The total financial involvement is of the order of 1,000 MCHF where industry has supplied cash contributions of some 670 MCHF of its own and the Confederation has granted 370 MCHF. The number of industrial companies involved in this time period totals about 2,300 of which some 90% were Small and Medium-sized Enterprises (SME).

A major consequence of the promotion of projects by CTI is its impact on higher education. The projects currently being supported by CTI covers the salaries for around 1,000 positions, the vast majority of which stand to benefit the development of Swiss Universities. In the period between 1995 and 2000, the salaries of some 6,200 positions at the Universities were financed: about 4,800 were supported by financial contributions from the Confederation whereas the cash contributions from industry to Research Institutes and the Universities covered a further 1,400. The number of people who are employed in research and profit from CTI sponsored work should be significantly higher.

The effect of CTI support is also clearly evident on reviewing the results obtained in the projects sponsored by CTI. The present report therefore includes a selection of short summaries of individual projects taken from the various initiatives and

**Facts and Figures 1995-2000:**  
**1700 projects**  
**1,000 MCHF R&D volume**  
**90% SME**  
**6,200 positions**

**Effect of CTI on the education of the next generation of scientists**

programs, and which CTI considers as 'success stories'.

Since the mid 80s, individual areas supported by promotional activities of the CTI have been subjected to review. In part, these evaluations take on the character of a quality assurance of the CTI criteria and project management. In part, it covers a scientific evaluation study of the individual initiatives being promoted. Since 1990, fourteen evaluations have been carried out at 'major CTI clients' to whom a large number of projects has been awarded in addition to the evaluations of specific CTI initiatives. It is difficult to make a comparison of the results because of differences in motivation, objectives, and methods (study of the documentation, verbal interviews, written questionnaires) but they do permit a good insight. The results of the existing evaluations are summarized in Appendix 1.

**Quality assurance of CTI initiatives**

CTI has a relatively good overview of the projects which it has sponsored through the numerous intermediate and final project reviews carried out on side by the CTI members and experts. Specifically, the initiative promoting expertise build-up in applied R&D at the Universities of Applied Sciences, in particular, has resulted in very many, between 50 and 80, annual project reviews. Consequently, CTI obtains a broad knowledge of the quality of project management in addition to an appreciation of the results achieved by those involved. In the majority of cases, the conversion of the results of the work into an industrial product by the associated company generally evolves some time after project completion. The information held by CTI on the direct industrial impact of its promotional efforts is necessarily incomplete. Unfortunately, there is no systematic, permanent check carried out by an independent body which overviews the conversion to product by the industrial partners.

**Supervision will be developed**

#### **1.4. Resources and Expenses**

CTI may only invest a maximum of 4% of its total budget in research overview, evaluation, contracts with experts, project management and various diffusion activities. In the block credit period 2000-2003, this corresponds to 3.2 MCHF annually. These funds are used primarily by CTI to finance the mandates with the permanent experts. The General Secretariat of CTI currently numbers 16 people, making up 13 full-time places, and comprises four scientific and nine administrative personnel. The running costs of the CTI General Secretariat are about 1.6 MCHF annually and are born by the OPET budget. The total expenses incurred in the administration and management of CTI are about 4.8 MCHF annually, corresponding to 5.9% of the total budget.

**Expenditure on management and administration is 5.9% of the total budget**

## 2. Mission and Strategy of CTI

**Key Question I: What is the role of CTI as a core player in an economic innovation policy in the Swiss system of promoting innovation, as well as science and technology transfer (National Innovation System)?**

**Key Question II: How is the strategic alignment of CTI to be assessed in terms of instructions and mission?**

### 2.1. Mission of the Commission for Technology and Innovation

The prime mission of CTI is the promotion of innovation, i.e., the transfer of new technologies and new advances in science into successful products and services as effective production processes and organization styles.

CTI carries out this mission in promoting collaboration between non-profit making research and teaching organizations, on the one hand, and industrial partners on the other. The non-profit making research and teaching organizations comprise primarily the Cantonal Universities, the Federal Institutes of Technology and the Universities of Applied Sciences ('the Universities'). The industrial partners are primarily privately-owned companies which are involved in innovation competition and thus have to continuously maintain a market-oriented capability, often involving technology-intensive innovation. Appearing increasingly among possible industrial partners are institutions in the public domain who have to improve their services and are subject to economic competition from the market (new public management).

The main beneficiaries of the collaboration are companies who themselves do not have the necessary knowledge and/or the necessary personnel and financial resources for research and development. This impacts the small and medium sized enterprises (SMEs) in Switzerland which are so significant in the employment statistics. The promotion of projects by CTI offers them concrete help towards the innovative solution to problems. In contrast to the equality applied to all aspects of program promotion in its core business, CTI generates thrust towards new technologies which will be very significant in the future for the companies, and the Swiss economy generally.

The financial support from the Confederation goes entirely to the research organization involved whilst the company has to finance its own efforts and, in addition, provide a cash contribution to its research partner.

The general aims of the promotional activities are given within its legal base<sup>7</sup>

- The promotion of the competitive capability of Swiss industry,
- The creation of new and the maintaining of existing employment.

In the Government and Administration Reform Act of September, 1997, the Federal Council commissioned two departments for the promotion of research in Switzerland, the Federal Department for Home Affairs (DHA) and the Federal Department for Economic Affairs (DEA). The Federal Council declared the CTI to be the federal agency for the promotion of application-oriented, economically significant, research and development at national and international level.<sup>8</sup> The

**The promotion of innovation via science and technology transfer viewed as the mission of CTI**

**Legal foundation:  
Mission of CTI regulated in the ERT Message; legal basis is the Federal Law covering the preparation for crisis management and promoting employment**

mission of CTI, its specific objectives, and its various thematic initiative programs, were laid down in its Message on the Promotion of Education, Research and Technology (ERT Message)<sup>9</sup> for a four year period with a defined strategy. This was discussed, modified, and approved by the Federal Parliament.

Currently, in addition to its core business, CTI is active in the programs and initiatives listed in Table 1, p. 13.

## 2.2. Activity of CTI in the Context of Competition in Innovation

Pressure to be innovative is particularly marked in the high income countries of which Switzerland is one. As shown by the latest study on innovation carried out by the Business Research Institute (BRI) of the Swiss Federal Institute of Technology in Zurich, innovation has become a routine part of their operations in 70% of industry and over 50% of service organizations in Switzerland.<sup>10</sup> The competition in innovation defines decisively the economic development of Switzerland. For the majority of companies, the effect of being non-innovative signifies stagnation and the danger of being ousted from the market. For society at large, it represents loss in quality of life and poorer perspectives for finding gainful employment in the future.

State-owned and privately-owned organizations whose prime purpose is promoting the process of innovation, primarily via the generation of knowledge with information and technology transfer, consequently acquire a far greater economic and political importance as has been the case in the past. In this respect, the importance of the activities of CTI has, in terms of its significance in the competitiveness of companies located in Switzerland and the whole of the Swiss economy, increased considerably.

The BRI study shows that the innovation index for Switzerland has fallen in the last few years. The reasons given for this are primarily centered around the economic conditions. In contrast, the efficiency of industrial innovation has risen. The developments show just how sensitively the innovation activities of companies can react to short-term economic changes, and just how important for Switzerland is the efficiency-promoting support of the innovation process which results from the promotion of knowledge and technology transfer, inter alia. Their significance grows yet more with the increasingly intensive involvement abroad of Swiss companies, via international joint ventures and foreign subsidiary companies, in strong growth and knowledge-intensive markets. The furtherance of an efficient exploitation of scientific potential, the rapprochement between the Universities and industry, and the on-going creation of qualitative advances in, and the economic exploitation of, knowledge strengthens Switzerland and makes it an attractive venue for local and foreign companies and scientists.

The competition for company relocation has increased the pressure on Swiss policy to align itself with the practices of 'good governance' which are starting to become established throughout the entire OECD. The CTI also has to deal with the question of the extent to which its strategy and measures correspond to the current international state-of-the-art on policies needed to enhance the strength in innovation of local companies and to make the local environment attractive for the relocation of new companies. Nonetheless, it should not be overlooked that the annual promotional funding of CTI, in comparison with the total R&D funding of 7

**Innovation: a survival necessity**

**The Swiss economy depends on the success of its innovative companies**

**Changes in the dynamics of innovation in the Swiss economy, internally and abroad**

**'Good practices' in the OECD**

MCHF for the whole country, is quite modest. This cannot be used for anything more than applying just a limited amount of thrust.

### **2.3. Role of CTI in the National Innovation System of Switzerland**

Industrial innovations develop from the application of new or, at least, new combinations of knowledge and new technologies. Scientific innovations based on R&D and the capabilities of the staff, their training and education, are critical factors in successful innovation processes. This knowledge is opened up, in addition to purchase through the 'factor market', increasingly through the availability of information from networks and the so-called clusters. These interactions can be the result of personal contacts, the consequence of personal mobility, or large scale cooperative research programs.

**Innovation: knowledge-based industrial pürocess**

Against this backdrop of knowledge-based innovation, industrial companies are searching out more intensively their optimal point of entry into this knowledge network comprising active suppliers, resourceful R&D laboratories, strategic business partners, and advanced education facilities which facilitate their ingress to external sources of information. The aggregate of this network is the National Innovation System (NIS). The NIS proceeds from the assumption that the complex process of innovation, starting with the generation of knowledge via its propagation, and through to the creation of innovations and new employment is best portrayed in terms of, and then analyzed against, a methodical system.<sup>11</sup>

**The innovation competition based on advances in science which are achieved increasingly through network-based knowledge and technology transfer**

At a political level, and considering the complexity of innovation competition, a multiplicity of interactions and interdependencies are generated: Political measures aimed at the requirements of industrial innovative capability in Switzerland and at enhancing its attractiveness for company relocation present an all-permeating challenge. Measures dealing with education, research and technology have to be resolved collectively. Obviously, no single government department in Switzerland can alone satisfy this task. Instead, it has to be a combined operation between the various players who contribute in any way to the generation and distribution of information related to innovation as based on R&D, as well on training and education. A further and prime concern is to intensify contacts with those companies which are innovative so as to be aware of where there is a real need for political involvement in enhancing the innovation dynamic in Switzerland.

**Innovation policy as cross section task**

CTI and the companies which are active in innovation are, thus, not independent of the other players and do not operate outside the framework of the Swiss economy, nor of the global competition in innovation. CTI takes into account the interactions between the various players who are involved in industrial innovation.

**CTI: contained within the Swiss NIS**

An appropriate and, meanwhile, well-proven concept for considering these relationships is the so-called National Innovation System (NIS). At its simplest level of application, the NIS serves as a situational 'road map' of the existing organizations and institutions (legal and cultural frames of reference) which are involved in science and technology transfer in a national or regional economy. The NIS thus comprises an overview of the composition and relationships between the players involved and which can also be summarized in graphical form.

**NIS as map of the organizations and institutions in science and technology transfer**

As can be seen in Fig. 5, five participating groups can be differentiated in the NIS concept. This is defined more precisely for Switzerland with the most important organizations. These are:

- companies active in innovation,
- the administration involving both the DHA and DEA, covering OPET, FES, seco and SSA,
- private and state-supported R&D organizations, where the latter comprise the two Federal Institutes of Technology, the Cantonal Universities and the Universities of Applied Sciences,
- Education authorities in the area of professional training (training and higher education), again with the two Federal Institutes of Technology, the Cantonal Universities and the Universities of Applied Sciences,
- private and state-supported organizations which in matters of science and technology transfer act as points of contact and moderators between science producers and users, where CTI (in the domain of applied research) and SNSF (in the domain of basic scientific research) are the two most important players.

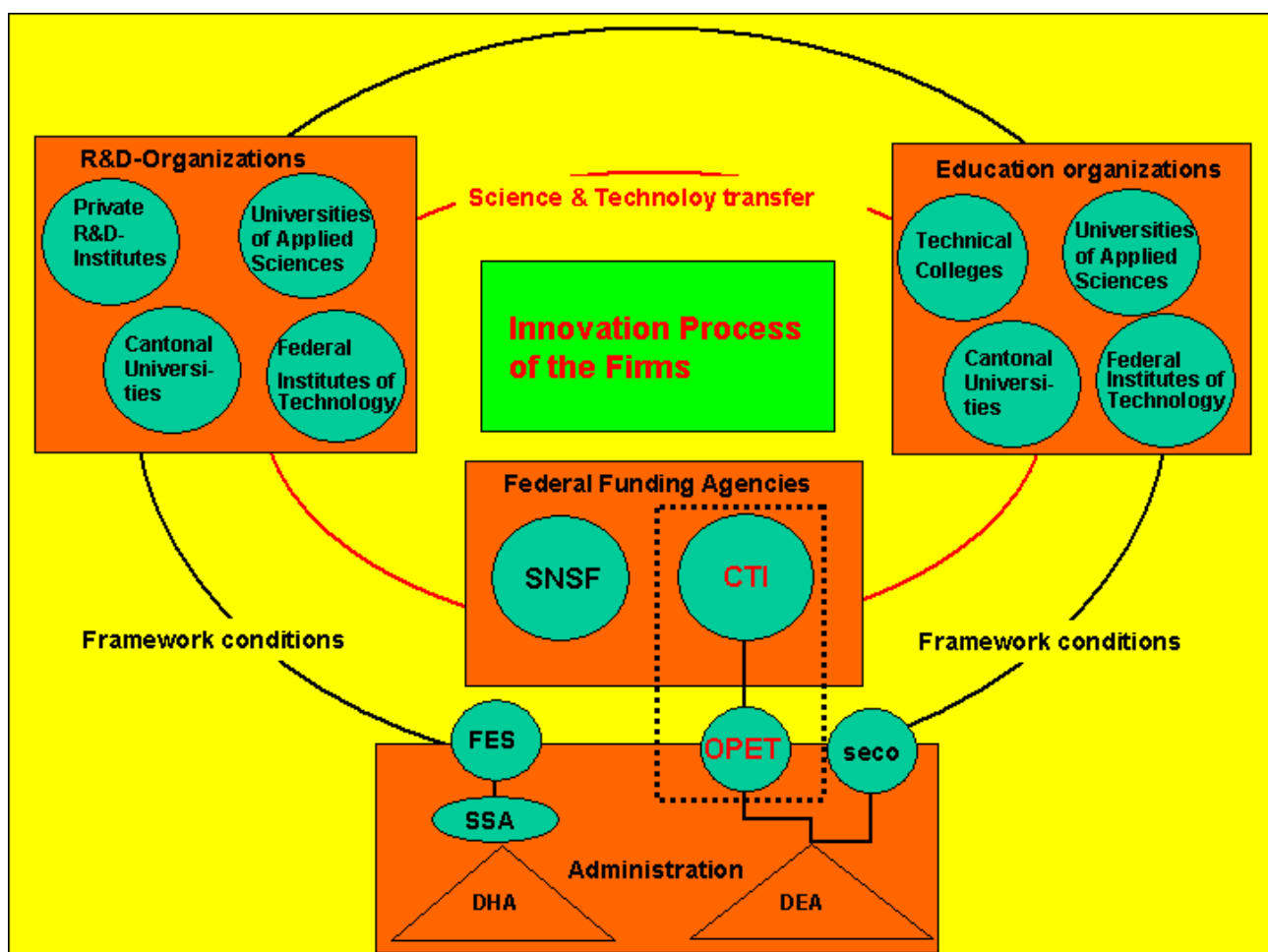


Figure 5: The National Innovation System of Switzerland; the inclusion of all organizations is not guaranteed



## 2.4. CTI-related Policy Implications of the NIS

The National Innovation System is a concept which has proven itself over the last few years in the policies practiced by the OECD. In terms of future development the concept has great potential to position the CTI more optimally in an international context, and to permit its achievements to be evaluated via appropriate benchmarks.

**NIS concept: a new field for CTI**

If the network based information transfer system in the NIS does not function, then the individual companies and the entire innovation system remain below their potential for innovative capability: available knowledge remains unused, knowledge resources of public research facilities are not oriented towards enhancing the innovative capability of industry simply because the needs of industry are not known.

**Political order aspects of system errors in knowledge and technology transfer**

Such deficits, whose existence is suspected based on the BRI innovation study,<sup>12</sup> justify a new role for federal agencies in innovation policy. Practically all the 'good practices' followed in the OECD countries and based on the NIS concept concentrate on removing these defects which reduce the efficiency of the national R&D endeavors.

In the light of this NIS concept, the econo-political task of CTI is to increase technological capabilities in the field of applied research, and to enhance the dissemination of new knowledge and new technologies – technological diffusion – via the support of a networking system and to strengthen it primarily through the interchange of personnel. Network-based diffusion procedures should be made available over a broad spectrum and elicit support equally for companies dealing with advanced technologies and for those which have only limited capability. The steps taken should not treat a company as an isolated entity but rather strengthen its capacity for innovation through its interactive capability with other players in the innovation system. Concomitantly, the measures selected serve to enhance the capacity in the sciences such that this becomes aligned with the needs of innovative companies and, thus, the success factors of modern innovation processes.

**CTI as initiator and moderator of science and technology transfer in the Swiss NIS**

A concrete consequence of this extended mission to the NIS approach is the cluster-based innovation policy. Clusters are – geographically, technologically or branch-specifically concentrated – networks between companies, science-producing organizations (Universities, research institutes, businesses offering technology) and clients who are interconnected through the links of a value-added chain. Clusters are also termed (regional) innovation sub-systems.

**Cluster-based policies**

Cluster linkages offer the typical network advantages to innovation-active companies. They allow the access via mutual-support groups to information at a lower cost than in-house activities. Consequently, cluster relationships open up better learning opportunities and scaling effects because the risk and cost are split among the partners while the individual company flexibility is raised. In the smaller OECD countries, the cluster concept serves primarily to focus their promotion of science and technology transfer. This covers promoting of re-location of compatible companies into existing clusters, provision of support services for the clusters, making available appropriate infrastructure to insure the necessary communication within a cluster, the guarantee of a sufficiency of qualified staff,

together with setting up incitements to increase competitiveness (competition and regulation policy). An overview of possible system and market failures is given in Table 2 together with the cluster-based policy measures designed to overcome these and the activities which are undertaken by CTI.

The question which concerns CTI is to what extent its activities correspond to these cluster-based 'good practices' or, alternatively, why this policy is not being carried out in some fields. Thus, possible cluster-based policy measures are, inter alia, compared below with the mission and strategy of CTI.

<b>Deficits in the innovation system</b>	<b>Possible cluster-based policy measures</b>	<b>Corresponding activities of CTI</b>
Inefficient marketing	- <i>Competition and regulation policy</i>	<i>No, is not within the sphere of competence of CTI</i>
Informational failure	- <i>Technological forecastin</i> - <i>Strategic market information</i>	<i>No, no other federal agencies in Switzerland carry out such forecasting</i>
Inadequate interaction between the players in the innovation system	- <i>Federal Broker and Network organization</i> - <i>Promotion of dialog platforms</i>	<i>Regarding brokerage and network organizing, CTI operates its project promotion consistently and efficiently. Dialog platforms are prosecuted primarily through interchange between CTI members and experts</i>
Institutional mismatch between federal information structure and market needs	- <i>Promotion of industry-academe cooperation</i> - <i>Training and education measures to strengthen the available innovation-relevant capabilities on the employment market</i> - <i>Technology transfer programs</i> - <i>Promotion of Spin Off's / Start Up's</i>	<i>With the initiatives "Development of Application-oriented Education Research" and "Inter-personal Info-Transfer", CTI promotes an efficient education and training policy. Technology transfer programs are promoted via the Softnet, Medtech and IMS programs. The Start-up Initiative takes into account the innovative significance of founding new enterprises</i>
Absence of discriminating clients	<i>Federal purchasing programs</i>	<i>No, is not within the sphere of competence of CTI</i>

**Table 2: Cluster-based policy**

## **2.5. The New Strategy of the Commission**

### **2.5.1. Strategic Profile**

The new strategy of CTI for the period 2004-2007 was proposed with the following question as a backdrop: how can CTI optimally fulfill its economic mission to improve the innovative capability in Switzerland in the coming years. For this reason and for the first time in its history, CTI has defined its mission and strategy in written form and, after a widely-disseminated discussion, completed it in May, 2001. This strategic document forms the basis for the practice of the Commission

**For the first time CTI has defined a Strategy Paper**

in the next few years (Appendix 2).

The profile describes CTI as the central policy instrument for promoting the competitive capability of the Swiss economy in innovation competition. The position of CTI is that this profile is the econo-political instrument of the Confederation complementing the instruments of research policy. It promotes science and technology transfer – in particular the ‘Inter-personal Info-transfer’ – between technologically innovative companies, public organizations and information systems. It takes on the task as an interface between research and industry in the NIS of Switzerland. Its programs contribute to clustering in new domains of technology and product. CTI takes a broad-based, comprehensive approach to its project requirements in applied R&D, i.e., it is open to proposals from all scientific disciplines. The support given by CTI covers financial contributions, and qualified services as well as provision of support in the management of innovation from CTI members and external experts from industry and the scientific community. This content is illustrated graphically in Fig. 6.

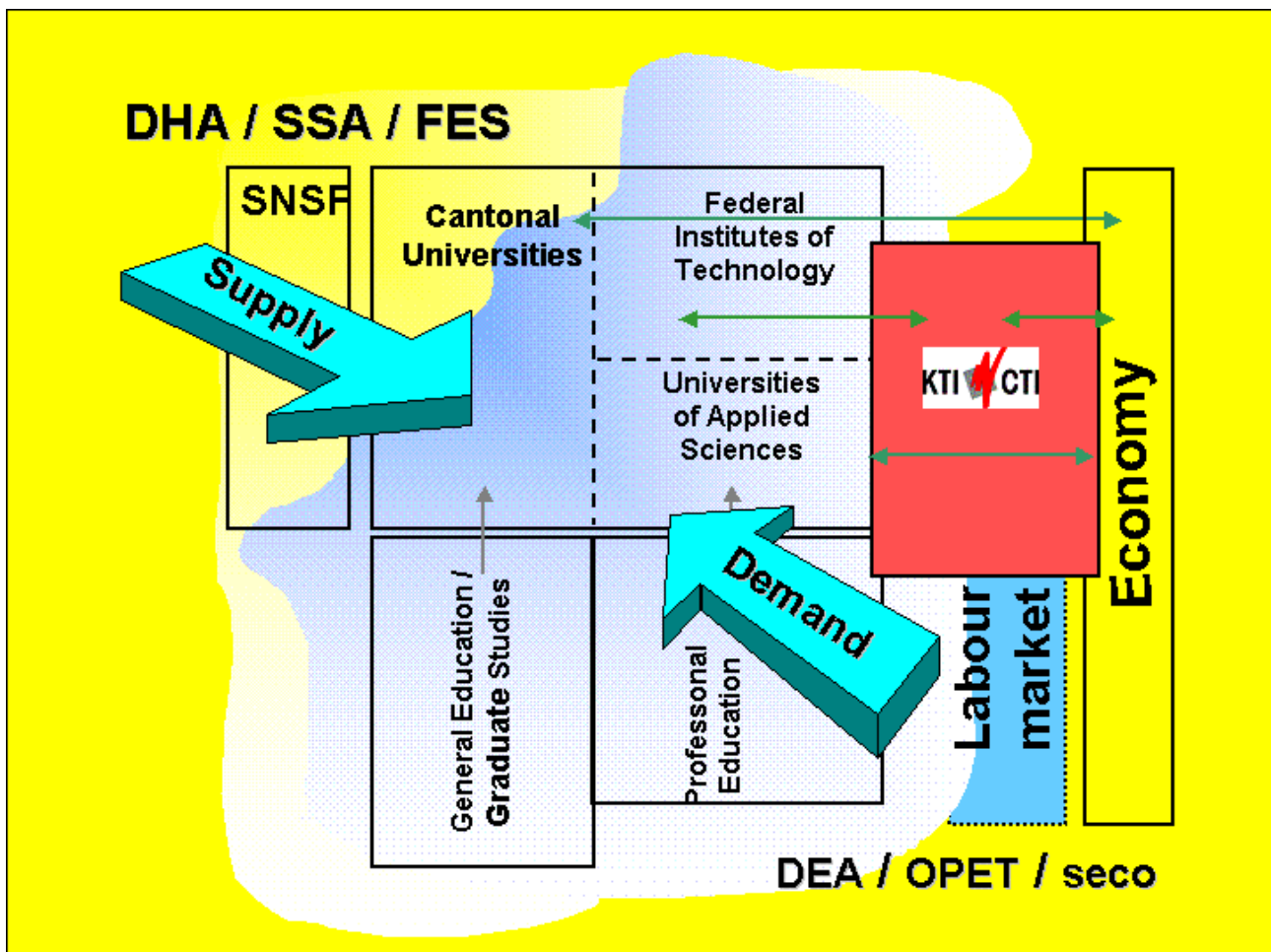


Figure 6: Location of CTI at the interface between science and industry

This positioning has the effect that the measures taken by CTI operate on three policy levels:

- at the level of innovation-oriented economic policy, in that the innovation

process of knowledge and technology transfer in Switzerland between the Universities and industry is promoted following the principle of 'Inter-personal Info-transfer',

- at the level of growth-oriented economic policy, where high value-added employment positions are maintained and generated, and the founding of new enterprises is promoted,
- at the level of science and education-oriented economic policy in that the 'Inter-personal Info-transfer' approach enhances industry-oriented higher education (university level).

The support from CTI is furnished through financial contributions, qualified services, and the availability of help in the management of innovation through CTI members and external professionals from industry and academe.

CTI pursues its strategic objectives within the framework of this profile. The two most important strategic objectives for CTI in the next few years are:

1. Support of the innovation process in industry through the project and program specific promotion of application-oriented research and development following the bottom-up principle and the subsidization principle (the 50:50 funding rule):
  - through 'Inter-personal Info-transfer', i.e., through mutually significant application oriented R&D projects between industry and researchers in the Universities as well as the transfer of researchers themselves into industrial positions,
  - through the acceleration of the transfer of scientific knowledge into economically viable products and services where industry and the Universities active in applied R&D work closely together; hence it is feasible for an SME to take advantage of research results and create innovative products.
2. Stimulating the development of a broad-spectrum, in-depth, industrially competitive applied R&D in the Universities. In this context, CTI:
  - strengthens application oriented R&D projects,
  - supports the creation and further development of nation-wide networks of excellence for future-oriented technologies in the Universities of Applied Sciences,
  - endeavors to strengthen the participation of the Universities of Applied Sciences in international R&D projects,
  - promotes more strongly non-technologically oriented research.

Further important strategic objectives of CTI are:

- a significant build-up of its international promotional activity and participation in international transfer-oriented research,
- increased collaboration with the Swiss National Science Foundation for a more efficient utilization of the interaction between basic research and applied research and development.

### **2.5.2. New Emphasis in CTI Strategy**

CTI does not only promote new technologies and technology-oriented research. Project support by CTI is open to all disciplines and is universal in its catchment, i.e., it considers ecological and social aspects in addition to economic and

technological ones. This has indeed been standard practice for many years, yet CTI still has the reputation of being a ‘technology promoting agency’<sup>13</sup>. The build-up of the capabilities in applied research and development in the Universities of Applied Sciences requires a greater receptivity towards faculties beyond the sciences and engineering, specifically, business and social sciences, health sciences, education, design, art, music, and performing arts.

CTI does not only promote business-oriented applied research and development in collaborative projects with companies in the private sector. Following the increasing market orientation in the public sector, it is promoting innovative projects which enhance the efficiency of public administration and the non-profit sector with partners from these spheres. In particular the capabilities in applied research and development of the Universities of Applied Sciences require an opening up the range of project partners beyond the private sector.

**Broadening project partnership**

CTI is increasing its presence in international applied research and development. It has already been promoting international applied research and development in the framework of international programs such as Eureka and IMS. CTI will increase its support of the involvement of Swiss companies and research facilities in international promotional initiatives and together with other federal bodies, particularly the FES, become involved in formulating the frame of reference of new international programs (e.g., the 7<sup>th</sup> EU framework).

**International Presence**

## 2.6. Assessment of CTI in the Light of Key Questions I and II

**Assessment: CTI is fulfilling its mission to enhance the innovation capability of industries in Switzerland. As a result of the wide spectrum of its operations in the innovation political measures and effects, CTI is a central economic instrument of the Confederation to support the National Innovation System in Switzerland. The core business and specific promotional initiatives and programs of CTI establish a coordinated and effective aggregate package. A cluster-based policy is however only rudimentarily recognizable. The role, strategy and promotional activities of CTI are consistent with the liberal economic policy in Switzerland. The mission has been successfully accomplished to date, but is now running into danger from the increasingly stringent resource availability.**

### 2.6.1. General appraisal of CTI Strategies

The ‘Inter-personal Info-transfer’ instrument used by CTI to achieve its first strategic objective, the strengthening of the competitive capability, is well suited and thus quite adequate for the objectives. International studies and ‘good practices’ based on the NIS concept confirm that information transfer is best achieved through personal contact. The promoting of application oriented R&D projects between industry and the research system, where the salaries of the researchers in the non-profit organizations are financed by CTI corresponds to the current non-linear understanding of innovation processes as it has become established, inter alia, in the NIS concept. The sciences and industry cross-fertilize each other in this formulation. Information transfer is not a one-way street going from the non-profit making institution to industry, but the researchers profit from the knowledge and experience available from industry within the frame of reference which applies

**First objective:  
Strengthening the competitive capability through ‘Inter-personal Info-transfer’**

there.

A significant factor is the central issue in project promotion following the 'bottom-up' principle, namely that it is the project partners themselves who define the subject matter of the projects. CTI thereby insures that it can support projects covering a remarkably broad range of topics, as required under point 2.4. of the framework of cluster-based policy. The promotion of projects is thus open fully to all sectors of industry. The orientation towards the 'real' problems confronted in practice is confirmed in that not only are the scientific-technical solutions sought, but also economic, ecological and socio-scientific aspects are considered when finding a solution. This broad spectrum approach of CTI offers a parallel contribution in the promotion of multi-disciplinary collaborations within and between research facilities.

The market and application aspect of CTI promotions is insured through applying the bottom-up principle. For CTI, the intimate participation of the end-user in a project is the distinctive feature of applied R&D. The approach adopted by CTI means that, in promoting a cluster-based innovation policy, the widest possible spectrum of business interests with their widely differing technological levels are supported and the extensive diffusion of information is promulgated.

The subsidization policy followed in CTI promotions has a parallel effect. A financial involvement at least 50% (the 50:50 rule) of the project costs is required of the industrial partner in the form of active participation. In addition, very often a cash contribution is made available by the industrial partner to the research institute. The strong financial involvement by the industrial partner insures that this latter has a genuine interest in achieving innovative and economically viable results. Free-rider positions are avoided.

In supporting the Universities to increase the breadth and depth of their applied research, CTI pursues thereby a strategy of creating better alignment of the Swiss academic research system with the requirements of innovative companies, and in generating competent partners for industry in the field of science and technology transfer. Following this strategy, CTI is insuring that the practice-oriented gap is being narrowed at university level in Switzerland.

**Second strategic objective: building up and broadening of a competitive applied research at the Universities**

It is the declared objective of the Universities of Applied Sciences to include the results of applied R&D in their teaching curriculum in an appropriate fashion. The majority of these universities pursue the policy: all the research staff should also have a teaching assignment. The development of these universities is not yet complete so that an assessment of how far applied R&D is contributing effectively to a modernization of the content of the teaching curriculum is not yet possible.

In the Universities of Applied Sciences, CTI is moderating the development of national networks of excellence which should build up a more strongly applied stance. These networks result in the steady development of their capacity in selected future-oriented fields through fusing their capabilities. Furthermore, an increased involvement in international research programs is being imposed on them, and non-technological research is being promoted.

In view of globalization and international re-location competition, an objective of CTI is to increase substantially its international promotional activities. An active and sufficient participation of Swiss research in the areas of applied research in the

**Third strategic objective: Internationalizing of CTI activities**

international research community has to be firmly established. The Universities of Applied Sciences will be actively supported in the next few years in integrating themselves into the international research community.

As CTI is involved in international promotional activities and supports Swiss companies and research institutes within the international science body, it will facilitate the use of internationally available knowledge to Swiss industry and access to international research networks. This contributes to strengthening the competitive capability of Swiss industry and its position in the competition for company re-location. In this context, CTI must concomitantly enhance its activities internationally at the information, project, and program level. A direct involvement of CTI is essential in all EU authorities responsible for applied research as well as in Eureka, IMS and ESA and requires a considerable expansion of its future activities.

Innovation processes are not linear today, interactions between basic research to applied research, and the reverse, are common. The organization of the interaction between SNSF and CTI must take this into consideration. Consequently, an agreement between the two research agencies is necessary covering common interests, areas of tension and the hand-over of projects promoted between both agencies. This interface between CTI and SNSF should be improved in the interest of continuously promoting innovative projects.

The endeavors of CTI to establish an expert body between SNSF and CTI are thus a direct consequence aimed at resolving questions of the correct assigning of project applications, and thus to avoid situations in which innovative proposals receive no support in instances where the responsibility is not obvious.

**Fourth strategic objective: enhancement of information transfer between pure and applied research**

### **2.6.2. Program-oriented Promotion**

In addition to the CTI core business, the program-oriented involvement of CTI covers the promotion of selected topical program areas and technologies, an equitable partnership-style thrust to newly founded enterprises (CTI Start-up initiative), the reorientation of companies, and research organization in innovation competition. According to an opinion survey carried out amongst CTI experts confirming their extensive project experience, no activities in such areas would be undertaken by companies, particularly by SMEs, without this thrust effect from such programs. Experience shows that this does not lie in a disinterest on the part of the companies, rather in a lack of the critical mass which hinders them from carrying out alone innovative work in risk-carrying technology fields.

Further, according to the comments of the CTI experts, it is indisputable that without such initiatives no, or only to an extremely limited extent, network-building would occur between the scientific community and industrial companies, or indeed within these two groups of players,. 'Who is doing what in a given field of technology' and what cooperative opportunities are available between industry and the Universities only become known to many SMEs when they get involved in the appropriate initiatives.

CTI programs create in this manner a critical mass, information and transparency in new fields of technology. It achieves this specifically in the build-up of human resources, via the education and training of researchers, and through other educational measures, e.g., the MedTech program with the assistance of the newly

created post-graduated curricula for further studies. The critical mass is not evoked by the individual companies alone, but also through a contribution made by employing a sufficiency of well educated people.

The CTI initiatives and programs are developed, on the one hand, from the accumulation of references in the proposals received by CTI on the necessity for research in new fields of technology and, on the other, as a result of stimuli from CTI members and experts should new developments arise internationally which could well be of future significance for Switzerland.

In the view of the CTI experts, future programs are only viable when the special features of the Swiss market and culture are taken into consideration. The benchmarks applied internationally are thus of limited applicability. This evaluation is confirmed by experience with the 'good practices' developed in OECD countries under the NIS concept: programs which do not take account of the local institutional and cultural features are doomed to failure. In addition, a minimum industrial base for technology programs must already have been established.

The principle of 'Inter-personal Info-transfer' is to be maintained in the CTI initiatives as well as in the core programs. The policy of CTI must be reinforced in leaving the issues of the financial support of research facilities in the Universities or in industry as the responsibility of these specific organizations. It can also be concluded that the CTI core business and the CTI initiatives are complementary promotional tools. Hence they must continue to function in parallel. On the one hand, ideas for possible initiatives originate from the core business activities and, on the other, follow-up proposals originating from initiative projects can be submitted to the CTI core business sector.

In summary it can thus be remarked that it is desirable for CTI to make SMEs aware of future-oriented technologies to enable structural renovation processes and thrust incentives. It is very probable that the CTI programs enhance the readiness, primarily in the SMEs, to pursue involvement in the newer fields of technology. The mode of operation and the principles of CTI are summarized in Fig. 7 against a backdrop of its strategy.

**The principle of 'Inter-personal Tech-transfer' also applies to the programs**



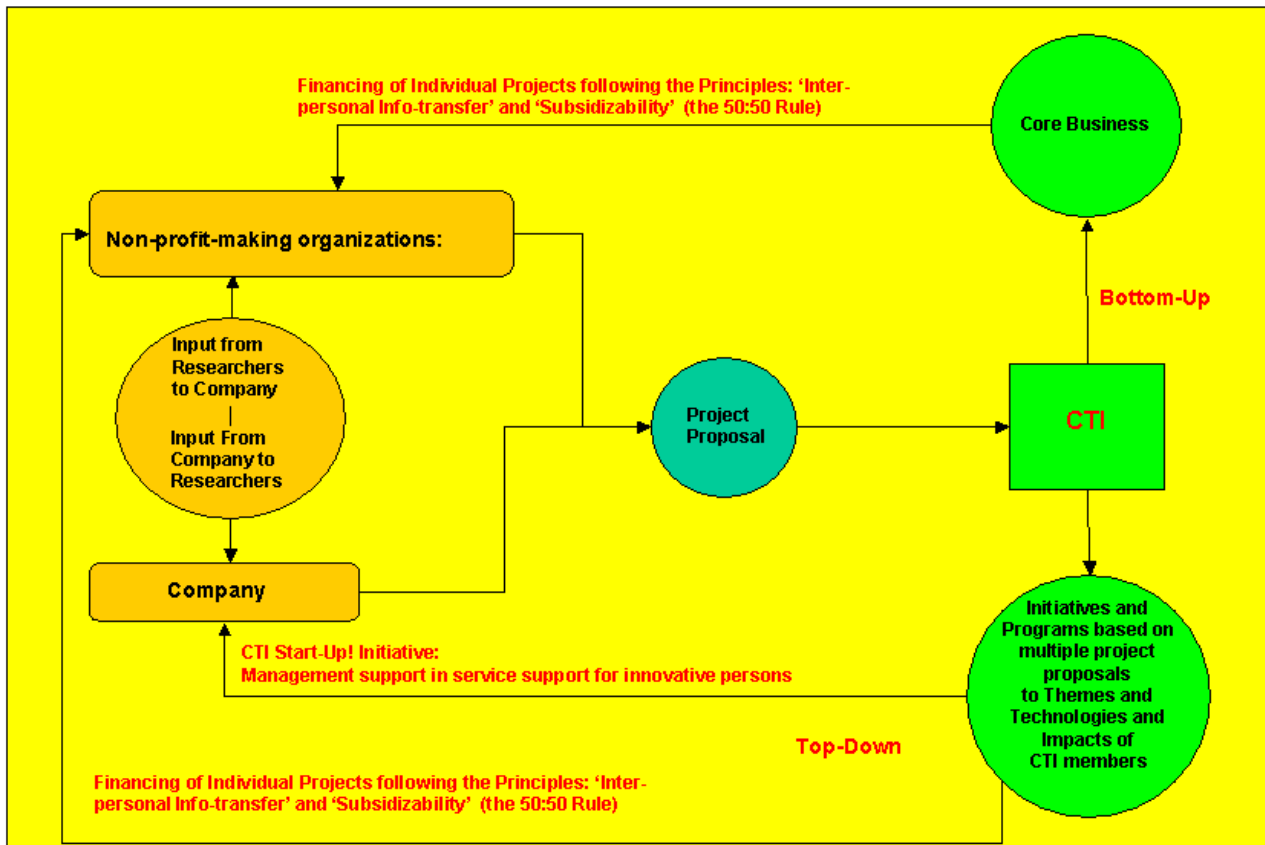


Figure 7: Mode of Operation of CTI

### 2.6.3. Cluster-based policy dispositions of CTI partially available

The strategy and operations of CTI correspond partially with the requirements of a cluster-based innovation policy. The promoting of projects strengthens the local innovation system because it takes into account the needs on the input side (factor markets) of the majority of the locally-situated SMEs. With the policy of 'Inter-personal Info-transfer' the SMEs gain an access into the human resources of the Universities, which they could not otherwise afford. CTI also strengthens the local innovation system in that the researchers at the Universities win a significant understanding of the needs and requirements of their local industry.

The initiative 'CTI-University of Applied Sciences' aimed at a project oriented capability development at the Universities of Applied Sciences strengthens the regional innovation dynamic additionally through supporting the Universities of Applied Sciences in their development as regional centers of excellence in their applied research. Various studies have demonstrated that those clusters which are the most dynamic are those which can demonstrate that their applied research organization is world class. These relationships are shown in Fig. 8.

Network-based  
information transfer -  
yes!!

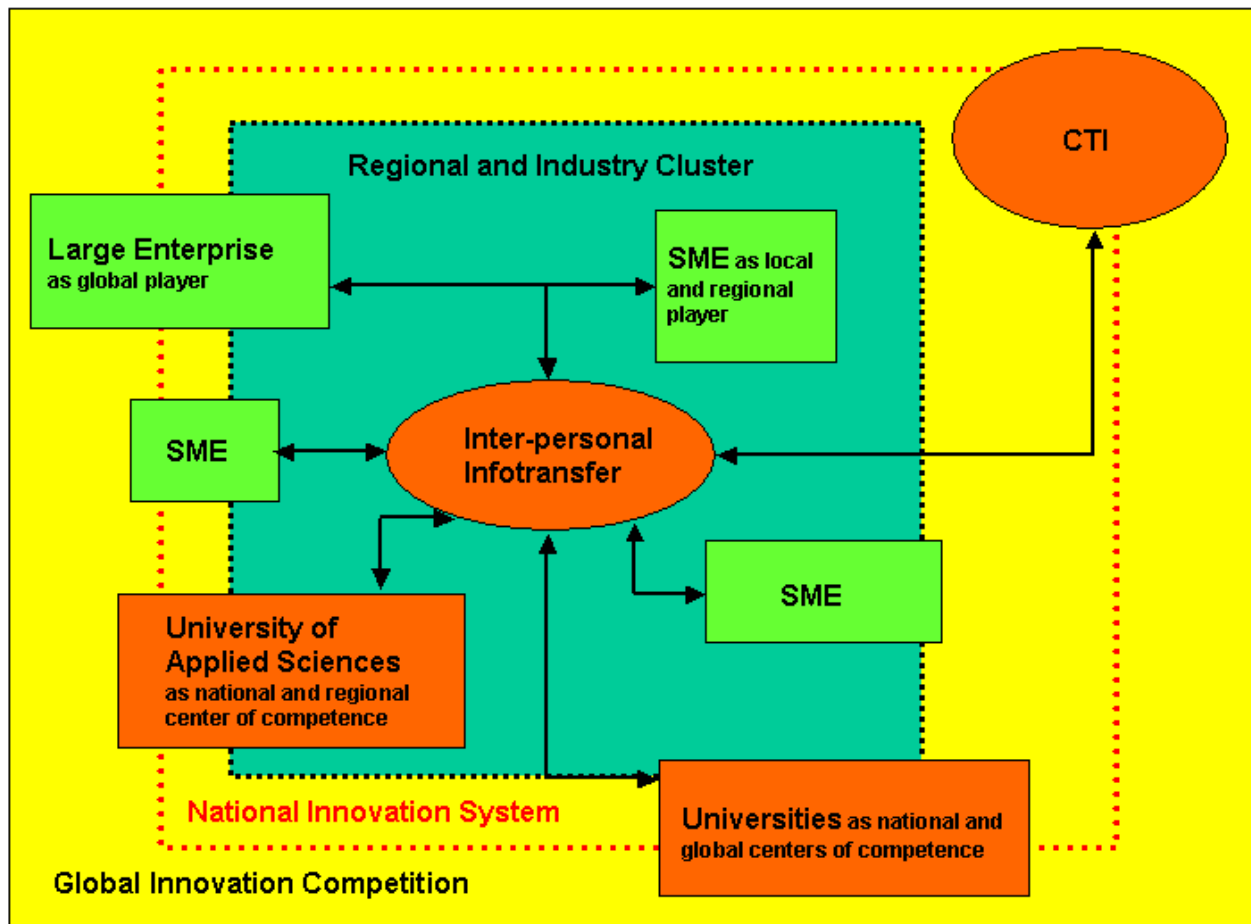


Figure 8: Strengthening Regional Innovation Systems by CTI

Deficiencies in a cluster-based innovation policy are evident from Table 2, p. 25. The list shows clearly that an institutionalized technological forecast is lacking, as is an empirical analysis of the effectiveness of measures taken by CTI on program-promoting clusters. Recent studies show clearly for Switzerland that the various industries and companies, respectively, which are active in different fields of technology cultivate very different channels of knowledge and cooperative relationships. CTI needs to pay more attention to this topical arena to insure an efficient promotional policy.

It should be noted that Switzerland's strengths predominantly lie within the more traditional fields of technology and weaknesses are apparent in future-oriented fields. If indications from the private sector economy regarding its R&D-activities bear the marks of a conservative attitude and if these are conveyed through less dynamic companies and/or regions, this could also have adverse effects on the dynamics and creativity of R&D promotion activities. There is a risk that emerging technologies with high future potential in the global innovative competition will be promoted in Switzerland too late even when CTI is aware internally of such developments through information received from its members and experts. In this respect a technological forecast and the publication of its results take on an exceptional significance.

It is obvious that the promotional activities of CTI do not fall within the framework of

**Cluster-based  
innovation policy -  
limitations!**

a federally integrated innovation policy. This is primarily due to the fact that there is currently no defined innovation policy for Switzerland at Federal Council level. Also in the system of law and the available political instruments, no such overall coherence exists. An indication of this is found in the legal base of CTI which dates back to the year 1954 based on recession policy for dealing with crisis management and the promotion of employment which was written under completely different economic conditions. In no way does this take account of the innovation mission of CTI as a prospective promotional instrument of the Swiss economy. The creation of a new legal basis is well advised.

A further index for the lack of integration of innovative measures at the Federal level and of untapped potential on agreements and synergy between SNSF and CTI and, as a direct consequence, a total alignment of the entire process in going from fundamental research through to a successfully marketed product. These deficiencies can only be laid to a very limited extent at the door of CTI, but have their origin in the current lack of integration of the various endeavors in innovation policy at Federal level.

#### **2.6.4. Internationalization of CTI Activities**

Swiss industrial companies are involved extensively in international competition. This is similarly true of the public domain in its competition for relocation. CTI can only contribute in an optimal and objective manner to the competitive capability of the Swiss economy, if it is fully familiar with the international situation.

In the present day 'good practices' are communicated very rapidly internationally and set new policy standards. Switzerland has to use its own representatives, even within the militia system, to become involved in the information network at all levels and, in particular, impact its interest onto the relevant R&D planning groups.

It is well known that Switzerland is not a member of the EU. Under the bilateral agreements, the formal opportunity for the participation of Switzerland is guaranteed for at least the 5<sup>th</sup> EU Framework Program, yet the options open to Switzerland are not in the least satisfactory. In particular, Switzerland is not represented in that most important phase: the conception of new EU R&D programs.

All thematic thrust directions of the 6<sup>th</sup> EU Framework Program 2002-2006 have a significance for Switzerland and to the operations of CTI, the integration of Switzerland therein is not guaranteed. The R&D projects proposed to the CTI in the Swiss 'bottom up' approach very often have prior, or at the very least parallel, developments currently in hand in the EU and in other countries. The increasingly more intensive and product-conversion orientation of EU research programs is forcing Switzerland to take strategic decisions even at the point of program conception.

CTI is already involved in international programs through the management and financing of projects in the Eureka Programs which promote R&D in many domains of the EU and in other countries and which are of great importance to Switzerland (Biotechnology, Robotics and Automatization, Information Technology, the Environment, etc.). CTI is well represented in the management and (together with the FES) financial support for IMS programs which promote R&D and other facets

in the area of production technology, issues of key significance for Swiss Industry.

The financial contributions made by Switzerland to EU research and other programs need to be of corresponding value to the Swiss economy. CTI has to enhance efforts to achieve this, in particular by:

- being acquainted with the development of international aspects of national promotional activities,
- being tied into international networking relationships and to play a recognized role in them,
- being able to pursue an independent Swiss promotional practice following an analysis of the content of EU programs,
- promoting the mobility of researchers in applied R&D.

#### **2.6.5. Inadequate CTI financial support**

The continually increasing number of project proposals which are submitted to CTI shows that CTI has been accepted as a partner by private industry and the Universities in promoting applied research, and its activity is held in an increasing amount of esteem. This makes it even more alarming that the staff and financial facilities of CTI can respond steadily less to this development.

In summary the situation is as follows: whilst competing countries invest an increasing amount of support available for promoting technological innovation, the flexibility of CTI is becoming progressively less. Even at present time, with a contribution of over 40%, it is forced to turn down a significant fraction of promising and advanced project proposals. Many of these rejected proposals represent a lost opportunity for Switzerland to create a new dynamic and high value employment opportunities. In this manner, its mission to support science and technology transfer is being undermined. In view of the increasing number of demands for support by such project proposals and the parallel increases in demands on its purse for matters lying beyond its core competences and the international horizon the situation is rapidly becoming untenable. Consequently, Switzerland has a choice to make: whether it wishes to insure playing an on-going leading role in the field of the technical sciences, or lag behind as a result of an inadequacy of qualitatively advanced R&D and an inadequate transfer of new technologies into innovative products.

#### **2.6.6. Assessment of political order**

The promotional policies of CTI result from the gaps, shown above in the framework of Point 2.4., within the Swiss NIS. Such failures have as consequence either that no information transfer takes place, or that external effects come into play such as spill-overs in creating knowledge or information transfer. External effects are always a less-than-optimal source of information which is innovation-related because they lack the necessary value indicators. This situation then serves the motivation for federal promotional measures such as those incorporated in the support of science and technology transfer by CTI. Alternatives in this respect cannot be furnished by private industry. The federal capability provided by CTI thus takes on, by definition, a monopoly position.

**The principle of subsidiary and market entrees**

Free-rider positions by industrial companies are mitigated through the subsidy principle involving the '50:50 rule' in project promotions. The massive financial contributions to the project by the company involved and the limiting of financial support to the non-profit-making organization offer a further reason for considering CTI to be unexceptionable in terms of political order.

Thus, the Swiss Commission for Trade Practices concluded in its statement on 'The Competitive Neutrality of CTI – Commentary on Questions of Political Order' in referring to its adherence to the subsidization principle that, although it cannot be guaranteed in each and every case, the collective selection of projects by CTI experts from academia and industry acting together with OPET, does include due consideration of the principle of subsidization. Further, the Commission takes the standpoint that the functioning of CTI leads to a reduction in the barriers to market entry.

The mechanics of competition and pricing between the companies active in innovation on the one hand, and research organizations on the other is guaranteed through the allocation of funds by the mode of operation in selecting project proposals through the 'bottom-up' principle. Entry into the world of innovation competition is only made possible to many companies through the promotional activities of CTI, this is particularly true of SMEs. The activities of CTI have thus the fundamental effect of enhancing competition.

In very recent political debates in Switzerland, the question has emerged as to what extent the pricing mechanics can be set so as to allow the CTI investment to be recovered, at least partially. Such a model of a 'fonds de roulement', linked to a reduction in the CTI function as guarantor of research credits, is to be clearly rejected. As the moneys from CTI go to the Universities and not to the companies involved, the promotion of the companies is only indirect. Under a system of forced repayment the companies would have to react by funding the Universities. Such a practice assumes a rapid ROI from the innovative product by the companies concerned. This is seldom the case in practice, and the ROI could only be linked directly and uniquely back to the work carried out by the researchers at the Universities. This is seldom the case in reality, the ROI can still be recovered, directly and unequivocally, based exclusively on the work invested by the researcher at the university. A model for repayment of the CTI subsidy is thus conceptually and practically untenable.

In view of the current regulations governing CTI promotion, the Swiss Commission for Trade Practices concluded that 'the role and strategy are fundamentally in accord with the principles of a liberal economic policy'. The competition-neutral stance of federal intervention is assured because the engagements follow objective criteria and the Confederation is only involved in the individual projects to a clearly defined extent.<sup>14</sup>

In summary, considering the measures taken by CTI in terms of their political order, it can be concluded that CTI pursues a strategy in its operations which is approved of in terms of political order when compared with the operations in other OECD countries which, in this limited frame-work, contribute extremely efficiently and effectively to the enhancement of the competitive capability of the Swiss economy in international competition.

**Competition and Pricing Mechanics**

**Refunding of Promotional Moneys not Advisable**

**Approval Certification by Swiss Commission for Trade Practices**

**Improvement of Boundary Conditions in Innovative Competition**

The promotion of programs which is often viewed as problematic from the point of view of political order should, as practiced by CTI, be regarded with approval. As the programs are developed as based on: either the accumulation of suggestions and requirements of industry and, hence, on the 'bottom-up' principle, or on proposals from CTI members (c.w. Fig. 7, p. 32: Mode of Operation of CTI), any danger of public failure is minor. The networks built up through the programs are thus a mirror of the federal economic realities. In addition, the response of private industry itself shows quite clearly that the orientation of the programs in innovatively active companies – and in particular in large concerns – represents a significant strategic instrument.

The heterogeneity of the various initiatives of CTI is also to be assessed as one of its real strengths. Technology-oriented initiatives should have no objective other than the promotion of innovation in the specific technologies. To that extent, the multiplicity of CTI programs with their various objectives is both consistent and sensible.

It can be confirmed that, under the promotional conditions of CTI, no inconsistency exists between the political order and innovation policies in Switzerland, but are indeed complementary instruments for promoting the competitive capacity of the Swiss economy.

### 3. Organization, Processes of Decision, Tasks

**Key Question III: What is the assessment of the functioning and work ethic of CTI?**

**Key Question IV: How is the collaboration and coordination when interacting with other organizations in the domain of innovation promotion at national and international level to be assessed?**

#### 3.1. Organization and Process of Decision

##### 3.1.1. Organizational Structure of CTI

The CTI strategy is carried out through via the so-called initiatives – promotional areas. Each of these is led by a review panel comprising 5-10 members. The panels comprise members of the CTI Commission together with permanent experts. The main responsibility of the panels is in assessing the proposals, advising the proposers, supervising projects in operation, carrying-out project reviews, and evaluating the results of the projects. Additional responsibilities may occur in specific initiatives, e.g., moderating the build-up of national networks of excellence.

Each panel is chaired by a CTI Commission member. The Commission members and the experts work for OPET or CTI on a mandate basis and are re-imbursed at an hourly rate between CHF 150.- and 190.- for the time expended. The mandate itself, as well as the maximum honorarium (expense ceiling), are laid down under a contract between the panel member and CTI.

The panels are supported within OPET by the CTI Secretariat. Between one and three staff may be assigned depending on the magnitude of the initiative or promotion involved.

The frequency of the panel meetings depends on the number of projects running and the number of new proposals received for assessment, and may occur in a monthly or a bimonthly cycle. The panel meetings last from a half-day to a day. Some 20 to 50 new proposals, running or completed projects are reviewed per meeting along with any other related business. The operational sequence is shown graphically in Fig. 9.

The coordination of the various programs and initiatives is carried out by the CTI Board and CTI Operational Council. The CTI Board meets annually for a closed-doors two-day conference and for four to six half-day meetings where strategic matters are discussed primarily.

The chairpersons of the review panels together with the CTI Secretariat staff members form the Operational Council to discuss operational questions and insure the necessary interaction between the initiatives and promotional programs. The Operational Council holds some six half-day meetings annually. The necessary coordination within the CTI Secretariat is effected bilaterally by its staff members.

**Promotional Areas and Review Panels**

**Coordination in CTI Board and Operational Council**

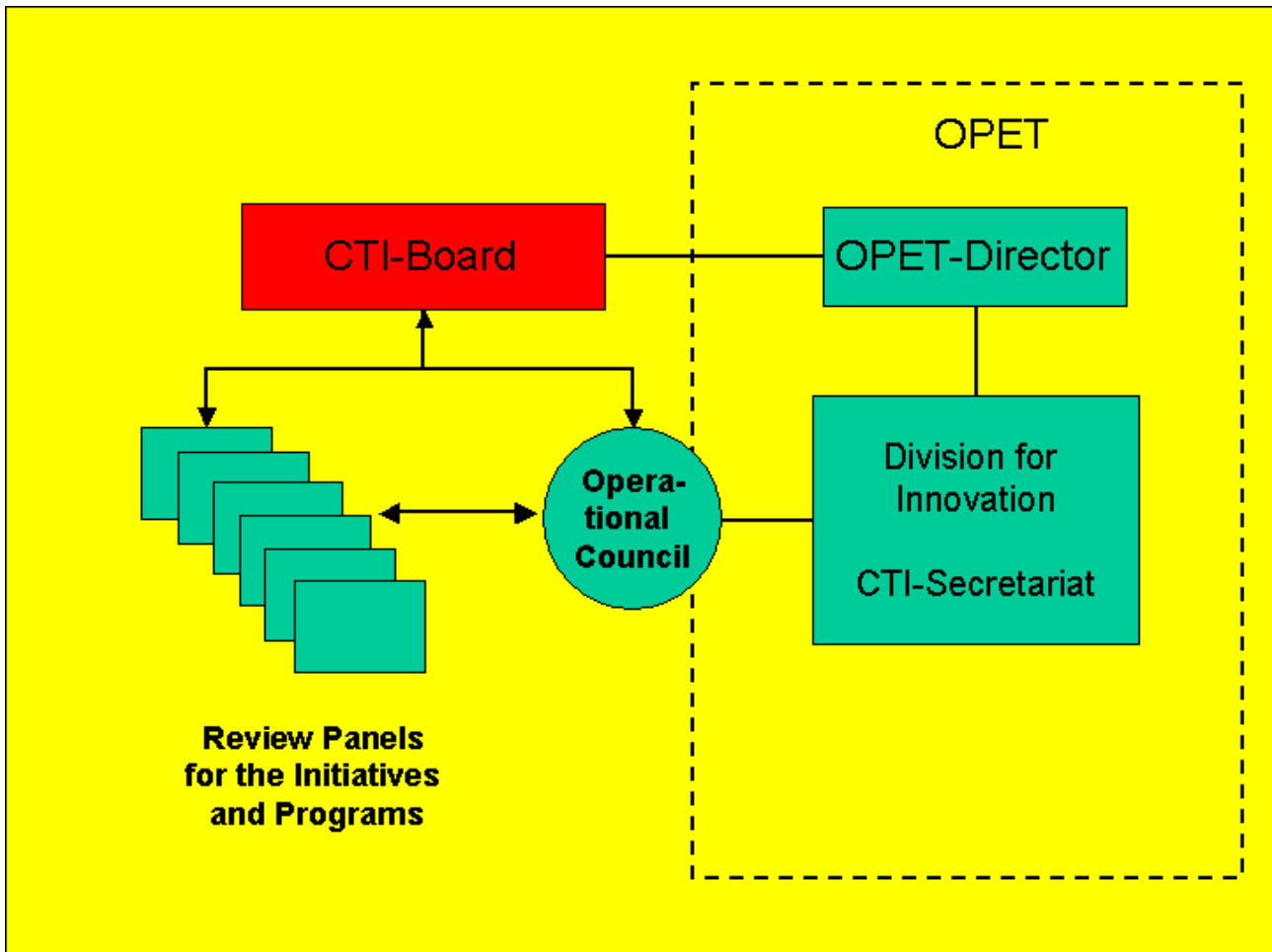


Figure 9: Organization of CTI

### 3.1.2. Operational Mode of CTI

CTI endeavors to organize its work in as flexible and bureaucracy-free a mode as possible, and to constantly improve its operating procedures. The unavoidable effort involved in submitting a project proposal should remain within bounds.

The function of CTI is to provide Federal support to promote a project as based on a written project proposal. Project proposals can be submitted to CTI at anytime. The fixed submission dates in use until 1996 were dropped to correspond particularly to the needs of industry, thus to allow R&D projects to be initiated at any time.<sup>15</sup> The forms for submitting a proposal can be down-loaded from the CTI web site.

**Submission of Proposals possible anytime**

The proposal forms have to be filled out completely, signed by the principal investigator and the most significant industrial partner, and submitted to CTI. Additional related documentation can be submitted to CTI subsequently. The proposal must contain the following information:

- complete details of the projects participants (principal investigator and his partners, his principal financial support partner and other financial co-partners),
- economic objectives of the project,



- scientific objectives,
- innovative content of the project in comparison with the current state-of-the-art in science and technology,
- research plan including milestones with deliverables,
- financial plan,
- signatures.

The proposal is submitted by mail to the CTI Secretariat and, additionally, per e-mail.

CTI offers the principal investigator and, more particularly, the industrial partners the opportunity to classify their proposals as confidential. CTI is thus able to comply with a requirement of the industrial partners not to make their participation known to third parties. In the case of such projects which are classified as confidential, specific conditions are imposed over the availability of information on the project, the publication of results, and the contributions made by the industrial partner.

**Confidential Proposals**

### **3.1.3. Submission Process**

Basically, CTI has only a single-step processing procedure. A proposal can be submitted for assessment and financial subsidy directly to the CTI Secretariat without need of any prior registration or abstract.

**Single-Step Process**

Occasionally, CTI does accept extended abstracts and draft proposals to assess the probability of being subsidized. In such cases the proposer receives a written or verbal opinion. This opinion does not in any way prejudice the decision over a formal proposal. CTI considers such opinions in the light of a service made available primarily to first-time proposers. The option has been made available more frequently by the Universities of Applied Sciences (Fachhochschulen) in connection with the development of their capabilities in applied R&D. In instances where the planned research is of a complex nature and/or there is a multiplicity of proposers, the submission of an extended abstract or a draft proposal has an advantage in potentially saving the proposers unnecessary expense. In such cases a discussion can be arranged during the initial phases of proposal preparation. Only in specific initiatives e.g., in the Top Nano 21 Initiative, a two-step procedure of submitting a pre-proposal and proposal is adopted.

**Assessment of Project Abstracts and Draft Proposals as Service**

The CTI Secretariat first checks each proposal for its formal conformity, and then issues a CTI project number to it. A few days after receipt, the proposer receives written confirmation of receipt by CTI. All proposals are recorded by the CTI Secretariat staff in a computer-based data bank (Promis) and a project dossier is opened.

**Admission Check and Allocation to a Specific Program**

The proposals are assigned by the staff of the Secretariat to a CTI program or initiative. The assignment is based primarily on the proposal itself (the appropriate box on the form has to be ticked indicating the area of technology involved). Cases which are not self-evident are clarified directly by the Program Manager in the Secretariat.

Each proposal is submitted by the CTI Secretariat to two referees who receive all documentation and assess them as 'reviewer' and 'co-reviewer', respectively. The

**Refereeing**

selection of the CTI experts is made on the basis of the established fields of professional expertise and preferences of the CTI experts as well as their availability at the given time. In addition, all the remaining members of the review panel of the particular program or initiative have all proposals in their area sent to them by the CTI Secretariat.

Not only the reviewers but also all members of the review panel are entitled to make an assessment of all proposals and to make their recommendations. The reviewer or co-reviewer may opt out of agreeing to make an assessment of a given proposal for reasons which have then to be specified (e.g., lack of particular expertise, insufficient time, conflict of interest).

The reviewer and co-reviewer make an assessment of the proposal under the following criteria:

#### Assessment Criteria

- Composition of the project partnership: Does it include the necessary competence? Are adequate resources available? Are the respective roles in the project well defined?
- Economic objectives: Are the economic objectives defined in a convincing manner: market, business plan, anticipated RoI, risks?
- Techno-scientific objectives: scientific/technological value and originality of the mode of solution? Are concrete objectives noted which can be checked? Are the criteria for success defined?
- Innovative content: Is the current state-of-the-art well described? Is the innovative aspect well explained? Is the research carried out to establish the state of the art convincing?
- Plan of research: Is the planned approach well defined? Are the work packages and tasks reasonable, methodically tidy, and the allocation of tasks appropriate? Are deliverables defined for each work package?
- Time scale: project steps, mile-stones (with results or consequences), defined beginning and end?
- Regulation of intellectual property (IPR): Is the regulation of intellectual property agreed, where appropriate?
- Finance plan: Are the expenses listed for equipment and other overheads reasonable? Is the cash contribution from the industrial partner appropriate? Is the salary-base level correct? Is the time calculated for the work involved realistic? Is the amount of financial support requested from the Confederation appropriate?

There is no checklist for the assessment by the CTI experts. Nor is a point system used by CTI in judging proposals. CTI wishes thus to afford a maximum in flexibility and adaptability.

The degree of detail given in the assessments is a matter for the CTI experts to determine. However, since the assessments are discussed by the review panels and are thus transparent to all members a certain style of standard practice has been developed. In general, the reviewer makes a detailed written appraisal concluding with a concrete recommendation. The co-reviewer may agree with that recommendation or deal with other specific aspects.

Proposal assessments and recommendations are made in written form and circulated via e-mail amongst the members of the review panel of the particular

program before their meeting.

The reviewers are free to make contact with the principal proposer and the project partners to clarify specific points and to request additional information. This opportunity is frequently taken advantage of, although in many cases a telephone call is sufficient to obtain any information lacking or to clarify any open aspects.

In principle, the proposers do not know the identity of the reviewers. The reviewers are nonetheless free to step back from anonymity on their own initiative, e.g., if they make direct contact with the proposers. If the retention of anonymity is desired, any questions and requests for subsidiary information by the reviewers can be forwarded to the proposer by the CTI Secretariat.

The reviewers may request expert opinions from one or more specialists external to CTI on any proposal which they are called upon to assess. Such consultants may be nominated by the reviewers themselves, by other CTI experts, or by the CTI Secretariat. Experts' opinions from such consultants are then requested in writing. The proposal and all ancillary material is then made available to the consultant. Submitting such an opinion to CTI is not subject to remuneration. The consultants remain anonymous in the interest of an impartial and objective opinion, keep the proposal confidential, and may not make contact with the proposers. Anonymity on the part of a consultant may only be raised with their express consent. Should it become desirable to communicate any significant commentary from the consultant to the proposer, this is done in a written, anonymous form by the CTI Secretariat.

**Expert Opinion from  
Persons external to CTI**

In the case of confidential submissions, the CTI Secretariat checks first with the submitters as to which people or companies should not under any circumstances be contacted, in view of potential competition issues with the industrial partner. The commentaries from consultants are primarily to assist the review panel in formulating their assessment. The CTI panels are at liberty to take their commentaries into due consideration.

All submissions are discussed and decided upon within the review panel of the corresponding program. The CTI Secretariat assembles the decisions, commentaries and all other documentation related to proposal assessment. The proposal is slated for discussion by the review panel as soon as the recommendations of the reviewer and co-reviewer are available.

**Deliberations on  
Proposals by the  
Review Panel**

In the deliberation procedure, the reviewer makes a summary presentation of the proposal together with his recommendations. In general, the co-reviewer then presents his views and recommendations, which may be the same as those of the reviewer with or without some modification. Finally the proposal is discussed by the panel. Decisions are mostly made by consensus. A vote is only taken in cases of diverging opinions and after controversial discussions. In principle, the recommendations of both the reviewers can be out-voted. All decisions are recorded in the minutes of the meeting. CTI decisions are always considered to be made by the whole panel rather than decisions by individual members.

As a matter of principle, the submitters of the proposals do not have the opportunity to defend their proposals during the meetings of the CTI review panel. Should a discussion be indicated, this is carried out before the meeting of the review panel. The proposers do not have any right to discuss their proposals before the panel meeting.

The decisions reached by the CTI review panel can read as follows:

**Decisions**

- accepted without conditions
- accepted with conditions
- not accepted in the current form.

In a case where the decision was made not to accept a proposal, the submitters are generally invited to revise their proposal. The nature of the recommended revisions is normally clear from the commentary given for the rejection, or may be discussed in a review meeting on the proposal.

Should a proposal be rejected, CTI only permits the submission of two revised versions of a proposal. If the third version of a proposal still retains grave shortcomings then a definitive rejection is handed down. No opportunity is afforded to revise a proposal when the first version is found to contain shortcomings of a scientific nature which cannot be corrected.

The decision to accept a proposal comprises making an award of federal funding to a specified amount for a project duration of a specified period of time. The proviso is that the co-financing in level and style<sup>16</sup> on the part of the industrial partner is contractually guaranteed.

Formally speaking, this is a team decision made as a recommendation submitted to the Director of OPET for approval. The CTI Secretariat forwards the recommendation in standard printed form. Following acceptance of the recommendation by the OPET Director, the decision is then communicated to the proposer in written form. In the case of the rejection of a proposal, the reasons for this decision are also sent to the proposer in written form.

CTI finances primarily the salary expenses of the researchers at the R&D facility. In addition, in cases where this is fully substantiated – particularly in projects which involve extensive expenses for consumables – an additional support of up to 50% of such expenses can be entertained. Federal support is not provided for infrastructure expenses and, in particular, for travel costs. Such expenses are expected to be covered by the ‘cash’ contribution made by the industrial partner.

**Principles of the  
Financing by CTI**

The industrial partners are involved financially to the extent of at least 50% of the project costs. This contribution on the part of the industrial partner includes the project-oriented salaries of their own staff, equipment expenses (e.g., purchase or leasing out of equipment, software licenses, etc.), expenses for consumables and travel costs as well as the ‘cash’ contribution at the agreed level to the non-profit research organization.

The ‘cash’ contribution may be used to cover project-oriented salary expenses by the non-profit research organization as well as any other expenses not covered by the CTI funding. The amount of the ‘cash’ contribution is evaluated by CTI as an index of the level of interest on the part of the industrial partner in achieving results which can be utilized commercially. In the case of confidential proposals, CTI expects a ‘cash’ contribution of at least 10% of the Federal funding. CTI does not accept as a ‘cash’ contribution any guaranteed future profits to be made from the commercialization of the project results.

CTI only takes note of the in-house expenses of the non-profit research organizations (Universities) in the way of salaries and infrastructure expenses.

These are not taken into account in calculating the 50% quota of the industrial partner.

Special financing conditions are applied to certain initiatives and programs. As examples: 15% overheads are added to the salary expenses for the Universities of Applied Sciences in projects aimed at expanding their R&D capabilities. This particular ruling is based on the situation at those Universities which is different from the Federal Institutes of Technology and the Cantonal Universities in that they do not receive adequate public infrastructure funding for R&D. In the case of Top Nano 21 Initiative, basic research projects can receive up to 100% financial support even though no immediate direct economic benefit of the results to the industrial partner is evident. A special ruling is also applied to the Start-Up Initiative program: the newly-founded companies which receive support under this program do not have to supply the financial participation at least 50% of the total project costs.

**Special Financing  
Conditions in Specific  
Programs**

The mean level of support furnished in Federal subsidies is CHF 165,000.– per project; the currently requested funding is CHF 180,000.–. The in-house expenses of the industrial partner averages out at about CHF 240,000.–. Currently the Federal contribution is about 41% of the total project costs whilst the industrial support is about 59%.

**Level of financial  
support**

The majority of projects last between 12 and 18 months. In the view of CTI, a project should not last longer than 24 months because longer-lasting projects can only with difficulty be made to correspond with the viewpoint that the 'time-to-market' should be kept as short as possible. An exception is made for projects from the agricultural and horticulture sector where generally-speaking many planting cycles are required to generate methodically insured results, consequently projects for up to 36 months are awarded.

**Project Duration**

The granting of a project is frequently made conditionally. These conditions have to be fulfilled either before a project is commenced, or when the project is running. Examples are:

**Conditions**

- Project Partners: the addition of further project partners, e.g. user-partners,
- State-of-the-art in science or technology, define more clearly the innovative aspects,
- Submission of additional information on the economic objectives, e.g., to the industrial partner, description of the business thinking, concept for the transfer of project results, expected turn-over and profit (RoI) as available,
- Phasing the project: acceptance up to a defined development stage at which point a review is to be held with a go/no-go decision,
- Requirement to regulate the ownership of the intellectual property from the project,
- Financial Plan: reduction in expenses covered by CTI, increase in the 'cash' contribution,
- Citing by name of project collaborators, these are often not available at the time of project award,
- Performing of project reviews at defined points-of-time, or on reaching milestones.

On average, an applicant can reckon with a time-period of up to about 2½ months before receiving a decision from CTI on his proposal. The time span is quite wide. In some clear cases a decision can be taken within several days, in other difficult cases it can take up to a year. A decision on approximately one quarter of the proposals is reached within about five weeks, the next quarter has to wait for some eight weeks, and after three months about three quarters of all proposals are reviewed and assessed.

**Time taken for Decision  
on a Proposal**

The time periods quoted also include the time taken for the submitting ancillary material and revisions. Twenty percent of all proposals are recommended for support after being returned for modification and then re-submitted. The time to process an application thus depends additionally on the time taken for the applicant to make available any additional material requested and also to follow any recommendations of CTI. There is no marked difference in the time taken for proposals to be accepted or rejected. The level of Federal subsidy requested plays no part in this. Proposals requesting small amounts of support are treated with the same care as those requesting large amounts.

#### **3.1.4. Supervising and Controlling of Current Projects**

The projects contract is completed by the CTI Secretariat following its award by the director of OPET. This is a standardized contract which, in addition to guaranteeing the Federal support, defines the specific services and, in particular, the 'cash' support to be provided by the project partners, and describes the detailed procedural arrangements (inter alia, payments, submission of reports, publications). This contract between OPET and the project partners is not subject to negotiation.

**Project Contract**

Three copies of the contract duly signed by the director of OPET are sent to the project partners. This contract must be signed by all partners and returned to the CTI Secretariat within a three month period. CTI has intentionally chosen a form of contract where the agreement to provide Federal subsidy is tied directly to the services to be provided and, in particular, to the concomitant provision of financial support by the industrial partner.

The payment of the approved Federal subsidies is made upon receipt by the CTI Secretariat of the official request-for-payment form submitted by the principal investigator; payments are normally made in annual segments. The form can be down-loaded from the Internet web site. The first segment is only paid once a copy of the contract duly signed by all project partners has been received by the CTI Secretariat. The payment can be made dependent on the fulfillment of specific conditions. The payment of a second or third segment is dependent on the provisos, first, that CTI has received copies on the official forms of a financial report and a scientific report which describes the work done in the preceding year and, second, that the assessment of the scientific report by the CTI Reviewer contains no objections to the work carried out to date. The payment of the second or third segment of the Federal subsidy is often made dependent on satisfactory progress recorded during an oral presentation made to a CTI delegation.

**Payment of Federal  
Subsidy**

The contract contains the requirement that the principal investigator submit written scientific and financial reports on the official forms designed for the purpose. In the cases of a project due to run for more than a year, intermediate scientific and

**Reporting and  
Supervision**

financial reports are to be submitted after 12 months.

Project reviews are carried out either at pre-determined points in the project (Milestones) or are scheduled if occasion demands, e.g., if there are major changes in the composition of the project partnership team, or in the project plan, or if so desired by the CTI Reviewer should there be problematic aspects in the reports submitted. The number of such project reviews held has increased markedly in recent years.

#### **Project Reviews**

The project reviews are carried out at the facilities of one of the project team, preferably of the principal industrial partner. The meeting has to be organized by the principal investigator. All the project partners must be represented at such a review meeting. In general, CTI is represented by the reviewer and co-reviewer, and by a member of the CTI Secretariat. The minutes of the review are circulated to all the members of the review panel of the particular program or initiative as well as to the principal investigator. Should any decisions be indicated, these are met by the review panel.

The experience of CTI with such reviews is remarkably positive. The project team value the opportunity to present their work to CTI and exchange their enthusiasm and stimulus with the CTI representatives.

CTI pursues a fair-minded, simple and yet clear ruling on intellectual property resulting from CTI projects. Following the employment-market oriented objectives of the CTI promotional activities, the exploitation of project results belong to the principal co-financing industrial partner. CTI can allow exceptions in well-justified instances. The project partners themselves regulate the rights to registering patent applications and to clarifying any resulting issues of compensation claims. During the evaluation of a project proposal the corresponding CTI expert confirms that agreement has been reached by the project partners that it is in accord with CTI regulations.

#### **Regulation of Intellectual Property**

The project contract contains a standard condition that the project partners agree that the exploitation of results may not be prejudiced by premature publication or in any other way. For its part, OPET insures that techno-scientific reports are handled confidentially until the completion of the project and/or completion of any patent applications whatsoever. In specific initiatives such as in Top Nano 21, the project partners are obliged under a provision in the award of a Federal subsidy to make available the non-confidential aspects of their results in the scientific literature or other media, and to present them at the annually-held information workshops.

#### **Publication of Project Results**

As the CTI projects are partially financed with public moneys the results should be published as a matter of general principle. Publication is the province of the principle investigator. The contract also obliges the inclusion of the acknowledgment co-funded by CTI' in all publications. CTI itself does not make any publication of project results. Selected projects are prepared solely in a journalistic style in the sense of 'Success Stories' for inclusion in the CTI Annual Reports and for marketing purposes. In the case of projects which are classified under the confidential heading, the publication of results can be delayed for up to three years after project completion.

## 3.2. Businesses of CTI

### 3.2.1. Promotional Domains and Programs of CTI

The promotional domain 'Core Business' is the one which includes all topics and Institutions covered within the CTI promotional responsibility, and which do not fall specifically within the promotional domain of any of the other specialist project promotions or initiatives. The evaluation of proposals and their overview is carried out by a team of seven CTI members which are supported administratively by the CTI Secretariat. The core business covers approximately 50% of all projects proposed to CTI.

CTI Core Business

The strategic objective of CTI core business is (i) the rapid and competent assessment of applied R&D projects from the full spectrum of the sciences as related to the business and public sectors, (ii) support for the development of new research areas, as well as (iii) screening success achieved in converting research results into product under the promotional activities among the project partners of research institutes, the industrial and public sectors (cf. the following success story from the core business of CTI).

#### Core Business: Innovative Mechanical Engineer as Problem Solver

The Stress Intensity Factor,  $K_{1C}$ , of a material must be known to allow its resistance to crack propagation following shock loading to be assessed. This value can only be measured experimentally with great difficulty. The data needed for the calculation of  $K_{1C}$ , the energy of impact and the crack opening displacement COD require a specially equipped impact testing unit which guarantees simultaneous measurements.

The objective of creating such an impact testing unit was pursued by Walter & Bai AG, specialists in mechanical test equipment, by making contact with the University of Applied Science in Sion. The latter developed a method of determining the COD based on the variation of the electrical signals from photocells. Two laser beams were shone on the test sample which had been drilled through at two points on either side of the crack. During the impact process, the deformation of the sample resulted in a deflection of the reflected light beam on the cells which was proportional to the deformation incurred. A prototype was first constructed to measure the impact deformation to allow rapid experiments to be carried out on velocity, energy, mounting of the photocells and the location of the measurement markers. This expertise was then incorporated into a commercial unit. "The opto-electronic method permits measurements to be made under difficult experimental conditions and allows a new interpretation of failure phenomena" explained Michel Cans, Professor of Material Science. "A comparison of the measurement markers when welding different material allows their behavior to be evaluated on both sides of the weld seam. The method can be used where current methods are not adequate, such as at elevated temperatures or in a corrosive environment". After the completion of the development, the industrial partner left one of the test units in Sion so that materials scientists can study new applications and trainee mechanical engineer can transform their creativity into practical avenues – an example that shows that real technology transfer can happen in both directions!

CTI is also involved in selected topical project programs, as outlined below.

Emergence of New Promotional Areas and Programs



Thematic topics of emphasis or individual initiatives emerge in the same way as the individual projects, not only 'bottom-up' – an indication of a market need – but also 'top-down' – on the initiative of far-sighted visionaries who bring to CTI future-oriented thematic topics with potential. When new program topics and areas are created — insofar as it is viable – collaboration is sought with professional organizations. As a rule, a one-to-two year viability pre-study is initiated until an initiative can be generated within the ERT Message framework as an independent promotional and action program. New promotional areas and programs are developed in such a manner that an enhanced efficiency can be anticipated through grouping strengths and developing a critical mass, particularly in the newer markets or in new technologies. CTI wants to generate new momentum through these activities. Such programs are always only for a limited time period, in general they are kept within a four year block credit period.

Projects can also be generated in a 'top-down' mode within the framework of promoting thematic initiatives.

In the past CTI has been concerned inter alia with the following promotional programs or initiatives:

- Impulse program Wood,
- Impulse program Building,
- Impulse program RAEE 'Rational Applications of Electrical Energy',
- CIM action program (Computer Integrated Manufacturing),
- Action program Microswiss,
- Laboratory Coalition on Tribology,
- Efficiency of the Swiss Building Industry (Effi-Bau),
- Production and Management Concepts, P&M,
- Project Coalition on Machine Tools, WZMO.
- Current Promotional Domains are:
- Capability Enhancement in Applied R&D (AR&D) in the Universities of Applied Sciences,
- Capability Enhancement in applied research at the Cantonal Universities of Applied Sciences DO-RE (joint project of SNSF and CTI),
- Top-Nano 21 (operational responsibility carried on behalf of the ETH Board),
- Action program Soft[net],
- Energy Technology (joint project with SFOE),
- Environmental Technology (joint program with SAEFL),
- Medical Technology (MedTech),
- Swiss Center for Electronics and Microtechnology (SCEM),
- From 2002: Biotechnology (Extension of completed SNSF Biotechnology program),
- CTI Start-Up,
- Eureka,
- Intelligent Manufacturing Systems.

The planned promotional areas for 2004-2007 are:

- Micro- and Nano-Technology (Extension of Top-Nano 21 program ending in 2003),
- Institute for Mechatronic Production Systems and Precision Machining IMP (joint program with ETH Board).

### 3.2.2. Promotional Areas and Programs in Detail

The building-up of the Universities of Applied Sciences is one of the most important projects in research and education reform in the education policy in Switzerland. The Universities of Applied Sciences are the novel element in the Swiss system of higher education. In March 1998 the Federal Council ratified the management of seven Universities of Applied Sciences. This ratification is provisional with a deadline at the end of 2003 and has conditions attached which, in their entirety, will over a series of stages lead to a complete re-landscaping of the Universities of Applied Sciences in Switzerland. The Universities of Applied Sciences, in their capacity as the technology-oriented third pillar, complete the Swiss system of higher education along with the Federal Institutes of Technology and the Cantonal Universities. The Universities of Applied Sciences have the legal obligation, in addition to practical-oriented training and education, to carry out application-oriented research and development and to offer service facilities to industry.

There is little or no tradition in the majority of the predecessor institutions for this increase in obligations. In 1997 CTI was charged by the Swiss Parliament to build-up the capability for AR&D. An additional 30 MCHF (million Swiss Francs) were made available for this task in 1998 and 1999. In the period 2000-2003 the total is 80 MCHF. The promotional program is led by a team of 8 CTI members and CTI experts together with 4 staff from the CTI Secretariat.

Capability Enhancement  
in AR&D in the  
Universities of Applied  
Sciences

#### Universities of Applied Sciences: Conquer new markets with low-cost LIGA

Masking technology is currently being applied in the industrial application of decorative two-tone PVD coatings. The photoresist for the color motif is applied by hand which leads to inaccuracies in the design. In the search for an innovative solution Preci-Coat SA in La Chaux-de-Fonds, a company specializing in surface coatings for the watch and jewelry industry, contacted the University of Applied Science for the Canton of Neuchâtel in Le Locle (EICN). They began a CTI project – using the Federal Institute of Technology in Lausanne as ‘brain tank’ – to develop a low cost LIGA process. In this technique, light-sensitive dry films 15-50µm thick, are deposited as laminates on various substrate materials, typically stainless steel. Laid-down by a photo-lithographic process these dry films form a finely structured relief pattern screen. The colored Preci-Coat films are then deposited in these 20-150µm structures. The dry film is then removed by an innovative lift-off technique permitting the definition of fine-scaled two-tone structures, the decorative function of which now depends only on the creative originality of the designer. Structuring of wear-resistant coatings is also possible with this technique. As an outcome of the aesthetic effects thus achieved, Preci-Coat can offer a wide range of previously unattainable decorative effects and open up new markets. “This work is part of a larger project at EICN where we want to build up a capability in the UV LIGA technology developed at the Federal Institute of Technology in Lausanne” explained Guido Frosio, Professor of Microtechnology at the EICN. “Our aim is to offer SMBs following a low cost, very high precision technique to make miniature parts and systems. The future of Swiss Microtechnology requires the mastery of these techniques”.

The development of their capabilities in AR&D by the Universities of Applied Sciences is taking place primarily via project promotion following CTI regulations with the objective of (i) achieving a first stage by 2004, then (ii) to continue the built-up achieving a qualitative advanced level by 2007, and finally (iii) to become recognized internationally as research partners.

**Project Promotion according to CTI Regulations**

A further major issue in this promotional program is the development of a number of competence networks of excellence between the various Universities of Applied Sciences in specific topical areas which are important for the future of Swiss Industry. CTI acts as moderator in this process. At this time, a total of six National Networks of Excellence at the Universities of Applied Sciences have received official recognition from the Head of the DEA. These are: Information and Communication Technology, Micro-Electronics, Wood, Integrated Production and Logistics, E-Business and E-Government, and Biotechnology. Three further networks have submitted their candidature: Materials Technology, Public Management, and Building Technology and Renewable Energy.

**Development of National Networks of Excellence by the Universities of Applied Sciences**

In a joint program, CTI and the Swiss National Science Foundation are supporting a program to develop the capabilities in Applied Science at the Cantonal Universities of Applied Sciences, specifically in the areas of Social Work, Public Health, Education, Art, Music, Applied Linguistics, and Applied Psychology. A committee has been formed for this purpose comprising equal numbers of members from CTI and SSF. Special promotional conditions are applied in this so-called DO-RE ('DO REsearch') program which are compatible with both organizations. In 2000-2001, 2 MCHF were made available in a preliminary test phase. An initial assessment of the success of the program is to be made at the beginning of 2002. Planned are a further 3 MCHF for the 2002-2003 phase which will be carried on in a form and under conditions to be defined by the ERT Message for 2004-2007.

**A Joint Program with the SNSF: Promotion of Applied Research at the Cantonal Universities of Applied Sciences**

Great expectations are being centered world-wide on the industrial exploitation of the knowledge being gathered on materials studied at a nanometer scale. Switzerland is well placed as a result of its ground-breaking research in the fields of new microscopies, tools, and nano-materials. This ground work in physics, chemistry and biology should, within the framework of TopNano 21, be developed into applications and transferred to industry. In a manner similar to that of information technology, nano-technology also crosses the traditional borders of the sciences such that all modern fields of technology are going to be heavily impacted.

**Nano-Technology**

A follow-up program is in the planning stage and is expected to begin in 2004 – based on the technology-oriented program Top-Nano 21 of the ETH Board – to take advantage of the results from TOP-Nano 21 and to apply them also at the micron scale. The TOP-Nano 21 program is currently at its halfway point and the experience gained is currently being evaluated. Further, a particular concern is to link the future program with the results from the basic research program being promoted by the SNSF 'Nanoscale Science – Impact on Life Sciences, Sustainability, Information and Communication Technologies'. The program is to be led by a sub-committee comprising two CTI members and a representative of the CTI Secretariat. (cf. the following success story from TOP-Nano 21.)

### **Top-Nano 21: Nanotechnology as a new branch of Swiss industry**

Over a project duration of 24 months, some 110 companies from Swiss industry have been working on over 130 projects. Forty-four institutes from the Universities have formed eight expertise clusters in the areas of: bio-sensors, artificial noses, nano-particles, nano-composites/thin films, nano-structuring and replication, nano-fabrication, tips and probes, and mechanical demonstration of magnetic resonance.

Outstanding projects results (viz. Second Annual Report 2001, Top-Nano 21) with high economic potential are:

- New illumination tubes using carbon nano-tubes as light emitters.
- New magnetic memories for data storage in the tera-bit range.
- Nano-structuring of surfaces for new optical elements and functions such as: polarizers in the near infrared range, antireflex structures on polymers, optical filters.
- Manipulators and operating systems with nanometer resolution and 5mm working range.
- Adaptation and molecular interaction of proteins on nano-structured interfaces for bio-materials and bio-sensors.
- Functional textiles based on new anti-bacterial nano-particles.

**Nano-crystalline are rechargeable batteries and high efficiency nano-crystalline solar cells for indoor use.**

The promotional program on Energy Technology combines the policy for the promotion the energy-oriented technology and innovation fostered by the Federal Office for Energy (SFOE) with the economically-oriented policy of applied R&D of CTI. From the point of view of SFOE the Parliamentary Concept for energy research of 2004-2007 applies; this is anchored in its own legal basis. This Energy Technology Initiative is a consequence of the Executive Decision of the Federal Council on Government and Administration Reform of 1997 which also conferred on CTI the responsibility for application-oriented research of other departments. As a result of its legal basis, SFOE has wider promotional freedoms than CTI: on the one hand it can support longer term research projects whereas, on the other, it can come closer to the market in that it can provide direct financial support to industry and the user, inter alia, through participation in pilot and demonstration projects. The project promotion under CTI and SFOE complement each other in a constructive fashion. The assessing of proposals is carried out by a joint team comprising two CTI members and two representatives from SFOE.

**Energy Technology**

The Initiative on Environmental Technology combines the policy of promoting technology and innovation axed towards the environment by the Swiss Agency for the Environment, Forests and Landscape (SAEFL) with the economically-oriented policy of AR&D of CTI. From the point of view of SAEFL the Terms of Reference for a Strategy of Promoting Environmental Technology are found under the Law on the Protection of the Environment dated December 21, 1995. This Environmental Initiative is a consequence of the Executive Decision of the Federal Council on Government and Administration Reform of 1997 which also conferred on CTI the responsibility for application-oriented research of other departments. As a result of its legal basis, SAEFL has wider promotional options in environmental technology than CTI in particular for providing direct contributions to industry and user, inter alia, through participation in pilot and demonstration projects, and other related

**Environmental Technology**

measures. The promotion of projects by CTI and SAEFL follows through in a complementary fashion. The assessing of proposals is carried out by a joint team comprising two CTI members and several representatives from AFEA. CTI is also represented in the Advisory Commission for Environmental Research of SAEFL.

The MedTech Initiative was begun in 1998 and is designed as an R&D program specifically for the Swiss Medical Technology Industry. The promotion of projects is subject to the standard CTI regulations. The points of contact with the fundamental research programs sponsored by the Swiss National Science Foundation are particularly well cultivated, particularly within the framework of key Federal research areas.<sup>17</sup> The MedTech Initiative promotes the development of competences in medical technology in research and teaching institutions and in information transfer, and is engaged in improving contacts between the sciences, the economy and the clinic sector. It supports technological research axed towards the market and value-generation, evaluates educational and research facilities for MedTech projects, brings project partners together and supports particularly innovative projects under the Start-Up umbrella. Medtech is led by a team of five CTI members and permanent experts. (cf. the following success story from MedTech.)

**MedTech Initiative**

### **MedTech: The Virtual Patient – Flight Simulator as Prototype Model**

**Surgeons are resorting increasing – where appropriate – to minimal invasive techniques. Instead of a full direct view of the operative area, they follow the operation within the body via an endoscope and TV screen. Introducing instruments requires a minimal in incision causing less discomfort to the patient, and the risks of infection and hospital costs are markedly reduced. This video-surgery makes major demands on the surgeon and requires extensive training.**

**Inspired by the Pilot training in flight simulators, the group under Professor Hannes Bleuler at the Federal Institute of Technology at Lausanne developed the ‘Virtual Patient’ working with the spin-off company XiTact SA. The Hi-Tech system conceived through a MedTech project creates a anatomic simulation environment which allows near-realistic minimal-invasive surgical procedures to be carried out whilst reproducing both graphic and tactile conditions. The virtual organs are reconstructed in three dimensions from x-radiographs of real tissue. Color, texture effects, and reflexes are added-in to create a realistic impression and to allow simulation of specific diseased situations for practical experience. For the first time surgeons can not only see the interaction of their instruments with the patient’s organs but experience the real feeling, texture and weight as found in a real surgical operation. This is all made possible by a load feed-back system based on a mechanism with parallel kinematics which was developed in Lausanne, a world-wide breakthrough. The XiTact system can be installed on a PC under Microsoft Windows. Consequently, the ‘Virtual Patient’ is not only a practically-oriented training instrument for student surgeons, who thereby develop experience under crisis and stress situations, but also the instrument of choice for the optimal planning of surgical operations.**

The key program SPP Biotechnology of the Swiss National Science Foundation is due to finish at the end of 2001. Following its promotional activities in AR&D, CTI will launch a new initiative as an extension of the existing SPP Biotech program as supported by CTI other institutions and industry in order to further develop the already established research network. The points of contact with the basic research programs sponsored by the Swiss National Science Foundation are

**Biotechnology**

particularly well cultivated, particularly within the framework of the National Centers of Competence in Research. This new initiative is currently in preparation and should start by mid 2002.

The Action Program Soft[net] promotes the development of a strong software presence in Switzerland both from the point-of-view of the developer and producer of information and communication technology (ICT) but also from the point-of-view of the ICT user. The objectives are:

**Action Program  
Soft[net]**

- the qualifications of developers and users are built-up through training and advanced education,
- the business capacity/excellence in software are strengthened,
- strong networks of excellence in specific software thematics are further enhanced,
- aR&D is strengthened in cooperation with other CTI promotional programs.

The Soft[net] action program was started in 1998 after a two-year viability study phase and currently runs until the end of 2003. The action program is led by a group of industrial experts. The applied R&D projects which originate in the soft[net] action program are supervised specifically by the CTI core team and the program for capability enhancement in the Universities of Applied Sciences. (cf. the following success story from Soft[net].)

### **Soft[net]: Light Rating – Choice of Location for Software Companies**

How can I, as an investor, judge whether a company which seems attractive to me today will tomorrow still have an edge in world competition? Am I, as a company owner, sure that my company is correctly equipped for the future in terms of customer appeal, quality assurance, and process optimization? Standard methods of company assessment rely primarily on financial figures which are an evaluation of past history. This approach is problematic particularly for young, ambitious companies in Hi-Tech niche technologies which often have high risk factors and need large amounts of capital input. "In cases where the market conditions and external influences change quickly, classical due diligence methods give no adequate answer on the future prospects of a company", states the company consultant Dieter Hohl.

He set up a rating system for the Action Program Soft[net] in a Light-Version which incorporates the so-called 'soft factors' such as an evaluation of the business processes by the company owner himself. The system is intended to permit an evaluation of Swiss software companies by identifying their potential systematically and completely by following through a simple and inexpensive analysis. It evaluates the current performance of the company, indicates further areas of potential, contrasts financial factors with the internal process cycle. "Software companies which base their production processing on optimizing for customer application achieve inherently higher value added" commented Dieter Hohl. "At the same time they adjust their technological core expertise to the changing market requirements. Using Light-rating they can see how effective their procedures are in reduction-to-practice". In the meantime, Light-rating has been shown to be a reliable basis for raising capability objectively: A help for self-help.

The CTI co-financing of the Swiss Center for Electronics and Microtechnology SA (SCEM) is under a contractually-based service agreement. The objective is to strengthen the Swiss economy through the development and application of new technologies in the areas of microtechnology and microelectronics, the

**Swiss Center for  
Electronics and  
Microtechnology SA  
SCEM**

strengthening and acceleration of technology transfer between research facilities and industry, as well as the encouragement of the scientific and technical education of young researchers.

Financial support is founded on Article 16 of the Federal Law on Research of October 7, 1983 through the award of a contribution to the financial base of the Institute. Application-oriented R&D projects of the SCEM are supported financially through the standard project procedures and supervised under CTI core business.

Similarly, the Institute for Mechatronic Production Systems and Precision Machining IMP will be co-funded by CTI based on a service agreement. The Institute will serve as a platform for teaching and for applied research for Swiss and foreign Universities in the area of production technology.

**Institute for Mechatronic  
Production Systems and  
Precision Machining  
IMP**

The contemporary process of innovation is very much a process involving newly-created companies. There is a steadily drift of more researchers risking the transition into business and who want themselves to manage the commercialization of their research results. But, anyone wanting to succeed in this competitive world needs not only an innovative idea but also an understanding of management and marketing. This is where CTI is active with its Start-Up Initiative. It works with a new entrepreneur in the delicate startup phase. CTI offers the new entrepreneur a network of experienced people from the business and finance worlds who advise on strengths and weaknesses, feasibility studies, market and patent searches, the setting up a business plan as well as the mediation of potential partners. An advisory group of ten people from the business world carry through a detailed critical check-out of the business scheme and confer the Start-Up Label 'appropriate for Venture Capital funding'. Since the launching of the CTI Start-Up scheme, about 300 infant companies have been checked out of which 52 have received the Star-Up Label. As a result, about 500 new employment positions have been created, directly and indirectly. (cf. the following success story from the area of microbiology.)

**CTI Start-Up**

### CTI Start-Up: From Molecular Biologist to Businessman

The costs in the pharmaceutical industry are quite literally exploding and yet the number of new medications launched annually world-wide has settled to about 40. One reason for this stagnation is the increasing requirements imposed on new medication in terms of their side-reactions in the human body. Much effort is expended on the steadily weeding out of data banks in the search for new substances for pharmaceutical innovation. A shrewd approach was selected by two microbiologists of the University of Zurich. In place of speed, they opted for an objective pre-oriented approach. They set their bearings on the interaction between proteins in a cell membrane. These comprise about one third of all the proteins in a typical human cell. Many are involved in the origin of nervous disorders, cancer, or arthritis.

Protein structure in three-dimensional space is decisive in its mode of action: whether proteins link up with others, or catalyze biological reactions. As the protein complex controls nearly all processes happening in a cell or organ, the proteins which can interact with each other need to be identified to be able to understand the function of a specific protein. The approach of using baking yeast by the two researchers – a further development of the so-called yeast two hybrid – is the most powerful known at this time in identifying interactions between proteins. In this manner complete protein libraries can be screened quickly and, what is more, efficiently, with high quality, and with competitive overheads. “We can not only demonstrate protein interactions, but also isolate the genes which codify the interacting proteins” explained the Spiritus Rector Igor Stagljar. With the support of CTI Start-Up, he founded the Dualsystems Biotech AG with his colleague Michael Hottiger and together they convert their unique know-how to a marketable product.

### 3.2.3. International Promotion Programs

The objective of the Eureka Initiative is to enhance the productivity and competitiveness of European industry through the collective promoting of market-oriented R&D projects in the Hi-Tech areas. The Eureka Initiative was begun in 1985 to support technologically-oriented branches of European industry in validating their enormous potential in the world market. Eureka carries out its task via a network of National Project Coordinators (NPC) located in the 31 Eureka Member Countries and the EU Commission by promoting and supporting trans-frontier projects in which companies, research institutions and the Universities involved in the Hi-Tech area take part. The Eureka Initiative operates under the same set of ground rules as CTI. CTI is the National Project Coordinator responsible for conferring Eureka labels in Switzerland for projects which are supported by Federal funding, and for projects where the partners provide their own financial support. Eureka projects in Switzerland are supported by CTI. Eureka proposals are dealt with and followed by the CTI core team. (cf. the following success story from Eureka.)

Eureka



### **Eureka: Energy Supply for Electronic 'Mini-systems'**

Solar powered watches are manufactured in Japan and do not need battery replacement. The solar cells are connected in series and are recognizable by the lines on the watch face. This does not permit any aesthetically-demanding design such as would be the hallmark of the Swiss watch industry. In contrast, of interest here would be a watch powered by a cell designed to include the entire watch face. The surplus energy needs to be stored in a storage battery so that the watch continues to function in the dismal winter months. This vision was the basis for a Eureka project begun by the Institute for Microtechnology (IMT) in Neuchâtel with the Asulab SA working together with the French solar cell manufacturer Solems SA. Their objective: the deposition of amorphous silicon solar cells on a stainless steel substrate using a high frequency plasma technique in a batch process as the energy source for an autonomous electronic system. There is economic potential in amorphous solar cells: A film thickness of 0.3-0.5 $\mu$ m is already sufficient for an efficient cell with a significantly higher optical absorption coefficient than crystalline silicon.

The specialists in thin film solar cells at IMT are among the leading research groups world-wide, but recognized themselves just what a challenge this represents. Considerations such as adhesion, interference fringes, and interface effects between the films generate difficulties. The prototype which emerged satisfied the steep requirements, even in terms of aesthetic appeal. The watch performed in poor lighting conditions even with a flat storage battery. As a direct consequence of this Eureka project cooperative work was initiated in the domain of sensor watch glass between a member company of the Swatch group and the French solar cell manufacturer.

IMS is the first world-wide program in the area of production technology. Switzerland is a full member along with USA, Canada, Japan, Australia, Korea and the European Commission. IMS projects with Swiss participants are supervised by CTI. IMS projects with Swiss and EU partners are currently financed in Switzerland by FES; this will continue to apply until the bilateral agreement will come into force, at which point they are to be supported by the EU Commission. The representation of Switzerland in the governing body of IMS is undertaken by CTI. (cf. the following success story from IMS.)

**Intelligent  
Manufacturing Systems  
IMS**

### **IMS: Process Configuration for Multi-Variant Products**

PROConfig is the Swiss part of the international Gnosis project, a project in the Intelligent Manufacturing Systems (IMS) program. It is funded by the Commission for Technology and Innovation (CTI). The Gnosis consortium comprises partners in the EU, Japan, and Canada. While only a few partners are directly involved in the PROConfig project, all work together towards a new post mass production paradigm.

**Motivation and Industrial Relevance:** The number of variants of a specific product is rising steadily. Product configuration applications are employed to manage this product spectrum by defining one generic model for a family of products and deriving a product variant from that model only when needed. A new manufacturing process plan has to be developed with each new product variant. Knowledge-based systems are often used to perform this process planning task. The definition and maintenance of process planning knowledge in such systems has proven to be a very time consuming and costly task.

**Project Approach:** PROConfig develops a framework model for process configuration that uses product configuration principles to solve the process planning task. The model builds upon the structural similarity of process plans within one product family. Process configuration knowledge is modeled using plan skeletons which are defined as graphs using a visual language. The visualization of process plan structures, which itself implicitly describes general sequencing knowledge, and the distinction between different knowledge categories, play a key role in simplifying knowledge description and maintenance.

**Project Results:** The process configuration framework was implemented and evaluated in a case study in the aluminum sheet and coil manufacturing industry. Its use significantly reduced the time required for process planning. More importantly, the use of plan skeletons to model process planning knowledge allowed the planners to perform a large part of the maintenance task themselves without the aid of the knowledge engineers. This form of knowledge modeling has been well received, but long-term effects on the knowledge maintenance effort cannot be assessed as yet.

### **3.3. Assessment of CTI in the Light of Key Questions III and IV**

**Assessment:** The organization and mode of operation are compatible with the mission and strategy of the CTI. The challenges of the future can only be met by an increase in professionalism of the entire organization. At the national level, the cooperation and coordination with other organizations is good. It should however be improved particularly with respect to the Swiss National Science Foundation. At the international level, there is a real need of action with respect to a massive build-up of the CTI presence in European institutions for promoting innovation.

The structure and mode of operation of the Commission is to a great extent up to its task of promoting the processes of innovation in industry. Sixteen of the current 27 members of the Commission have many years of management experience in industry. In addition, the majority of the seven members from the Universities have professional experience in industry. The CTI members and experts speak the language of industrial business and are used to moving about in an environment dominated by competition and innovation.

**Economic Expertise of  
Commission Members  
and Experts**

Collaborating in the militia system insures that familiarity with present business practice is not lost but remains current continuously. The CTI members understand

their role of acting in the manner of agents for industry in a general sense, particularly to SMEs, and not as representatives of an association or a specific industrial interest group. CTI is thus well advised to maintain the militia system in spite of the steadily increasing numbers of proposals and broadening spectrum of assignments.

The 'inter-personal information transfer' is also effective inside the Commission. The members bring an exceptional breadth of professional expertise and industrial experience to the operations of the Commission. This is extended through the inclusion of a large number of permanent experts who are involved in the review panels of the promotional programs and initiatives. As a consequence, the claim of the Commission to be open to all disciplines is validated. Obviously, not every discipline can be represented via a member of the Commission. Traditionally, expertise in the sciences and engineering are strongly represented. There are gaps in areas such as architecture and building, informatics and communication technology, economics and social sciences, design, as well as the finance and banking sectors. Such gaps can be closed as necessary through the inclusion of permanent experts who are involved in the review panels of the promotional programs and initiatives, and remain in view during the periodic re-elections of the Commission.

**Broad Spectrum of Capabilities**

The individual election of the Commission members rules out almost completely the representation of particular interest groups and the resulting conflicts of interest, and spot-lights the collective and networked knowledge and 'know-how' represented by the commission. It is the members who count, in making available their technical and professional experience as well as their expertise and contact network in the service of the Mission of CTI. This bestows on the Commission a high degree of independence and high level of competence in decision making.

**Independence and Powers of Decision.**

CTI has always operated under a fundamental axiom of 'separation between players and referees', thus being able to maintain its autonomy. It can thus best serve companies who are in a competitive situation regarding innovation, and make their recommendation for the financial support of particular projects purely on the basis of the quality of the proposals.

A key element in the mission and strategy of CTI is the promotion of the innovation processes in industry, particularly in small and medium-sized enterprises (SMEs). This objective is also covered appropriately by the mode of operation of CTI. This is also underscored by the waiver of calls for proposals and deadlines for submitting proposals. The option to submit proposals at any time accommodates the needs of the industrial partners so that they can tailor their R&D collaboration to the chronological needs imposed by market requirements (time-to-market). As far as we are aware, CTI is the only agency, also at international level, which offers this service facility.

**SME-friendly Regulation of Proposal Submission**

The mode of operation of the review panels of the promotional programs and initiatives is validated in this respect also. The monthly or bi-monthly meetings of the review panels allow a rapid assessment and discussion of the proposals. An average processing period of about ten weeks for reaching a decision on a proposal (and this including any necessary revisions on the part of the proposer) can be cited as index of the economy- and SME-friendly operating performance of CTI.

**Client-friendly Processing of Proposals**

Even without comparative data from other promotional bodies being made available to CTI, the average time-to-decision of proposals submitted to CTI does seem to be quite short. Nevertheless, occasionally the time-to-decision is criticized as being too long in their opinion by companies and research facilities. It needs to be pointed out that they take too little account of the fact that the assessment of a proposal only starts when the proposers have completed their work and that the time taken in the decision-making process of a militia-type system is necessarily time-consuming. The reality of the situation in time-critical projects should also be put in question as to whether these are then truly research projects because, in the view of CTI, these should rather have medium-term time frame.

The willingness of CTI to clarify any open questions quickly and unbureaucratically through direct contact with the proposers should also be reckoned as a positive indicator of a high level of market and client sensitivity. The opportunity offered to revise proposals, the submission of missing information, the frequently occurring proposal discussions, all indicate that great pains are taken to insure a high quality of CTI projects. In this respect, there is a clear differentiation from other promotional bodies which make calls für proposals and follow a only proposal assessment path incorporating a paper-trail.

**Willingness to enter into Dialog**

Further, the organization and mode of operation of CTI is validated in view of the strategic objective of promoting the in-depth and breadth development of a competitive, application-oriented research and development capability at the Universities (Cantonal Universities, Federal Institutes of Technology and Universities of Applied Sciences). The support of a development of the AR&D capability in the Universities of Applied Sciences has been a major area of emphasis at CTI since 1998. A specific initiative program was started specifically for this purpose with its own management team and secretariat. In this case, the promotional function of CTI is not limited to assessing proposals and making available financial support. As part of the idea of building capabilities in the Universities of Applied Sciences, CTI carries on an intensive dialog and supervises closely their projects so as to improve the quality of the projects and the project management. There are annually more one hundred proposal discussions and project reviews held by the management team, and these all take place at the facilities of the principal investigator or the industrial partner.

**Capability Development of competitive R&D at the Universities**

In this connection, there is also the increasing number of extended project summaries and draft proposals to be taken into account. These offer particularly the less experienced proposers the opportunity get qualified feed-back to improve the probability of their proposal being successful. CTI considered this as a service offered to improve the quality of the projects. CTI members are also available to support the Universities of Applied Sciences by acting as discussion or sparring partners in developing their R&D strategies.

CTI is also involved in networking activities for the AR&D of the Universities, and, in particular, in building up national networks of excellence within the Universities of Applied Sciences. CTI envisages its role as moderator in that it defines the criteria and ground rules for the official recognition by the Head of the DEA, and organizes the evaluation of candidates through international experts. Further, CTI members are available as discussion partners and, in specific cases, take on the responsibility for coaching in strategy development for the national network of

**Building National Networks of Excellence**

excellence at the Universities of Applied Sciences.

The collaboration and coordination with other organizations in Switzerland has been promoted for many years and is well developed. CTI fosters close contact with the Federal Institutes of Technology; the delegate of the ETH Board is also a CTI member. In the arena of promoting innovation in the energy and environmental technologies, a close and intensive collaboration has been built up with the corresponding Federal Offices (SAEFL, SFOE). CTI is represented in the commission for research of Switzerland's leading business association 'Economie Suisse' as well as the Swiss Academy for Technical Sciences (SATS).

**Collaboration and  
Coordination with other  
Organizations at  
National Level**

CTI has promoted good contacts with the Swiss National Science Foundation. Indeed some CTI members are also members of the Research Commission of SNSF. The top representatives of CTI and SNSF meet annually for an exchange of ideas, particularly on matters of strategy. An improved relationship between the two agencies on strategic and operational levels is one of the strategic objectives of CTI for the next few years. The need for appropriate negotiation has already been mentioned elsewhere in this report.

In recent political debates the question has arisen, being formulated in various ways, whether CTI should be made into an independent agency, separate from OPET. Extensive inquiries amongst the CTI members and experts have shown that the question is not simply "CTI: an agency outside DEA – yes or no?". The question becomes more like "where?" and "what then?".

**CTI must remain an  
integral part of OPET!**

The inquiries make it clear that any tendency to centralize politically the promotion of research, which is probably tied in with this proposal, is categorically rejected. CTI is a part of economic policy and should remain integral within it. In particular, with such an independent agency in the proximity of SNSF, the SMEs and other economic interests would be in danger of hardly entering into consideration.

The proximity of CTI to the head of DEA and policy is seen as a clear advantage. SNSF may well hold a similar view, if it considers this as a disadvantage for itself in its own 'Self evaluation' report. Further, the viewpoint is expressed that all the advantages which have been cited in favor of CTI becoming an independent agency can equally well be achieved through partial reforms under the system currently in force.

In particular CTI could not, as an independent agency, work any better together with SNSF than it does now. In order to achieve an enhancement of the extent of CTI/SNSF collaboration, such an independence is neither necessary nor adequate. Instead of this, as expressed above, what is necessary is a clarity in the mandates and collaboration via mutual understanding and the members involved, e.g., through sitting together in a specified committee setting.

Instead, what was underlined in the inquiry was an inalienable necessity of the partnership with industry in all promotional activities of CTI. Thus, all technology platforms without industrial partners oriented to practical conversion were rejected. Also, Institutes should not be promoted through service contributions, only through projects carried out with industrial partnership.

CTI is also integrated in international programs for promoting applied research. Its members offer contacts over a world-wide network of contacts. CTI has however only achieved limited success in integrating the international dimension into all its

**Strengthen the  
International  
Representation of CTI**

activities; its 'international culture' is not strong enough. Globalization and international competition require a more aggressive stance if CTI wants to achieve its objective of a steady and on-going enhancement of innovative processing in the economy of Switzerland. The corresponding need for action is recognized and is included as a significant element in its strategy. CTI must therefore absolutely strengthen its position in the international community for promoting AR&D in the coming years, working with those other bodies in Switzerland responsible for the research foreign policy to achieve this end.

The organization and mode of operation of the Commission assume a good working relationship between the Commission members and the CTI Secretariat. The CTI reviewers, members of the review panels and the CTI Secretariat staff must always be on the same wave length in terms of documentation and other information. In a system operating in such militia style, this requires a well-coordinated and experienced team and a highly professional 'back-office' which makes feasible a timely and simple entry to all relevant material by the Commission members and experts. The project data bank Promis makes available a powerful instrument for project management and administration to the CTI Secretariat. There are still weaknesses in terms of external access (allowing a high level of security). The need to correct this is recognized and an appropriate access route, e.g., via Internet, to the information and documentation bank of the CTI Secretariat (CTI box, e-Promis) are currently being created or built up.

There are currently shortcomings in the capacity and the required capabilities in the CTI Secretariat. These have been recognized and the necessary development should be carried through as rapidly as possible in the interest of increasing the capabilities to provide both professional support for the Commission members and experts, as well as for a competent service and advisory for the proposers and their project partners.

CTI has recognized a need to enhance its supervision and impact analysis and plans to improve the analysis of its promotional operations. A first step has already been taken whereby the supervision procedure has been extended to obtain information regarding the conversion of project results into a marketable product by the industrial partners.

**Support of the  
Commission by a  
Professional Back-Office**

**Supervision and Impact  
Analysis**

## 4. Recommendations for Improving the Swiss Policy of Innovation

### Recommendations based on Key Questions I and II

#### Recommendation 1: Political Dialog on Innovation Policy

Considering the changed economic and social structure in Switzerland consequent on global innovation and relocation competitions, CTI regards it as necessary to hold a broadly-based discussion concerning a new strategy on innovation policy for Switzerland. In particular, there are various policy measures now in force which are not well aligned with a smooth entrepreneurial innovation process. Thus, the transitions between pre-competitive and applied research are not considered sufficiently, and the complexity of the innovative process – which is more than just the marketing of science via new technologies – is neglected (c.w., for example, the difficulties associated with the interface SNSF and CTI and the corresponding Recommendation 5). CTI should take part actively in the forthcoming debate, and the formulation of a concept for an innovation oriented Federal economic policy. In the course of such a discussion, the modernization of their innovation policy undertaken by many European countries in recent years needs to be passed in review, and, particularly, of the changed role of politics as a moderator of innovation. Besides this, new public-private partnership instruments have been developed which, considering Swiss particularities, could offer interesting political dispositions (c.w., also Recommendation 3 on cluster-based innovation policy). In this connection, the legal basis of CTI needs to be scrutinized, also bearing in mind the creation of the new article on Higher Education for the Federal Constitution. This is expected to be subjected to a plebiscite in 2003, and if accepted by the populace will enter in force in 2004.

#### Recommendation 2: Significantly Higher Financial Capital for CTI

As the Federal Agency for promoting of industry-related and application-oriented research and development, CTI has a need for enhanced financial assets in 2004-2007 for the following reasons:

- The potential for innovation in technology fields and industries which contribute substantially to the modernization of the technology and information portfolio of Switzerland is not exhausted, e.g., informatics and communication technologies, micro- and nano-technology, life sciences and biotechnology. Also, the potential for demands from industry for applied R&D on the part of the Universities is not yet exhausted.
- The number of proposals is increasing: It is estimated that the current number of 700 new proposals annually will rise to about 1,000 annually by the year 2007. In particular, the Universities of Applied Sciences are going to built up their activity in AR&D, not the least as the result of an improved basic fiscal support (viz. Revision of the Federal Law on the Universities of Applied Sciences).
- As a result of the increasing number of proposals received, the rejection quota of requests for Federal subsidy has risen to over 40%. The inclusion of excellent proposals amongst the rejections puts the continuity of innovative activities in question. The positive effect of quality competition has proved to be increasingly in contradiction to promoting of proposed innovation processes, particularly for SMEs.
- Integration of the Universities of Applied Sciences in Cantonal Jurisdiction under a revised Federal law governing the Universities of Applied Sciences (dependent upon the decision concerning the responsibility for the promotion of R&D).
- The development of international involvement by CTI will – at least in the initial years – require additional funding.

### **Recommendation 3: Improvement of Cluster-Based Competence Policy**

CTI must increase its capacity for being aware, in good time, of new technologies and entrepreneurial movements, and to evaluate systematically their significance in view of future promotions. One option for achieving this is to institutionalize the CTI cluster-oriented economic policy and its strategic technology monitoring, as well as its technological forecasting. An on-going comparison can thus be established between global and national developments in the arena of new technologies. In general, in view of the size of Switzerland, it is anticipated that industry-specific developments would be more important than regionally-specific ones. In particular, included here is the launching of network-based transfer projects with private industry which do not have the support of a particular company in view, but rather take into account the reality that each company is part of a more complex value-added chain with regional and industrial connectivity.

As a matter of principle, CTI should take on more moderation and platform functions pragmatically, advise networks, and offer the organizing of dialogues on technological potential, and options for support functions. In this context, it should particularly address the question of SMEs actively. The promotion of 'good projects' remains in center stage.

### **Recommendations based on Key Questions III and IV**

#### **Recommendation 4: CTI to remain incorporated within DEA**

The CTI policy has to be formulated, and converted into practice, in touch as closely as possible with the SMEs and the industry-oriented circles of Switzerland. A partnership with the industrial users or with public institutions should be a prime condition of all promotional activities. The most important objective of all is the enhancing of the innovative capacity of Swiss industry.

Consequently, CTI is the prime instrument for the innovation oriented policy of the Federal Government. Further, the institutional embedding of CTI within DEA and OPET must be retained. This incorporates the advantages of direct access to the departmental director and to the Federal Council. CTI makes significant contributions to the development of the strategies of the Confederation in Education, Research and Technology (ERT) through OPET and its representation on the inter-departmental ERT committee, and particularly through DHA. A centralizing of the management in all arenas of the entire promotion of research for Switzerland (a fusion of the SNSF and CTI agencies) is to be rejected.

OPET/CTI take a leading role at federal level in the dossiers dealing with the mission of CTI: far more clarity in the CTI mandate and a focusing of CTI activities need to be striven for and converted into practice. In this respect, the following topics must remain central:

- Strengthening of the applied R&D at the Universities, in particular through promoting the build up of applied R&D at the Universities of Applied Sciences,
- Promotion of conversion, transfer, spin-off, and new ventures through interaction with fundamental research,
- Promotion of a stronger application-orientation in the next generation of science graduates, and a strengthening of the bent to innovation in Swiss society in general,
- Active representation of these concerns in international committees and programs.



### **Recommendation 5: Improved coordination between SNSF and CTI**

CTI holds the view that the current distribution of responsibility between CTI and SNSF should not be altered. The question of the distribution of competences and the corresponding promotional instruments should be considered in the light of economic perspective. How can the best result be achieved for the research and science of Switzerland?

The support of the innovative process in industry is the central theme for CTI in the new strategy of CTI. In satisfying its basic mission, CTI is inherently open to all disciplines and follows a 'full spectrum' policy. A strategic objective of CTI is an effective usage of the transition between fundamental research and AR&D. The collaboration between CTI and SNSF is thereby strengthened when their basic responsibilities are taken into account – SNSF for fundamental research with a long-term view, CTI for industry-oriented AR&D with a middle-term time-frame. The two agencies complement one another; information exchange between them in both directions becoming enhanced when administered efficiently.

Existing gaps in the promotional activities of the two agencies, CTI and SNSF: proposals which are too fundamental for CTI or too applied for SNSF must be closed off. The coordination between the two agencies must be improved for this purpose. CTI is in favor of maintaining a certain polarity and fruitful tension between the two institutions. These should concentrate on their individual strengths, nonetheless with an improved transparency between them (creation of a joint committee, consideration of individual cases, joint search for pragmatic solutions). The best coordination can be achieved collegially, between people who are engaged in the activities of both bodies (CTI and SNSF). CTI needs to receive a place on appropriate and relevant SNSF committees for this purpose.

Practical solutions need to be found for applied research which is neither market- nor economy-oriented, i.e., where the objectives are not new products nor services, and where no industrial partner is available. This applies, e.g., to human sciences, partially to economics, to the fundamentals of engineering sciences, but also for parts of the departmental research of the Confederation. CTI must uphold absolutely the requirement for the participation of industrial partners (in the widest sense of the term). CTI is nonetheless prepared to be flexible within defined limits in its understanding of this critical criterion in applied R&D.

### **Recommendation 6: Strengthening of CTI's International Position**

Experience and quality assurance studies have shown in the past that the services of CTI are called on by industry and used by professors as well as researchers at the research and educational establishments. Similarly, the services of CTI have received international recognition. With the newly emerging Europe-wide research arena, the demands on CTI in connection with international collaboration are going to continue to increase. The increasingly weighty and conversion-oriented EU program research is forcing Switzerland, even at the program formulation stage, to make strategic decisions. Switzerland must become involved at all levels in the information network through its own representation (from industry, the sciences and administration) even within the militia system, and impress its own interests in relevant R&D planning groups at an early stage. CTI can only then make an optimal and objective contribution to enhancing the competitiveness and innovativeness of the Swiss economy if it is conversant with the international scene, and is itself engaged in the international groupings on applied research.

### **Recommendation 7: Strengthened Attention to Questions of intellectual Property**

CTI should take further measures to improve the financing opportunities of companies through clarifying the rights of intellectual property. As advised by the CTI members, project management by a company is only worth while if the research results can be brought to the market by the company. Increased attention has to be dedicated to this issue in the University-Company relationship. It is to be anticipated in this regard that in view of the increasing tendency of the Universities to market intellectual property, conflicts-of-interest between industry and university in the collaborative projects will develop increasingly, which CTI must disarm through appropriate courses of action.

This aspect should be dealt with by maintaining the existing proven basic principles, whereby the exact provision of rights to intellectual property remains an issue for the partners to resolve. Before a project is launched, these latter have to reach a clear and contractually-binding agreement on the use of intellectual property from the results obtained.

### **Recommendation 8: Improvement of Internal Monitoring**

CTI is going to streamline and broaden its control functions significantly. This is to be done in terms of the internal quality assurance of the administration, the survey of its subsidized projects, and a systematic check on their effectiveness.

The improvement of internal quality assurance of the CTI Secretariat forms part of the current tasks in OPET in developing a general quality assurance system. This should be completed by the end of 2002 through the certification of OPET per ISO 9001.

The existing control system on the projects themselves will be improved through a tougher monitoring of the deadlines, the compliance with conditions set on conditional awards, the timely submission of reports, and the conducting of project reviews. CTI does not currently have sufficient personnel resources and infrastructure available to maintain an overview with an acceptable time expenditure on all projects which are subsidized, nor to maintain a watch on the compliance with submission deadlines. The technical requirements are currently being developed, namely, extending Promis the computer-based project management and information system, as well as the corresponding procedures which are also being installed. Experience with project control shows that the vast majority of projects run without major difficulties and the principal investigators fulfill the requirements made of them.

From the beginning of 2002, CTI is planning to test a new system of regulation, and to introduce it step-wise. The new system plans: to replace the existing documenting of results through a success check, which implies a reduction in effort expended by the principal investigator and by CTI itself, as much self-regulation by the principal investigator as possible, a focus on application transfer and innovation (e.g., what plans are there to convert the project results into practical application?), and a more efficacious use of IT-support. A new element to be introduced is an audit of the applications achieved by a project, this to be held some time after project completion.

CTI has not carried out a systematic check on the effectiveness of the projects which it has subsidized. The assessment made of the final report by the CTI reviewer is very useful, but permits only a 'single-case' quality assurance check. CTI is working up a concept and developing indicators for a systematic style of analysis which can be applied by an independent third party to assess the specific industrial and economic effects of its promotional activities.

**Recommendation 9: Improvement of Information Policy**

Altogether, the positive effects of the promotional activities of CTI in the core businesses, the initiatives and promotional programs must be made better known publicly. CTI has a communication and marketing hurdle to overcome. CTI is well known to the Universities through its promotional activities but, in contrast, far too little known in industrial circles. CTI lacks a certain transparency among its 'clients'. On the one hand, it was very conservative in the past in terms of setting down its criteria in writing so as to retain flexibility and an adaptability to new topics. On the other hand, it appears to many to be an agency for 'simply promoting technology'. That CTI is open to a broad spectrum topics for R&D, and is very multi-disciplinary is hardly recognized at all, and is too little appreciated. CTI and OPET are currently working on a new communication and marketing concept, and which does not exclude a possible change of name.

## Appendix 1: Monitoring the effect of CTI Promotions

Individual sections of the CTI promotional operations have been monitored since the mid '80s. These evaluations have in part the character of a quality assurance to check the CTI criteria and project management, and in part comprise a systematic scientific evaluation study of individual programs.

Since 1990, a total of fourteen evaluation studies have been carried out with 'major clients' of CTI who have a large number of projects, as well as of individual initiative programs. As a result of the differences in reason for the study, the objectives, and methods (analysis of documentation, verbal interviews, written questionnaires) the results can only be compared with difficulty but give nevertheless a good insight.

The results of the previous evaluations are summarized in the following.

The first comprehensive evaluation of CTI was carried out in 1990 by the Institute of Advanced Studies in Public Administration of the University of Lausanne and the Research Office for Science and Policy in Bern under the direction of Dieter Freiburghaus<sup>18</sup>. The most important results were: CTI is not well enough known in industry. Up to the end of the 80s, over 70% of the CTI funding went to the two Federal Institutes of Technology, less than 30% went to the Cantonal Universities. In spite of their practical orientation, the Engineering Colleges (now: Universities of Applied Sciences) were poorly represented with 4% of the promotional funding. The collaboration between research institutes and industry in CERS projects was designated as intensive and problem-free. The research objectives were mostly fully or partially achieved. Fourteen percent of the industrial partners interviewed could use the results completely, 44% partially. As a result of the projects, 33% of the companies could strengthen their market position, and even 8% could build up a new market sector.

An evaluation of five CERS projects completed or still running at the Engineering College in Bern was carried out in 1992<sup>19</sup>, primarily to assess the project management at the College.

Survey and analysis of CERS promotions in the area of chemical analytics and physical sensor technology in 1986-1993<sup>20</sup>.

Survey and Analysis of the promotion of tribology and the Swiss Laboratory Coalition on Tribology by CRSR in the period 1986-1993<sup>21</sup>.

Evaluation of the CERS projects of the Institute for Technology Management at the Business School St. Gallen (now: the University of St. Gallen) in 1994<sup>22</sup>. A total of ten projects run over the period 1998-1994 were studied, they had financial support amounting to about 2.6 MCHF. At that time, the promotion and development of management methods was a relatively new area for CTI. Result: The usefulness of method-oriented projects to the project partners is significant. However, the diffusion of the results beyond the narrow circle of project partners is difficult. Decisive for success are clear objectives defined at the beginning of the project.

Evaluation of 11 CERS projects carried out with the Sulzer company as industrial partner working with both Federal Institutes of Technology and a promotional investment of 5.5 MCHF in the time period 1990-1995.<sup>23</sup> Result: the Promotion corresponded to the CERS requirements. The initiative for the projects began primarily at the Federal Institute of Technology but finding open doors at the industrial partner. The results from the project were applied widely in the partner company. The university profited from the demanding collaboration.

Evaluation of CERS projects in the Department for Industrial Research at the Institute of Physics and Engineering of the Federal Institute of Technology in Zurich in 1995.<sup>24</sup> Nineteen projects with a promotional investment of about 4 MCHF were checked out. Result: the results corresponded with the CERS objectives. The projects were carried out correctly. They demonstrated the strengths and weaknesses of the Institute.

Evaluation of 27 CTI projects at the CIM Center of (Western) French-speaking Switzerland with a promotional investment of 8 MCHF where the correspondence with CTI objectives, efficiency of the project work, and achievement of the objectives were checked out.<sup>25</sup> Result: very valuable expertise was generated in the Center and the projects were carried out following the CTI guidelines.

Eighteen projects at the Universities of Applied Sciences in the forefront of the CTI promotion of competence enhancement in AR&D were analysed in 1996.<sup>26</sup> Result: All projects generated results which had a particularly positive influence on research and teaching at these Colleges. The evaluation also showed the necessity for building up a critical mass via collaborations between different departments at the Colleges.

Evaluation of the Swiss CIM program from 1990 to 1996 by the Fraunhofer Institute for System Technology and Innovation Research.<sup>27</sup> The centerpoint of this multi-year study, which ran parallel to the research projects themselves, was the build-up and operation of seven CIM centers, in which a total of 52 projects were involved. The results of the evaluation were translated into use by the program leadership and also applied within the promotional activities in the Universities of Applied Sciences.

Concomitant research and evaluation of the Action Program Microswiss 1991-1998. Within the framework of the overall assessment of this complex program 47 of a total of 68 projects supported by CTI were studied in terms of their success per the viewpoint of the industrial partners.<sup>28</sup> The techno-scientific objectives were predominantly achieved. In contrast, the industrial applicability of only about a half of the projects could be shown convincingly. This was the case because, following from the objectives of capability development by SMBs and the Universities of Applied Sciences, many partners inexperienced in AR&D were working together. In contrast, practically all projects which were aimed at developing equipment for direct industry application were evaluated at 'good to outstanding'.

The effectiveness of diffusion-oriented technology promotion by the Confederation was the subject of a difficult, methodical, scientific evaluation of the CTI programs carried out under the CIM and MicroSwiss Action Programs; the study was completed by economic research laboratory of the Federal Institute of Technology at Zurich. Companies with CTI-supported projects were interviewed and compared with a control group without such project support. The innovation profile of companies which has taken part in CTI-sponsored projects was found to show an above-average level of innovative activity, offensive innovation strategies, more frequent usage of company-external information sources, and more shock as a result of innovation barriers (technical risk, bottlenecks in financing and personnel). The industrial partners from CTI projects are in addition more frequently active in markets with low cost demand perspectives.

An inquiry was carried out by Institute for Technology Management of the University of St. Gallen<sup>29</sup> within the framework of an analysis of the success in the CTI Coalition Project on Machine Tools (WZMO). This covered 27 centers of excellence at the Universities and 64 industrial partners of CTI projects in the machine tool industry. The partners in the WZMO projects were more than happy with the projects and the vast majority would be prepared to take part in future CTI projects. The objectives of CTI were achieved in their entirety. Some improvements in the collaboration between the Federal Institutes and industry were desired. Application of the results by the industrial partners is at a comparatively low level, however, the SMBs could take advantage of the results more rapidly.

The effectiveness of CTI-supported Eureka projects in Switzerland is continuously and uninterruptedly monitored by the Eureka Secretariat in Brussels. One, three and five years after completion of a project, all project partners are requested to complete a Market Impact Report. Nine out of ten companies assess the technological results of their participation in Eureka projects with good to very good. Two thirds of the polled companies have developed new products or processes. Sixtytwo percent report positive economic effects already by the end of the project.

Results: CTI has a relatively good overview of the projects which have been financed through the numerous intermediate and final reviews which are carried out on the spot by CTI members or experts. Associated specifically with the promotion of their capability development in AR&D, 50 to 80 project reviews are carried out annually at the Universities of Applied Sciences. CTI obtains consequently a wide understanding of the quality of project management as well as the results achieved by the partners involved. In many cases, the conversion of the results into industrial practice often takes a significant time period after completion of the project, the information available to CTI on the direct economic impact of its promotional activities is very incomplete.

There is no systematic, on-going check by an independent body on the industrial conversion of the results by the industrial partners. CTI has recognized this need and in the future will improve the analysis of its effectiveness. A first step has already been taken in terms of altering the mode of controlling how the project results have been converted into practice by the industrial partner.

## Appendix 2: Strategy Paper of CTI for 2003-2007

### Mission Statement

- CTI supports the innovation process of the economy by promoting the development and application of new technologies. Innovation process
- CTI links dynamic enterprises as well as public sector institutions with researchers of non-profit research facilities. This is primarily done through support of projects in applied research and development, both national and international. CTI pursues a comprehensive approach open to all scientific disciplines. Support of R&D
- CTI strengthens sustainable competitiveness of the economy and improves performance in the public sector. CTI enables accelerated transfer of research results into successfully marketed products, processes and services. Accelerated transfer
- CTI swiftly and effectively supports innovators and their projects with impact on the economy. This is done by providing funds, qualified services and know-how in innovation management by CTI-members and other experienced managers and scientists. Investment into innovative ‚brains‘
- CTI is an instrument of the economic policy of the Swiss Confederation and as such complementary to the instruments of science policy. Economic policy

### Objectives and Strategies of the CTI

#### 1<sup>st</sup> Strategic objective: CTI strengthens the innovation process of the economy by supporting applied research and development.

CTI will be further developed as a support instrument of the Swiss Confederation. Its impact will be enforced along three dimensions:

- as an instrument of a sustainable **innovation policy** = support of the innovation process of the economy via efficient and effective knowledge and technology transfer between universities and the business sector,
- as an instrument of a growth-oriented **economic policy** = maintaining and creating high-value jobs and creation of new enterprises,
- as an instrument of **education policy** targeted to the future = improvement of a business-oriented education at tertiary level (Universities of Applied Sciences).

CTI and its services:

- are fully supported by the Swiss Federal Council and the Federal Parliament,
- are sought by the economy = exploitation of project results, training of next generation management,
- are used by **lecturers** and **researchers** = oriented to the needs of the economy, integrated into international networks,

- are internationally recognised.

## Strategies

All CTI activities are based on a competition-oriented economic and innovation policy. CTI is targeted to the creation of economic value.

Investment into innovative 'brains'

### 1. Transfer via people

Knowledge and technology transfer is most efficiently done via people (innovative 'brains') i.e., joint projects of business and public enterprises with university researchers as well as the people transfer from research to business.

**= Via aR&D projects CTI invests into the education of researchers and thus indirectly co-funds the next generation R&D-staff of the economy.**

- CTI funds joint projects between partners from the economy (proof of existing demand) and non-profit research and education facilities. CTI support is always subsidiary: it requires a financial engagement of the business partners (at least 50% of total project costs). Federal funding is exclusively made to non-profit research and education facilities.
- Researchers engage themselves in projects with close contact to the market i.e., accept conditions imposed by the participating business partners. Thus researchers upgrade their professionalism in an environment dominated by competition and market forces.

### 2 Value-creation through knowledge transfer

CTI enables and strengthens co-operation of the economy and the university system in applied R&D. Particularly, it enables SME to get easier access to research results to foster their innovations.

Rapid transfer university/market

CTI project support accelerates the transfer of scientific knowledge into competitive products and services ? **support of the innovation process** of the economy.

### 3 Pillars of CTI project support

Project partners define their own projects

- CTI project support follows a **bottom-up approach**: The project partners define their projects themselves ? oriented towards exploitation in the market.
- CTI project support is **open to all scientific disciplines** and pursues a comprehensive approach i.e., encompassing both technological, economic, ecological and social aspects.
- CTI also focuses on **selected topics**:, CTI helps to establish new businesses through its Start-up initiative; CTI helps to create awareness of future topics among industries and research facilities; CTI launches action programs on selected topics and over a limited period of time.
- CTI supports aR&D projects within the scope of **international R&D-programs**, especially the EU-framework programs, EUREKA, and IMS.
- CTI employs coherent **quality management** in its project support.



## 2<sup>nd</sup> Strategic objective: CTI supports the establishment and deployment of highly competitive aR&D in the university system.

CTI supports particularly the Universities of Applied Sciences to establish and develop their competencies in aR&D. This is part of the Universities of Applied Sciences' mission as:

Attractive partners  
for enterprises

- competent **problem solvers and partners to the economy in knowledge and technology transfer** ? support of the innovation process; closing the loop of business needs, aR&D, and teaching;
- **partners to the universities and Swiss Federal Institute of Technology** within the Swiss university system ? filling a gap in the range of university services at the market and application end;
- co-operation partners in international university networks.

### Strategies

CTI supports the development of the Universities of Applied Sciences through:

Enhanced project  
support

- intensified support of **aR&D projects**,
- supporting the creation and development of **national networks of excellence** between the Universities of Applied Sciences in fields with a high future economic potential,
- promoting the participation of the Universities of Applied Sciences in **international aR&D-programs**,
- enhanced support of non-technology oriented research.

## 3<sup>rd</sup> Strategic objective: CTI enhances its international presence and activities.

CTI activities take place in Switzerland and abroad. CTI enforces substantially its international presence and support activities.

Enhanced  
international  
activities

### Strategies

1 CTI is integrated into international aR&D support activities. In particular, CTI engages in application-oriented international research. CTI helps Swiss enterprises and research facilities to better use existing opportunities for international support and funding. CTI also supports international project partners, if no suitable Swiss partners can be found.

Information,  
Projects, Programs

2. CTI analyses and evaluates international activities in view of their potential for the Swiss economy and develops concepts for appropriate support activities.

3. CTI supports international mobility of researchers.
4. CTI and the Federal Office for Education and Science collaborate jointly in all application-oriented international research programs for the benefit of their clients.
5. CTI expands its international activities at three levels: information, projects, and programs. CTI participates in the design and development of new international aR&D-programs:
  - CTI utilises the network of Swiss Science and Business Consulates.
  - CTI participates actively in all relevant R&D-commissions of the EU, EUREKA, IMS, and ESA.

#### **4<sup>th</sup> Strategic objective: Interactions between basic research and aR&D will be efficiently exploited.**

CTI and the Swiss National Science Foundation SNSF intensify their co-operation. SNSF and CTI are the support agencies of the Swiss Confederation:

**Improved interchange SNSF/CTI**

- **SNSF** for **basic research** with a long-term horizon,
- **CTI** for **business-oriented aR&D** with a medium-term horizon.

Both agencies are complementary; the exchange of information between them will be improved and efficiently managed.

### **Strategies**

The transition from basic research to applied R&D and back will be efficiently utilised. CTI and SNSF supervise this transition especially in view of the National Research programs of the SNSF:

**Improved transition from basic research to aR&D and back**

- Mutual understanding of CTI and SNSF of joint interests and possible areas of conflict,
- Optimised division of labour between SNSF and CTI,
- Improved co-ordination between CTI and SNSF as well as other research institutions of the Swiss Confederation,
- CTI and SNSF establish a joint expert committee, responsible for handling project proposals that do not clearly meet the requirements of either agency; this is to prevent highly innovative projects from failing to receive necessary support.

### **CTI resources 2004 - 2007**

- **Block credit for the four year period** (estimation; resources budgeted in other Federal Offices, such as the Swiss Agency for the Environment, Forests, and Landscape SAEFL and the Swiss Federal Office of Energy SFOE, are not included here): **580 million CHF** (? 2000 - 2003: 320 million CHF)
- **CTI administration** (estimation): **20 posts** (full-time equivalents)

## References

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<sup>1</sup> C.w., also the discussions in Chapter 2.4. and the commentary given there on the legal basis of for the Federal law on 'Preparation for crisis management and promoting employment' dated 30 September 1954 as well as Articles 5 section 2 and 14 section 2 of the associated Executive Order dated 12 March 1956.

<sup>2</sup> Decisions on projects by the director of OPET or by the Federal Council are a rare occurrence.

<sup>3</sup> C.w. ERT Message 2000-2003, p. 67.

<sup>4</sup> Law on Energy dated June 26, 1999.

<sup>5</sup> Federal Law on Research dated October 7, 1983.

<sup>6</sup> The term "Universities" is taken here, and generally throughout this report, to include the Federal Institutes of Technology, the Cantonal Universities and the Universities of Applied Science.

<sup>7</sup> Legal basis of the CTI Mission is the Federal Law covering the 'Preparation for crisis management and promoting employment' dated September 30, 1954 as well as Articles 5 section 2 and 14 section 2 of the associated Executive Order dated March 12, 1956. The particulars of the pre-requisites, conditions and the mode of granting federal support, as well as the organization and duties of CTI are covered by the Executive Order of the Federal Department of Economic Affairs (DEA) covering Federal contributions for the promotion of Technology and Innovation dated 17 December 1982 (updated 11 August 1998). The key statements are the Confederation supports procedures to strengthen the competitive capability of the Swiss economy in particular through the promotion of collaboration of industrial companies with non-profit making organizations. The collaboration takes place in the framework of projects which aim directly at material, process and production innovations. The Confederation may also support measures for preparing such schemes such as researches, feasibility studies coaching of small and medium-sized companies (SMBs) as well as conferring research commissions such as fall in the sphere of general interest. In contrast projects which involve the testing of prototypes and demonstration facilities not supported. Further it is stated that the DEA orders the Commission for Technology and Innovation from representatives from industry and the Universities for this purpose.

<sup>8</sup> Resolution of the Federal Council Dated December 18, 1996

<sup>9</sup> Most recently in the Commission on the Promotion of Education, Research and Technology for the Period 2000-2003 dated November 25, 1998 (ERT Message)

<sup>10</sup> BRI Innovation Study, 2001

<sup>11</sup> OECD Managing National Innovation Systems (1999), p. 3

<sup>12</sup> BRI Innovation Study, 2001

<sup>13</sup> The term 'technology' in the title of CTI is often criticized in this context. A name is being debated in connection with the realization of CTI strategy and its concept for future communication.

<sup>14</sup> Expert Report on 'The Competitive Neutrality of CTI – Commentary on Questions of Political Order', 2001

<sup>15</sup> Through 1996 there were two annual submission deadlines: March 31, and September 30.

<sup>16</sup> A 'cash' contribution and in-house expenses of the industrial partner covering equipment, other expenses and salaries.

<sup>17</sup> There are points of contact with many national key research programs, in particular with the following programs: Molecular Oncology – From Basic Research to Therapeutic Approaches, Frontiers in

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Genetics – Genes, Chromosomes and Development, Molecular Life Sciences: Three Dimensional Structure, Folding and Interactions, Nanoscale Science – Impact on Life Sciences, Sustainability, Information and Communication Technologies, Neural Plasticity and Repair, CIMINT – Computer Aided and Image Guided Medical Interventions.

<sup>18</sup> D. Freiburghaus, W. Zimmermann, A. Balthasar, Evaluation of the Promotion of Practice-Oriented Research (CRSR) Federal Office for Economic Questions Study No. 12, Bern, 1990

<sup>19</sup> H. van der Floe, Evaluation of the CRSR Projects at Intec Bern, unpublished report, August 3, 1993.

<sup>20</sup> E. Schumacher, CRSR Promotion of Analytic-Sensoric, unpublished report, August 4, 1994.

<sup>21</sup> P. Junod, Tribology: a key technology, its industrial significance, and promotion by CRSR, unpublished report, 1993

<sup>22</sup> A. Krieger, H. van der Floe, Evaluation of CRSR projects at the Institute for Technology Management of the College of Technology, St. Gallen, unpublished report, August 24, 1994

<sup>23</sup> C. von Planta, A. Krieger, Evaluation of CRSR Projects of the Sulzer Company with various University Institutes, unpublished report, December 2, 1995.

<sup>24</sup> A. Krieger, E. Schumacher, Evaluation of CRSR Projects with AFIF, unpublished report, November 13, 1995.

<sup>25</sup> J. Jacot, W. Salathé, H. van der Floe, Evaluation of Projects of the CIM Center of (Western) French-speaking Switzerland with CTI Support, unpublished report, May 21, 1996.

<sup>26</sup> A. Krieger, H. Chardonnens, R. Glardon, P. Gygax, M. Grunt, Evaluation of CTI Projects with Colleges of Engineering, unpublished report, December 2, 1996.

<sup>27</sup> C. Dreher, A. Balthasar, Evaluation of Swiss CIM Action Programs from 1990 to 1996, unpublished report, 1997.

<sup>28</sup> Federal Office for Professional Education and Technology (editors): MicroSwiss – Concomitant research and Evaluation of the Action Program MicroSwiss 1991-1998, Rüeger Publishing, Chur & Zürich, 2001.

<sup>29</sup> G. Schuh, B. Harmann, C. Speth, Final Report – Analysis of the Effect of the WZMO – Priority Program, Institute for Technology Management, University of St. Gallen, unpublished report, 2000.