Evaluation Of The Egyptian Science, Research and Technology Landscape For the Design of the Egyptian Innovation Policy and Strategy

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List of Abbreviations

CIS	Community Innovation Survey
EEIF	EU-Egyptian Innovation Fund
EGTI	Egyptian German Telecommunications Industries
ESCWA	Economic & Social Commission for Western Asia
ETTIC	Egyptian technology transfer and innovation centers
EU	European Union
EWSD	Electronic World Switch Digital
FDI	Foreign Direct Investment
FEI	Federation of Egyptian Industries
FTE	Full Time Equivalent
GAFI	General Authority for Investment and Free Zones
GDP	Gross Domestic Product
GEBRI	Genetic Engineering and Biotechnology Research Institute
GERD	Gross Expenditure on Research and Development
GTZ	Deutsche Gesellschaft für technische Zusammenarbeit
HCST	Higher Council for Science and Technology
HRST	Human Resources in Science and Technology
IATNM	Institute of Advanced Technologies and New Materials
ICT	Information and Communication Technology
IDA	International Development Association
IMC	Industrial Modernization Centre
IPA	Investment Promotion Agencies
IPR	Intellectual Property Rights
IRI	Informatics Research Institute
ISIC	International Standard Industrial Classification

ITIDA	Information Technology Industry Development Agency
MENA	Middle East / North Africa
MHESR	Ministry of Higher Education and Scientific Research
MIGA	Multilateral Investment Guarantee Agency
MIT	The Ministry of Industry and Trade
MSTQ	institutions in measurement, standards, testing, and quality assurance
MuSCAT	Mubarak City for Scientific Research & Technology Applications
NGO	Non Governmental Organisations
NTRA	National Telecommunications Regulatory Authority
ODA	official development assistance
OECD	Organisation for Economic Co-operation and Development
PERISKOP	Program Evaluasi Riset Sains Teknologi Untuk Pembangunan (eng: Evaluation of the Indonesian Science, Research and Technology Landscape to Strengthen the National Innovation System)
PhD	Doctor of Philosophy
PSDP	Private Sector Development Program
R&D	Research & Development
RDI	Research Development and Innovation
RDIN	Research, Development and Innovation Network
RI	Research Institute
RSE	Researchers, Scientists and Engineers
S&T	Science and Technology Agencies
SDF	SEKEM Development Foundation
SME	Small and Medium sized Enterprises
SPX	Subcontracting and Partnership Exchanges
SRT	Science, Research and Technology
STDF	Science and Technology Development Fund
TNC	Transnational Corporation
TTO	Technology Transfer Office
UNESCO	United Nations Educational, Scientific and Cultural Organization

UNIDO	United Nations Industrial Development Organisation
USA	United States of America
USSR	Union of Soviet Socialist Republics
VDI/VDE	German Institute for Innovation and Technology
WP	Work Package

Executive Summary

The purpose of this project was to establish a solid foundation for future Egyptian innovation policy and related strategies. To achieve such a target, a thorough analysis of the capabilities of Egyptian institutions for science, research and technology (SRT), the administrative organization and its business processes and the needs of the Egyptian industry (especially of the innovative SMEs) had to be done. The accomplished input will be used to generate design principles for policy proposals and suggestions for the reorganization and revitalization of the Egyptian SRT landscape in different timeframes in a sustainable way.

The project design is based on the methodological approach by working on three main modules as vertical tasks:

- Performance of science, research and technology
- Industry demands and needs to be served by science, research and technology
- Design principles for science, research and technology development and guidelines for restructuring

To assure, that a maximum of already existing but maybe locally scattered knowledge will be used within the project, it seemed reasonable to start with a preliminary assessment to "collect" knowledge. Furthermore, considering the strong soaring integration of the Mediterranean rim into the European Union an attempt was made in conducting a screening process to ensure input from various experts.

1. Overall Objectives

The title reflects the overall objective of this project: evaluation of the Egyptian Science, Research and Technology Landscape for the Design of the Egyptian Innovation Policy and Strategy. It entails three elements, which will be explained in this report.

The project goals can be divided into short-term, mid-term and long-term objectives. A direct effect results in achieving the short-term objectives while mid-term objectives address follow-up actions after the project itself to guarantee sustainable effects. The long-term objectives correspond directly with the overall political aims of Egypt to change the structure of SRT system.

The project partners (Ministry of Higher Education and State for Scientific Research and Fraunhofer IPK) are responsible to take short-term measures, as a direct effect triggered by the project. The mid- and long-term measures have to be realized after the project is finalized. The Egyptian partners are given appropriate measures and procedures in order to reach mid-term and long-term objectives.

In cooperation with experts from Germany (e.g. Fraunhofer-Gesellschaft etc.) different science, technology and research institutions in Egypt were evaluated and so a unique chance was created to build long lasting partnerships between the corresponding institutions for further cooperation.

Another very important issue of the project was passing on knowledge to the involved Egyptian partners. This took place along the knowledge chain:

- Preparation of relevant knowledge
- Adaptation of knowledge to country specific framework conditions
- Transfer of knowledge
- Exemplary implementation
- Consolidation
- Dissemination for public use

1.1 Short-Term Objectives

The project established data for the areas of:

- Policy definition for research, science and technology
- Definition of key fields with achievable targets and sub-goals
- Viable support mechanisms for sustainability and future growth
- Proposal for organization of division of labour between government and other institutions in the research, science and technology area
- Needs for research, science and technology in the economy and society
- Reorganization proposal for SRT landscape to revitalize its service function for community and industry, here especially the small and medium sized companies (SME), which are considered as the backbone of innovation and employment
- Definition of fields of research, science and technology to be developed in the future (long-, mid- and short-term)
- State of the capabilities and future plans of Egypt SRT institutions in comparison to other surrounding countries and Europe (Competitiveness Benchmarking)
- Know-how transfer on the assessment process of the industry and the community's and policy needs throughout the project
- Proposal for a SRT master plan.

1.2 Mid-term and Long-term Objectives

The mid-term objectives were defined as those goals (milestones) that need to be achieved in order to obtain the sustainable implementation of actions, which are required to achieve the long-term objectives. Both mid-term and long-term objectives will rely strongly on the results of this project. Of course, the achievement of those results was only possible due to the sincere efforts of Egyptian decision makers.

Short-term

- Emergency actions: Focus on existing resources to support economic recovery

Mid-term

- Built on analyzed proven strengths
- Restructuring, optimization, reorientation, upgrading

Long-term

- Competencies networking, demand driven, performance accountability, strategic orientation

2. Project Approach

The overall project approach is organized in three major modules. Module 1 and 2 will be conducted simultaneously while Module 3 will follow as a logical result of the first two modules, though it will be initiated from the beginning of the project. The modules' topics are:

- Analysis of Industrial Demands and Societal Needs for Science, Research and Technology
- Assessment of the Performance of the present SRT System
- Design Principles to Improve the National Innovation System

The following figure (Fig. 1) shows how the three modules are interlinked and visualizes the input capacity on the project timescale.

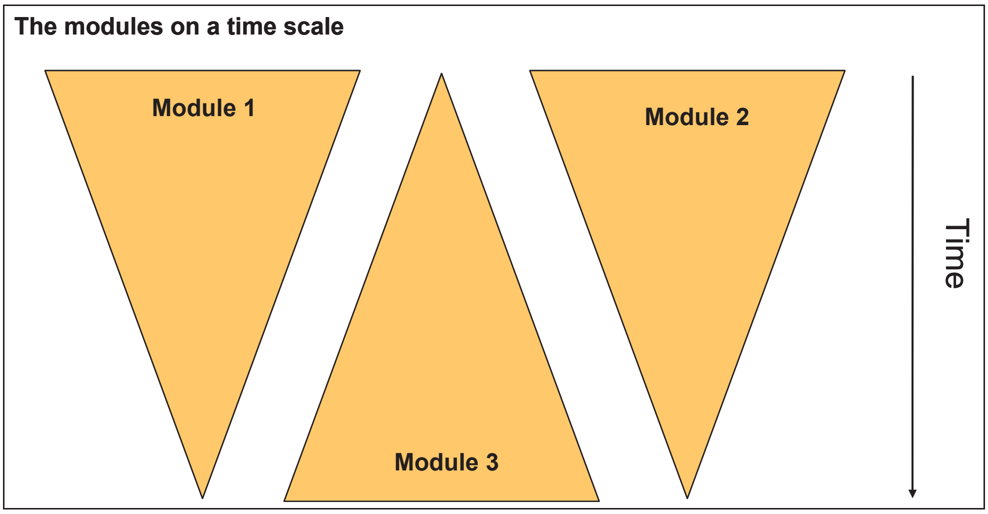


Fig. 1: The three project modules on a time scale

Those three modules are subdivided into twelve work packages. All work packages basically follow the same work structure: structuring the objects, observing, assessing and finally analyzing. The different work packages are shown in the following table 1).

Module 1	**Analysis of Industrial Demands and Societal Needs for Science, Research and Technology (SRT)**
Work Package 1	*Assessment of Industrial Needs*
Work Package 2	Setting up of a Technology Foresight Process
Module 2	**Assessment of the Performance of the present SRT System**
Work Package 3	*National SRT Performance and International Benchmarking based on R&D Indicators*
Work Package 4	*Performance of University Research*
Work Package 5	*Performance of Research Institutes*
Work Package 6	*Performance of Technology Transfer and Regional Distribution of Technology Supply*
Module 3	**Design Principles to Improve the National Innovation System**
Work Package 7	Relevant Framework Conditions of SRT in Egypt
Work Package 8	Design Principles for Institution Building, Reorganization and Support
Work Package 9	Design Principles for the Incentive Structure of Industrial R&D
Work Package 10	Design Principles for Technology Transfer and Regional Development – Strengthening SME
Work Package 11	Design Principles for Strengthening International Cooperation in R&D
Work Package 12	Proposal for Activities Accompanying the Implementation of an SRT Master Plan

Table 1: Overview on Work Packages

The work packages, which are marked with a grey background were performed as described in phase 1. It is proposed to work on the module 2 in an additional project, which will be phase 2, after phase 1 is completed.

The results of the individual work packages will be described below.

The Ministry of Higher Education and Scientific Research (MHESR) in conjunction with the Industrial Modernization Center (IMC) belonging to the Ministry of Industry and Trade (MIT) undertook the initiative to design a comprehensive national innovation policy and strategy. Once it will be realized it will enhance and strengthen Egypt's economic prosperity and international competitiveness.

The results of this project within this offer will provide concrete recommendations on how to properly implement the mentioned strategy.

MHESR decided to conduct the required national innovation policy and strategy by means of the evaluation which resulted by a series of studies and surveys. The project is meant to be helpful also for the design of various other projects and surveys needed.

By using the elements of a knowledge transfer the project will provide also design principles for the planning as well as for the layout of further investigations either to assess new matters or to reassess already established facts, for instance verifying the success of implemented measures.

The application of the above mentioned multiple proven methodologies will ensure that crucial factors for the Egyptian innovation strategy like:

- Focused R & D strategy and policy
- Platforms for private public dialogue on innovation
- Framework to address current and future industrial demands
- Restructuring and repositioning towards an Egyptian culture of innovation
- Coordination between all stakeholders assuring a common set of targets will be available.

On the level of policy recommendations questions like:

- How the government / public sector could support innovation
- How the private sector could be encouraged to put innovation on the top of their agenda
- How to develop a strong, innovation based research landscape
- How to tap on international innovation
- How to create an innovation friendly culture and environment in Egypt by incorporating all parts of society will be answered.

In regard to the development of implementation plans, it is considered to:

- Establish strong and viable technology transfer mechanisms
- Provide a sound data base for the national R&D capabilities available
- Establish business technology incubator schemes
- Organize national capacity building programs concerning, management of incubators, commercialization of R&D results and IPR issues, etc.
- Trigger entrepreneurships at all relevant levels in Egypt
- Attract international organizations to take part in funding the innovation system of Egypt on mutual benefit basis.

Phase 1 priority work packages (selection of the above mentioned work packages):

Taking into consideration the above priorities and requirements, this Phase 1 project includes the following work packages (WP) – (Modules 1 and 2):

WP1: Assessment of Industrial Needs

WP3: National SRT Performance

WP4: Performance of University Research

WP5: Performance of Applied Research Institutions

WP6: Performance of Technology Transfer and Regional Distribution of Technology Supply (Regional Development)

All principal remaining work packages (work packages 7 – 12) are proposed for a later phase 2 as before described and are not subject of this project report.

The results of the work packages marked with a grey background (see Table 1) as part of this final report will extensively describe reliable information for the following outputs:

- Well documented design of the assessment study to identify the current strengths and weaknesses of the 'Egyptian Innovation System'.
- Set of indicators to evaluate and monitor the Egyptian Innovation System continuously.
- Draft document describing Egypt's newly defined innovation strategy together with the connected new policies.
- Rough implementation and action plan to set the new innovation strategy and policies into motion.

3. Work Package 1 – Enterprise Innovation Survey

3.1 Introduction

Work package 1 was adapted to the Egyptian needs and prerequisites. During 2008, the Egyptian Ministry of Higher Education had run a survey on industry innovation performance with a specially designed questionnaire. The results of this survey have been used within the project to assess the status quo of innovation activities in the Egyptian industry.

According to the standard of the European Union, the instrument used in the innovation performance measurement systems is the so called community innovation survey (CIS). It measures the output of innovation with a defined set of quantitative and qualitative indicators.

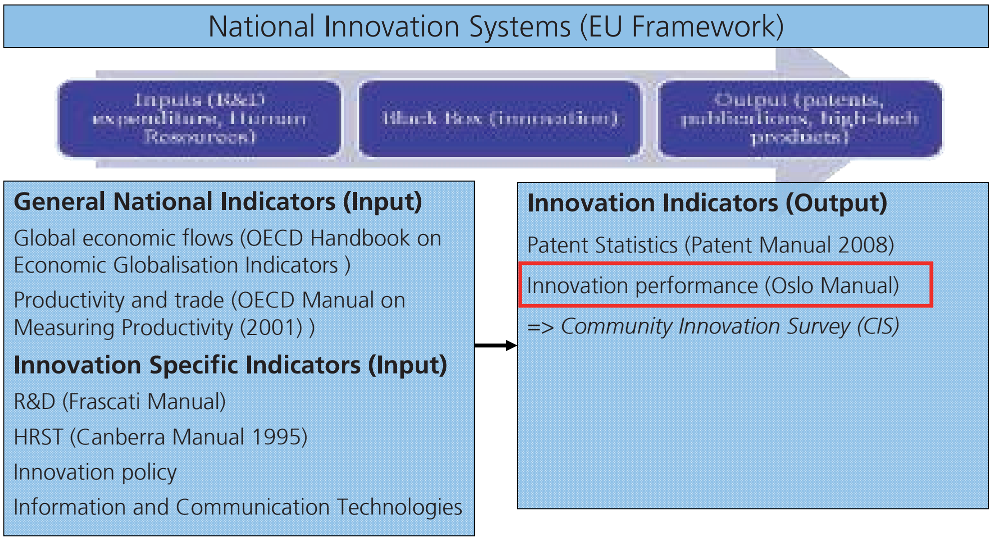


Fig. 2: EU Framework for the measurement of innovation performance – input and output factors

Source: Fraunhofer IPK

3.1.1 Design of the Study

The questionnaire used for the enterprise innovation survey was designed according to the Oslo Manual, which describes how to collect and measure the indicators needed to assess national innovation performance in the private sector. Based on a questionnaire adapted from South Africa, the Egyptian questionnaire was translated while maintaining the same codes (see Annex 2: Questionnaire of Egyptian National Innovation Survey 2008). The adjustments were done by the team prior to the starting of field work stages.

The questionnaire was designed to collect data in terms of different characteristics of enterprises from various governorates and cities all over Egypt. The frame of the sample selection was drawn by the Egyptian manufacturing federation according to ISIC. It represents all sectors of the Egyptian enterprise landscape.

3.1.2 Selection of the Sample and Field Work

Enterprises, which are located in new manufacturing cities were also assessed. These new cities are 6^{th} of October City, El-Oubout City, 10th of Ramadan City, Alexandria (Borg AlArab City) as well as the Delta region El-Mahalla ElKobra City that represent the textile industry and Damieta City that represents the furniture industry. From Upper Egypt the sample was drawn from El-Minia, El-Gedida and Assuit.

The field work contained the following activities:

- The pre-testing stage to check the questionnaire (n= 150) and the design of the sample.
- The selection of the field staff: A data collection personnel was selected from qualified staff of NCSCS, or from new graduates who had prior data collection experience.
- The task team trained these nominees and provided an extra number of candidates to allow for the attrition of disqualified candidates.
- Innovation awareness documents were also prepared.
- Filed reviewers, supervisor and interviewers included females besides males.

After the initial general office training sessions, consequent training sessions were held in small groups because of the specific areas and different governorates: Cairo, Alexandria, Gharbia, Assuit, and Minia.

Pre-test field training was also conducted. The questionnaires were reviewed each day by the research team and common mistakes were discussed in the following morning. The staff of field was selected based on their performance and evaluation results throughout the week.

The data collection process started after the training phase. The review of the questionnaires was done by field reviewers during the data collection process. Reviewers were also instructed to visit enterprises with researchers in case there was any doubt of the data validity.

Supervisors were responsible for the stock of blank questionnaires and also for the collection of questionnaires after they were reviewed by field reviewers. As well, they were in charge of the distribution of samples assigned to the team among researchers.

	Progress					
Phase	1 month	2 month	3 month	4 month	5 month	6 month
Office preparation						
Questionnaire Design						
Pre-Test						
Field Work						
Office review, coding and validation						
Data Entry and re-interview						
Data Analysis						
Report Writing and documentation						

Table 2: Timetable of enterprise innovation survey (Source: Ministry of Higher Education Egypt)

3.2 Study Results

The following pages will give an overview of the most important findings from the analysis of 2943 valid data sets, which were collected during the survey. The whole section is structured as follows: first, some general information about the analyzed data is given in the first section (3.2.1 Basic Structural Data) in order to describe the data sample of this study.

The following section (3.2.2 Overview on Innovation Activities) outlines some basic information on innovation activities in Egypt. The most important groups like sector, region and company size are analyzed according to their innovation performance. Then this rough overview is being specified in section 3.2.3. (Innovation Activities in Detail: Innovation Active Companies) taking a closer look at different kinds of innovation activities (product and process innovative companies). The following questions are analyzed in the above mentioned section:

- Who developed these innovations?
- Did these innovations mainly originate in Egypt or abroad?
- Were any of these innovations new on the market or new to the firm?
- Which were the most important sources of information for the innovations?
- Which were the most important outcomes/effects of those innovations?

The subsequent section (3.2.4 Background Information: Prerequisites of Innovation) displays the sources, effects, perceived constraints etc. for all companies taking part in this study in comparison to all innovative companies (product and process). It includes the results from the following questions:

- Were there any innovation activities abandoned or are still ongoing?
- What were the types of innovation activities, the enterprise was active in?
- Was there any public financial support for innovation activities?
- Which were the most important barriers to innovation?
- Which were the most important sources of information for your innovations?
- Did the enterprise engage in any organization or marketing innovations?

Generally, all answers refer to a period between the years 2005-2007.

3.2.1 Basic Structural Data

The following figures give an overview of the enterprises, which have participated in the survey according to their location, size and sector. The major part of enterprises is located in the Cairo region (Cairo and Giza). Generally, the selection of the sample in terms of sizes corresponds to the actual distribution of enterprises across Egypt. This means, within the total sample of 2943 enterprises participating in the survey, the sample distribution reflects the real local distribution of all enterprises in Egypt.

size of enterprises involved in the innovation survey in percentage

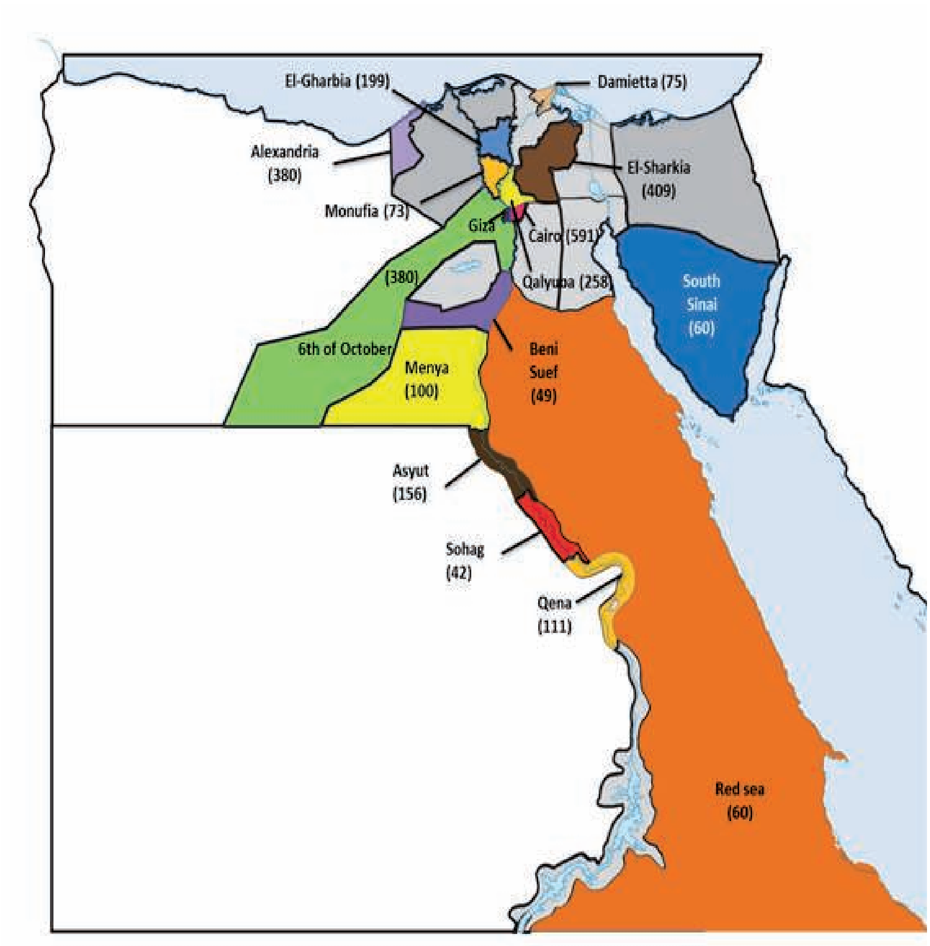


Fig. 3 Number of enterprises involved in the innovation survey per Governorate

Concerning the size of enterprises included in the study, the great majority are micro (1-5) and small (6-49) enterprises (80,4%). This ratio reflects the situation of the Egyptian economy, which is mainly based on the performance of very few big internationally acting companies and depending highly on the economic performance of a very high number of very small companies. The officially published percentage of SMEs in the Egyptian economy differs slightly according to the information source, but according to estimations, more than 99% of Egyptian enterprises are micro, small or medium sized enterprises (1-49 employees).[1]

[1] Central Agency for Public Mobilization and Statistics, Arab Republic of Egypt, 1996 Establishments Census

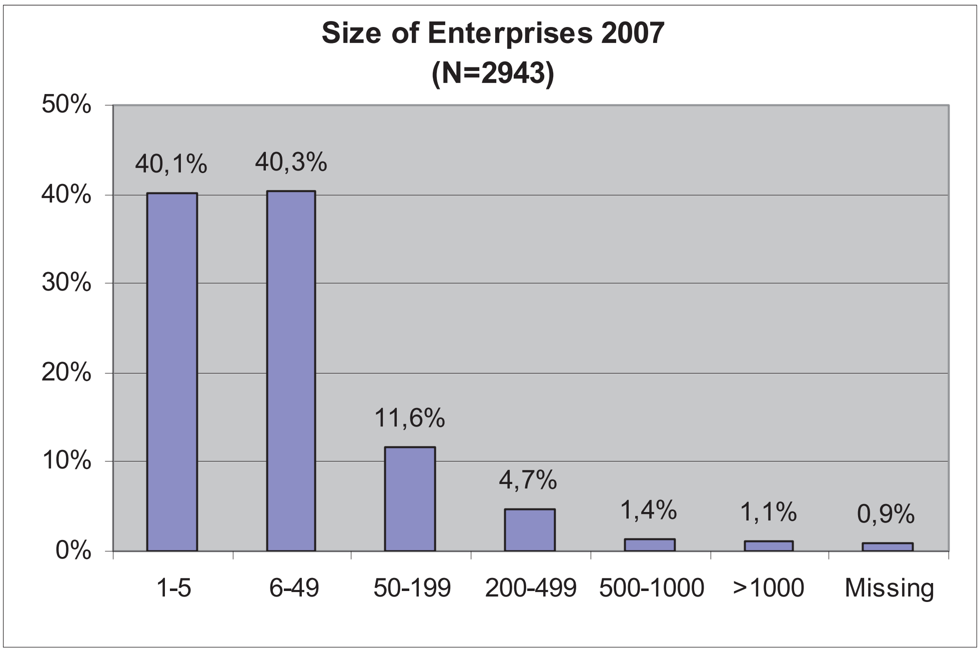


Fig. 4: 2007 size of enterprises involved in the innovation survey in percentage

The following chart (Fig. 5) display the distribution of participating companies across sectors and branches. Generally, more than 86% of the participating companies are coming from the manufacturing sector and only 13,8% are working in the services sector.

The distribution of the survey does not reflect the real ratio between companies working in the service and the industrial sector in Egypt. According to the most recent data available, the service sector accounts for almost half of the GDP (48,9%) while occupying about 51% of the labor force. Industry accounts for 37,6% of the Egyptian GDP while occupying only 17% of the total labor force.[2]

The agricultural sector accounts for 32% of the countries GDP but has not been involved in the study.

From a total number of 2943 companies involved in the study, the biggest group of companies works in the textile industry, which is the most important industrial branch in Egypt. In the study, this rank is closely followed by the metallurgy and wood industry. Within the group of service industry, companies working in the field of gastronomy and tourism are the biggest group.

[2] https://www.cia.gov/library/publications/the-world-factbook/geos/eg.html

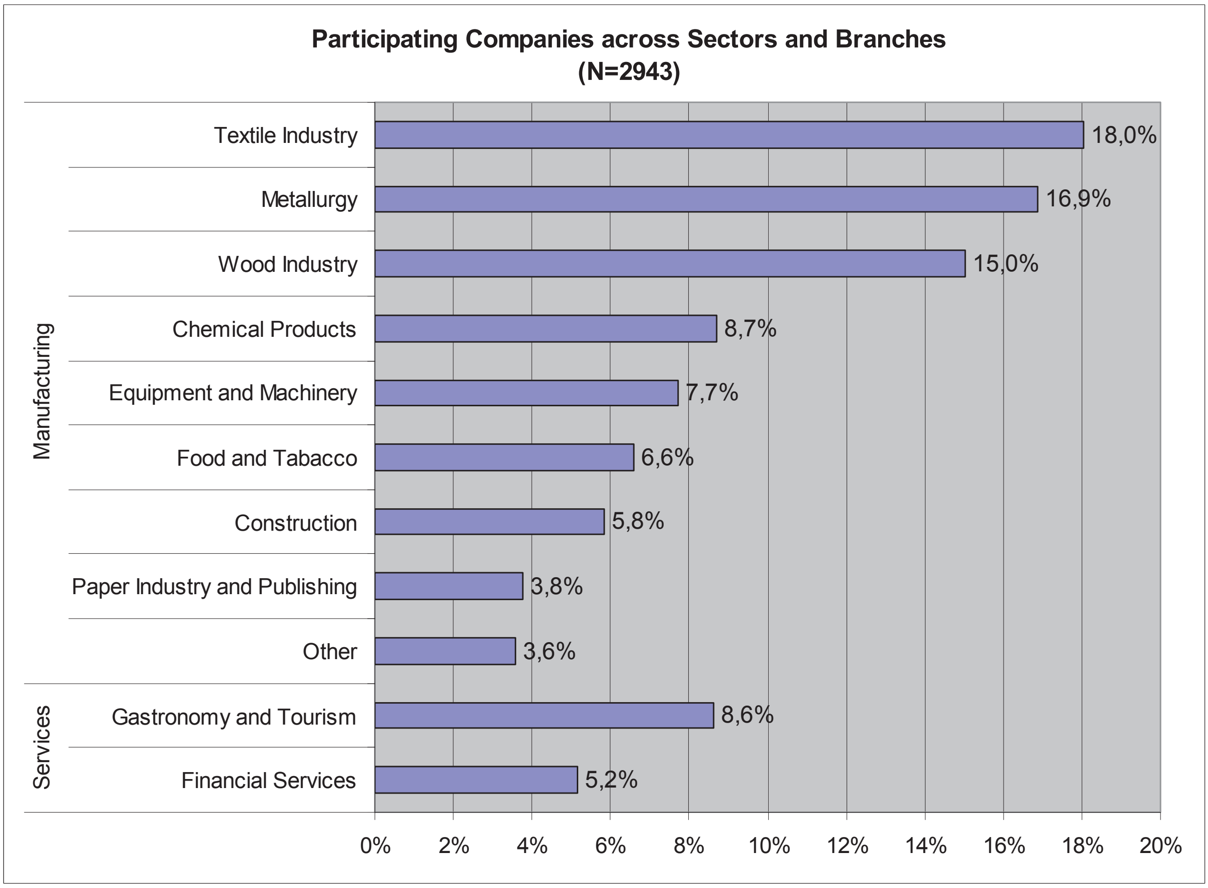


Fig. 5: Number of companies participating in the innovation survey displayed by sector and branch in percentage

Almost 99% of these companies do serve customers in Egypt (see figure below). Only few companies have additional customers in Africa (7,6%), Asia (7%) and Europe (6%). Only 4,5% sell goods or services to America.

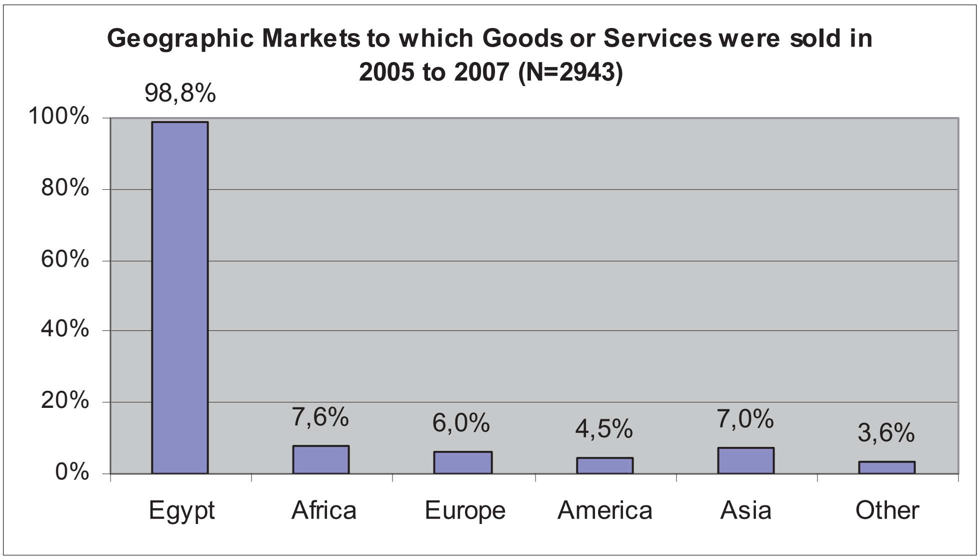


Fig. 6: Geographic markets to which goods or services were sold in percentage

3.2.2 Overview on Innovation Activities

The purpose of this section is to give a broad overview of the range of indicators of innovation activities in Egypt and to show a general picture of innovations in Egypt. Later sections will explore elements of this broad picture in more detail in order to give deeper insights for policy and practice.

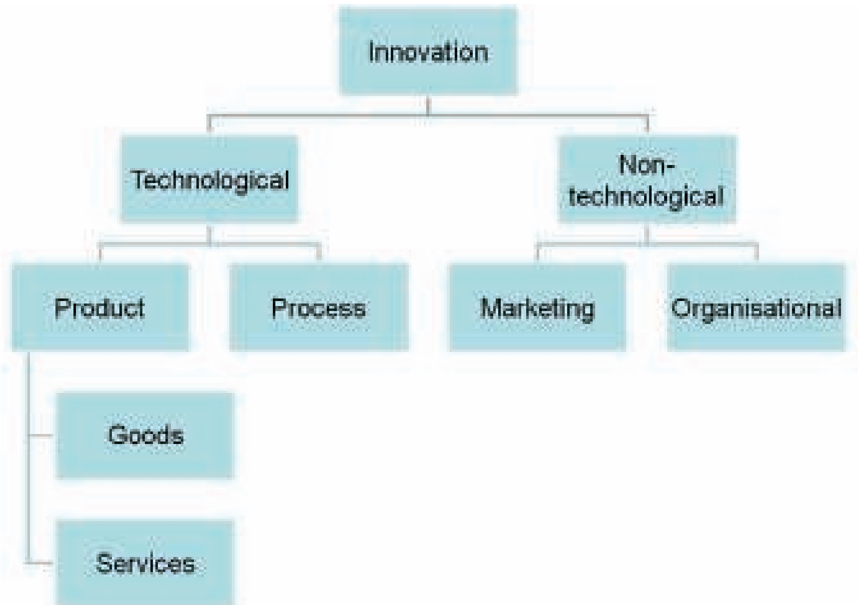


Fig. 7: Basic concept of firm-related innovation activities

Underpinning the analysis, a classification of enterprises in 'innovation active' and 'none innovation active' had to be realized. The common concept, which helps to explain and to describe corporate innovation, divides innovation into technological and non-technological innovation. The definition of an 'innovation active' business implies the following criteria: the enterprise has to introduce a new product or significantly improved product (good or service) or the process of making supply. Insofar, technological innovation is consisting of both product (goods and services) innovation and process innovation.

The following section only describes the innovation performance of Egyptian companies in terms of technological innovation. Non-technological innovation is being regarded as an important prerequisite for technological innovation. Therefore it will be analyzed in the section 3.2.4.6.

An analysis of those enterprises which indicated innovation activities shows, that about 18,8% of Egyptian companies are active in either process innovation or product innovation. Breaking down the analysis to the single types of innovation reveals that out of these almost 19% innovation active companies, 13,2% are active in goods or services innovation, and 21,8% are active in process innovation.

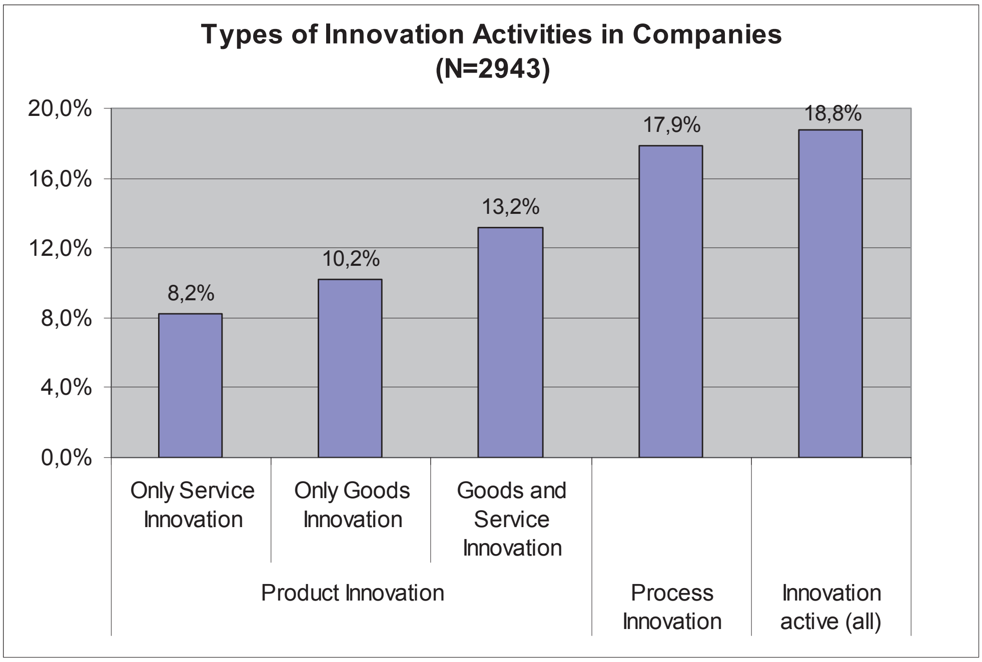


Fig. 8: Innovation active companies – split by types of innovation in percentage

3.2.2.1 *Innovation in Sectors*

Looking at the differences between innovation activities per sector, the analysis outlines a higher percentage of innovation activities in the service sector. Almost 25% of service companies indicate innovation activities compared to less than 18% in the manufacturing sector.

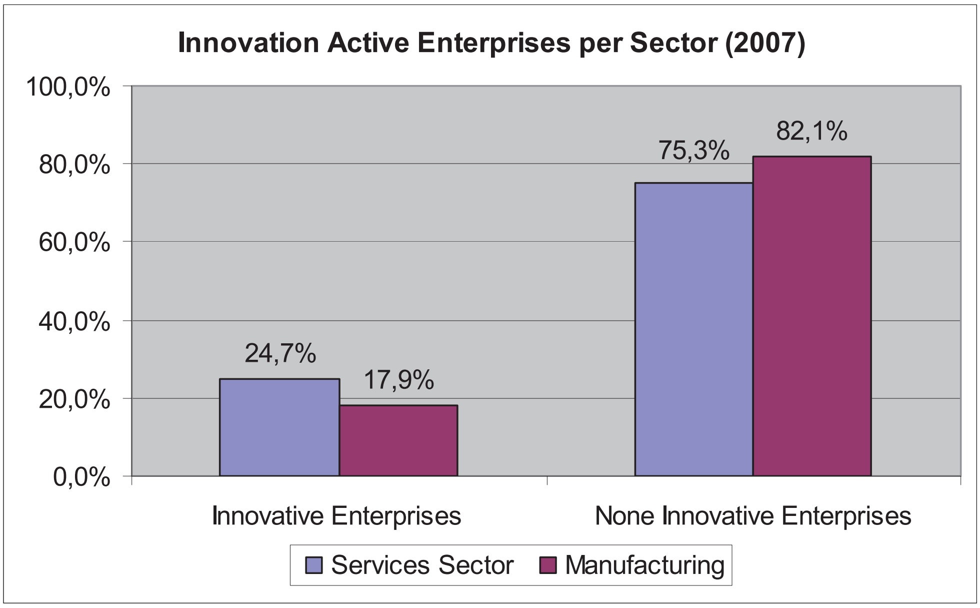


Fig. 9: Innovation active enterprises per sector in percentage

The company sample of the services sector includes 152 companies from the financial sector and 253 companies from gastronomy and tourism sector. Astoundingly, the financial sector is responsible for the high innovation rate within the services sector as a whole: 32,9% of the innovative enterprises do perform process innovations and 28,9% do perform product innovation. The tourism and gastronomy sector is less innovative with 18,6% of product innovation activities and 22,5% of process innovations.

The proceeding text will give a more detailed analysis of all companies, which are active in either product or process innovation. The total number of companies which are active in at least one of these innovation activities is 554 across all sectors.

3.2.2.2 Innovation and Size

Taking a closer look at the innovation activities performed by different enterprises classified by size clearly shows that the rate of innovation is growing with the size of the company. Micro enterprises as well as small enterprises are the least innovation actives. Most innovative active companies are those with 500 to 1000 employees. Especially process innovation seems to be a major issue within this group: 50% of those enterprises perform process innovation.

Generally, service innovation is the innovation type showing the lowest rate, close to product innovation. The most important type of innovation irrespective of the size of the company is process innovation.

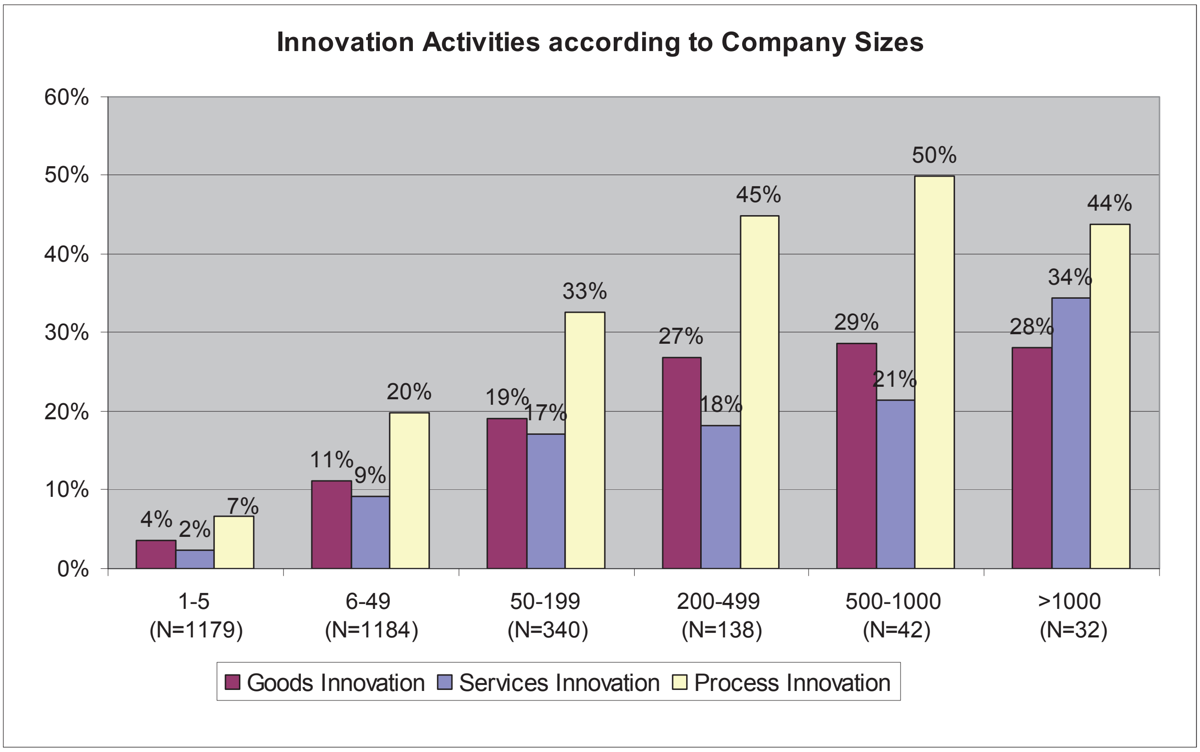


Fig. 10: Innovation activities in enterprises according to size in percentage

3.2.2.3 Innovation and Region

Looking at the different regions in Egypt and their innovation performance, the analysis clearly states great differences between single regions. The two regions, which can be clearly identified as the innovation-leaders among the Egyptian Governorates are Beni Suef (42,9%) and Monoufia (38,4%). Qena and Asyut have a surprisingly low innovation rate with only 4,5%.

The Cairo region with the two governorates of Cairo and Giza, which is the majority of companies involved in this study, is located at an average level in the middle of all innovative regions. It has to be noted, that the sample is not representative for the number of industries in the governorates.

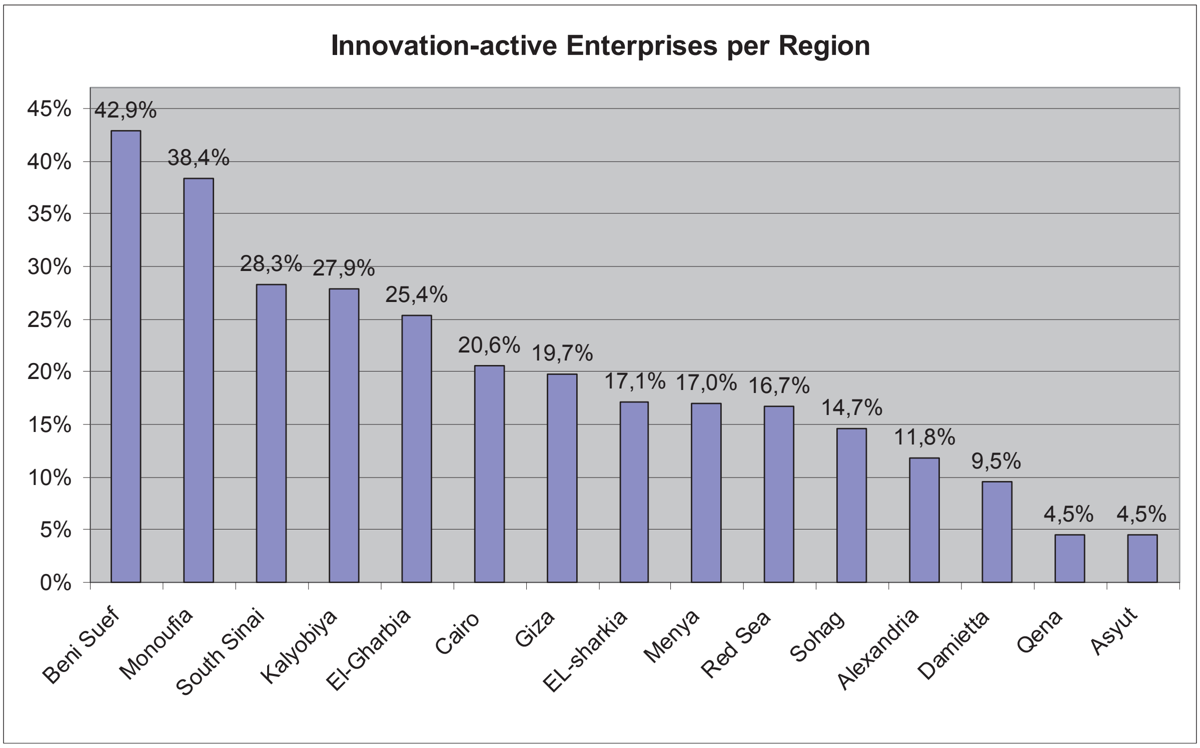


Fig. 11: Ratio of innovation-active enterprises per region

3.2.3 Innovation Activities in Detail: Innovation Active Companies

The following section takes a closer look at innovation activities in Egyptian companies. The analysis distinguishes between product innovation (goods and services) and process innovation.

3.2.3.1 Product Innovation

In the following section, only those enterprises are described, which are active either in goods or in service innovation, meaning they are generally active in product innovation. The total number of this group counts 388 across all sectors and sizes.

The question about the responsibility for the innovations was answered by 352 enterprises – which equals 90,7% of the group with the result that innovations were mainly developed within the enterprise itself or within the enterprise group. Only a marginal percentage states, that other enterprises are involved or completely responsible for innovation activities.

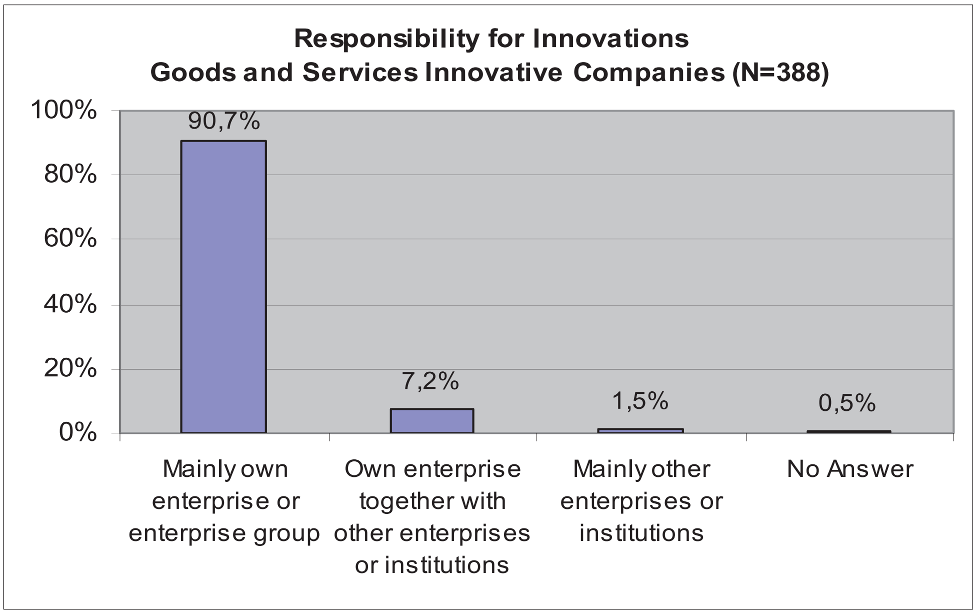


Fig. 12: Responsibility for innovations in percentage (innovation active – goods and services only)

The following answers are responding to the results described above, i.e. the majority of innovations are realized within the enterprises themselves. Accordingly, the majority of product innovations are coming from Egypt and from not abroad.

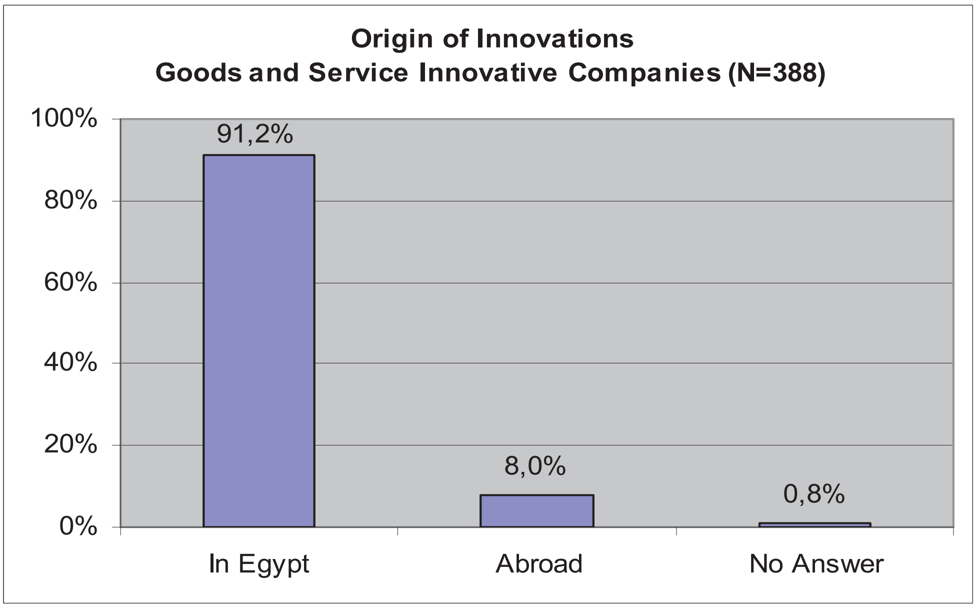


Fig. 13: Origin of innovations in percentage (innovation active – goods and services only)

Enterprises were also asked about the degree of novelty of their innovations: "Where their goods or service innovations new to the market or new to the firm?"

According to the definition of an innovation, a new or improved product, service or process has to be a first-time result of the firm at minimum. An innovation which is "something new to the firm" means that a new or improved product or process has been established in the firm and likewise it is technologically novel for the enterprise. It is possible that it has been already established in another form in other firms or industries. The maximum of an innovation is the introduction of something completely new on the market.

According to the answers of those 388 companies, which are active in product innovation, the rate of innovations that are new to the market is very high: more than 55% of the companies stated, that their innovation results (new or improved products or processes) were introduced to the market for the very first time!

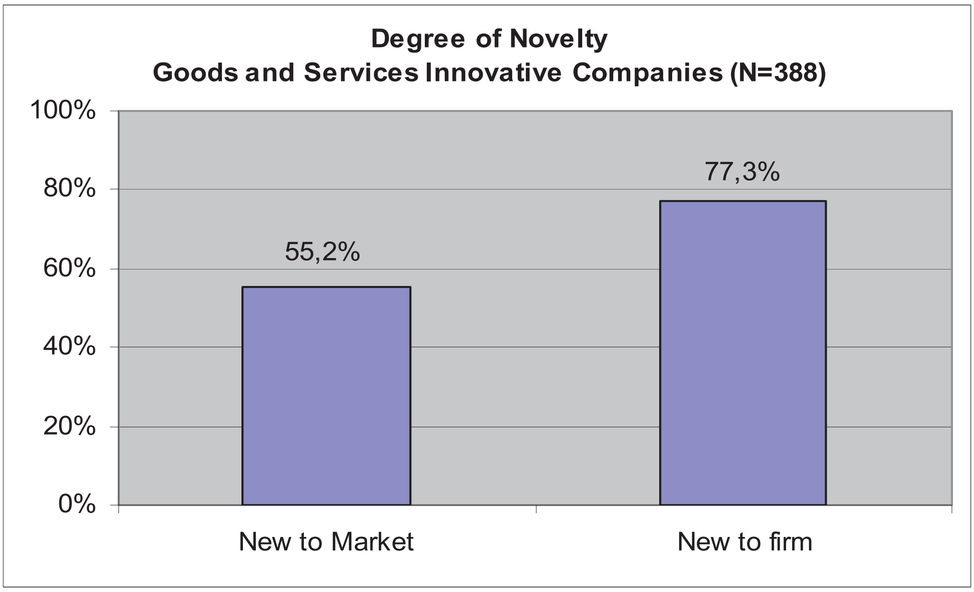


Fig. 14: Degree of novelty in percentage (innovation active – goods and services only)

Recently, the innovation literature discussed how the ideas and the use of an innovation can be accomplished. Furthermore, the importance of various sources of information was noticed. In particular, the balance between internal and external sources of information and amongst external sources, the balance between public and private information sources has to be taken into account. With this in mind the next figure (Fig. 15) outlines responses given in the survey.

Regarding the sources of information, which are used to plan or to establish an innovation activity, a closer look at the cooperation partners of research institutions will follow.

The most important information sources for innovation are the own enterprise or the own enterprise group, meaning that Egyptian enterprises rather prefer in-house R&D activities. Nearly the same preference is given to cooperations with clients or customers as well as suppliers. It indicates a very well ongoing networking between enterprises and a good cooperation within the companies supply chain.

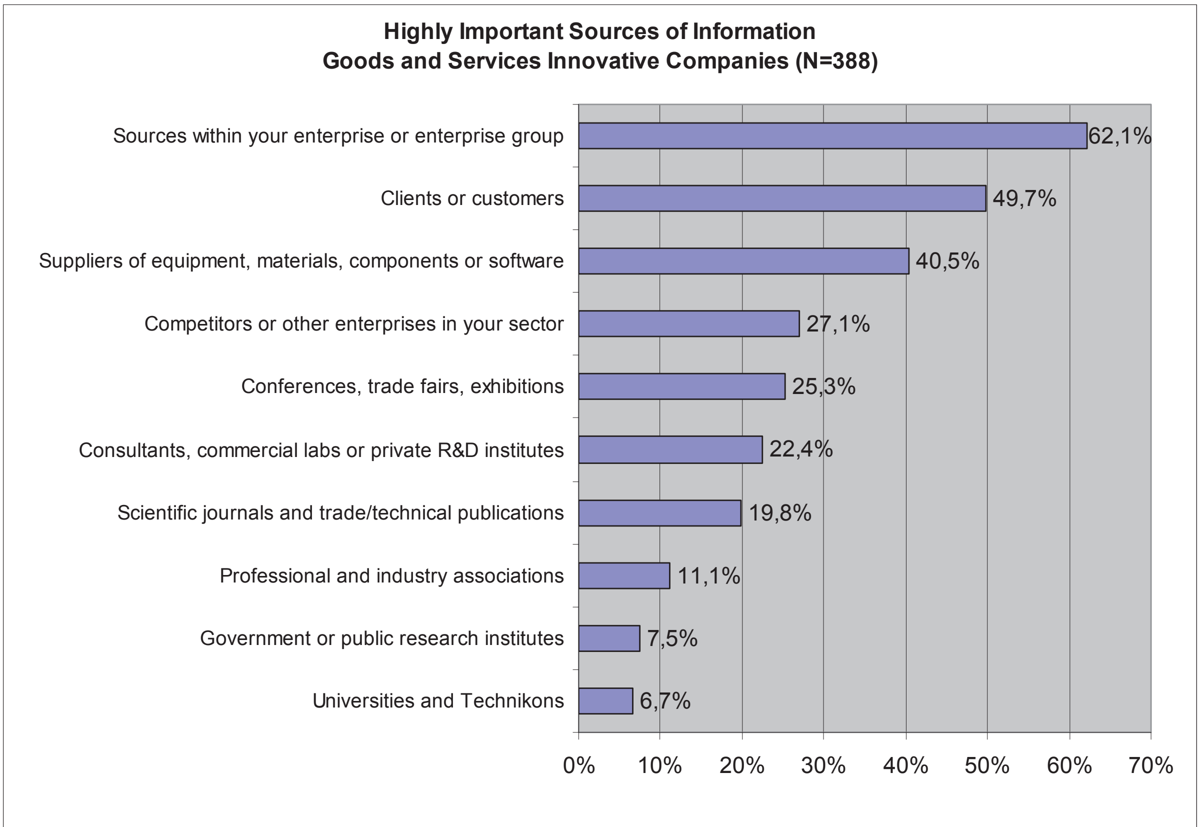


Fig. 15: Highly important sources of information for innovation activities in percentage (innovation active – goods and services only)

As result, R&D institutions and universities are the least important partners for enterprise innovation activities in Egypt. This fact is confirmed by the analysis in section 3 – work packages 4 and 5 on the survey of university and research centre performance. Generally, scientific sources like journals or conferences are less considered as innovation input factors for enterprises. Private R&D laboratories and consultancies seem to be even more important than the public institutions. In short, Egyptian companies rely much more on non-academic input for innovation. Hence, information sources from the own company, clients, customers and even suppliers are the three most important information sources.

The effects of innovation attempts and activities highlight other aspects: many enterprises stated a very great impact of innovation activities in terms of successfully entering new markets. As well as increasing their market shares, product or service quality or in general the capacity of production processes or services. Due to innovation activities, enterprises are also improving the flexibility of production processes and services. But innovation had less effect on labor costs and savings in materials or energy.

Being innovative indeed seems to be a benefit for innovative companies in Egypt. Because increasing market shares will have a direct effect on the financial income of a company and so investments in innovation activities will pay off in the long run.

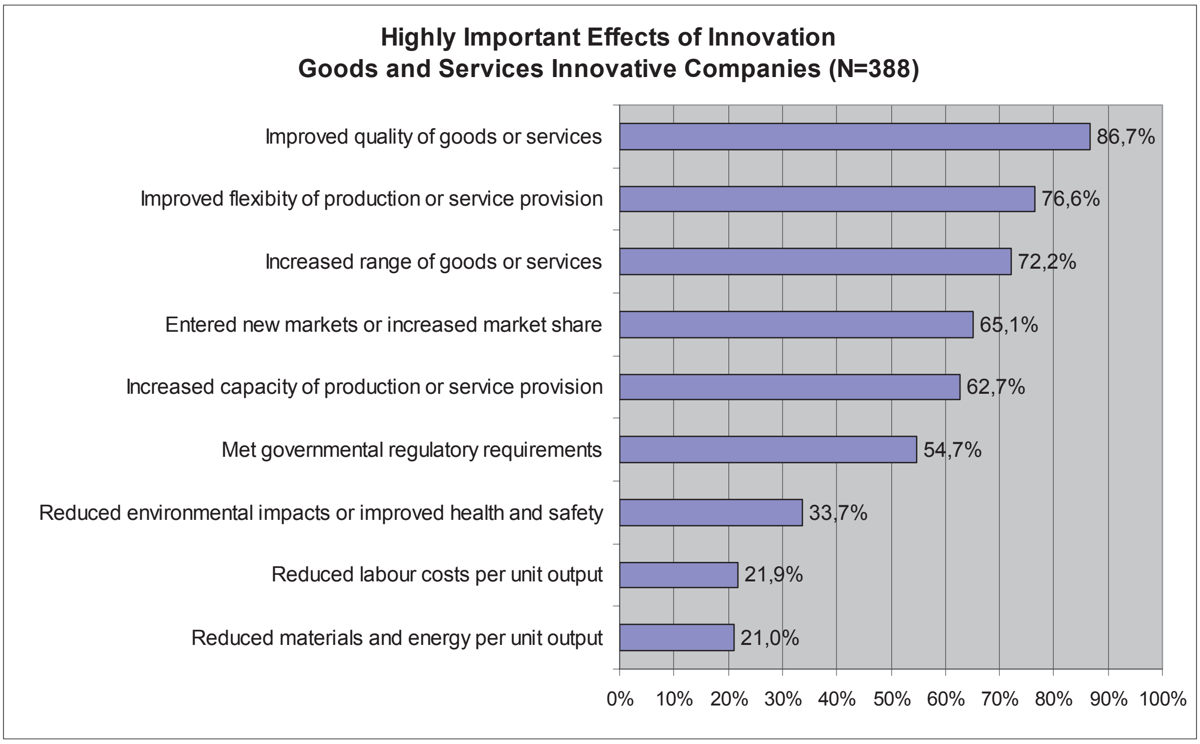


Fig. 16: Highly important effects of innovation in percentage (innovation active – goods and services only)

3.2.3.2 *Process Innovation*

Now the following section only takes a look at those enterprises, which are active in process innovation. The total number of this group counts 527 across all sectors and sizes. The results of this group will be compared to the group of product innovators analyzed in the section above. Generally, there are no major differences between the two groups so that the explanations and main results of the section above apply equally for product and process innovators.

The questionnaire distinguished between 3 types of process innovation activities. Companies are considered as process innovators, if they chose one of the following options:

- Introduction of new or significantly improved methods of manufacturing or new or significantly improved methods of producing goods or services
- Introduction of new or significantly improved logistics, delivery or distribution methods
- Introduction of new or significantly improved support activities for their processes.

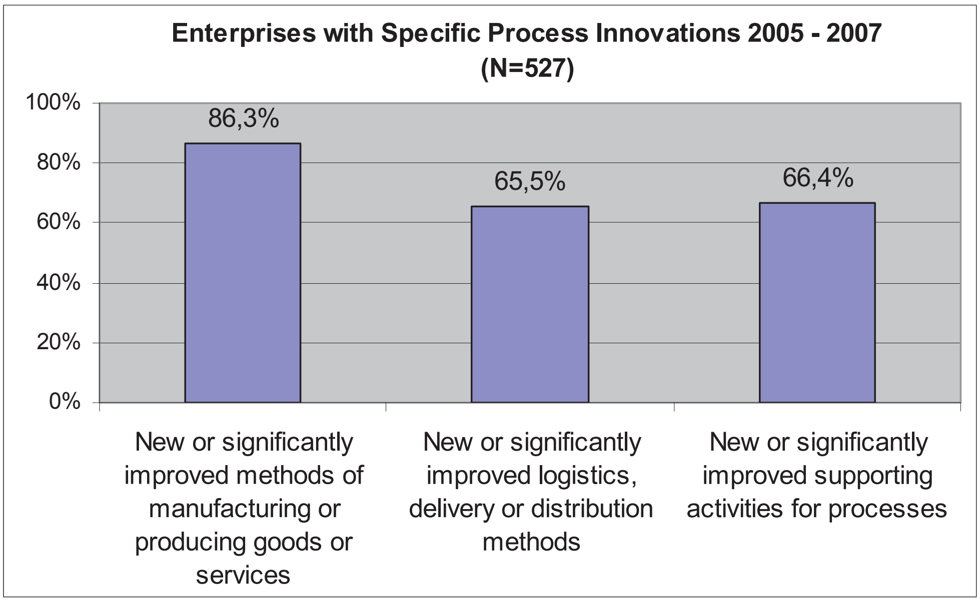


Fig. 17: Specific process innovations 2005-2007 in percentage (innovation active companies only – process innovations)

The figure above shows, that most companies introduced new or improved manufacturing or production methods for their goods and services. New logistics and supporting processes are considered almost equally important and were introduced by about 66% of process innovative enterprises.

The question about the responsibility for the innovations was answered by 519 enterprises – which equals 98,7% of the group with the result that innovations were mainly developed within the enterprise itself or with in the enterprise group (88,4%). Only a marginal percentage states, that other enterprises are involved or completely responsible for innovation activities.

In comparison with the group of product innovative enterprises (see previous section) this percentage is a little higher: compared to product innovators (7,2%), 8,6% of process innovators stated, that innovations were developed in cooperation with other enterprises.

The percentage of externally delivered innovations is almost equally low within both groups – product and process innovative enterprises.

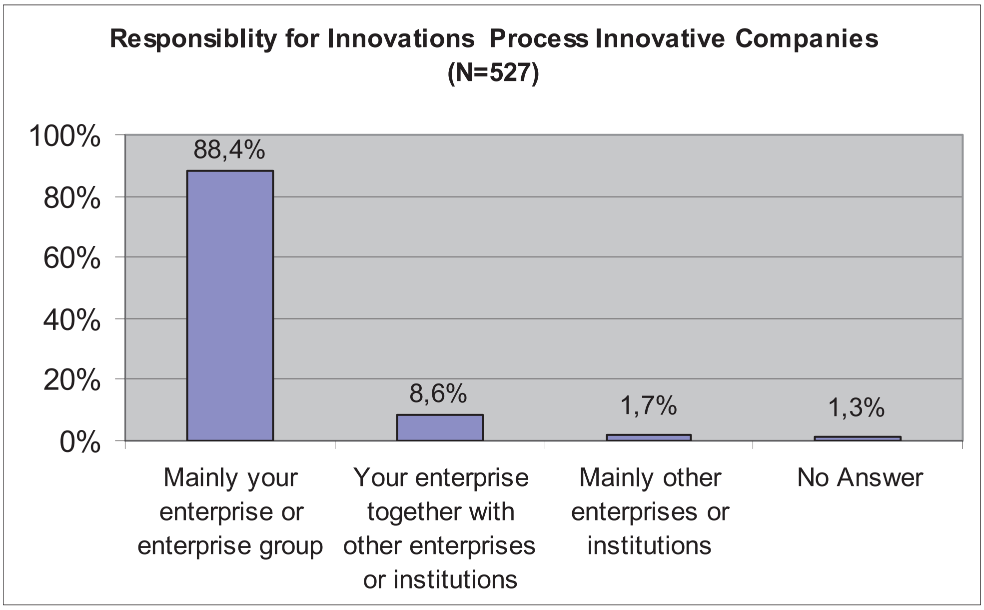


Fig. 18: Responsibility for innovations 2005-2007 in percentage (innovation active only – process innovations)

Just as for product innovative enterprises, the answers to the question whether these innovations originated in Egypt or abroad confirms the results which were just described in the paragraph above: the majority of innovations are realized within the enterprises themselves so that in consequence the majority of process innovations are coming from Egypt and from not abroad

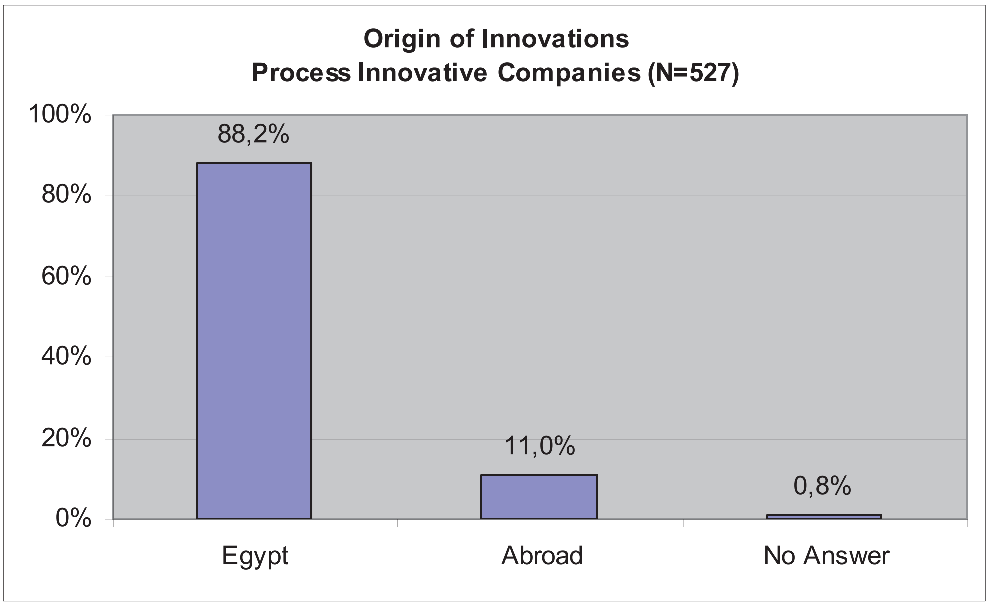


Fig. 19: Origin of innovations 2005-2007 in percentage (innovation active companies only – process innovations)

Just as for product innovative enterprises, the sources of information, which are used to plan or to establish an innovation activity are analyzed in detail in the following graph.

Generally, the results do not differ heavily between product and process innovative companies as already mentioned. Also for process innovative enterprises, the most important partners for innovation are their own enterprises or own enterprise groups, meaning that Egyptian enterprises rather prefer in-house R&D activities also in terms of process innovations. Nearly the same preference is given to cooperation's with clients or customers as well as suppliers.

Least important information sources are universities, research institutes and industry associations. Surprisingly, scientific journals are even more frequently used (18,1%) for information on latest developments than universities or research institutions (only about 7%). In consequence, a company which plans or is interested in implementing innovation activities would rather prefer to read a journal than asking an expert from research directly. This applies for product innovators as well.

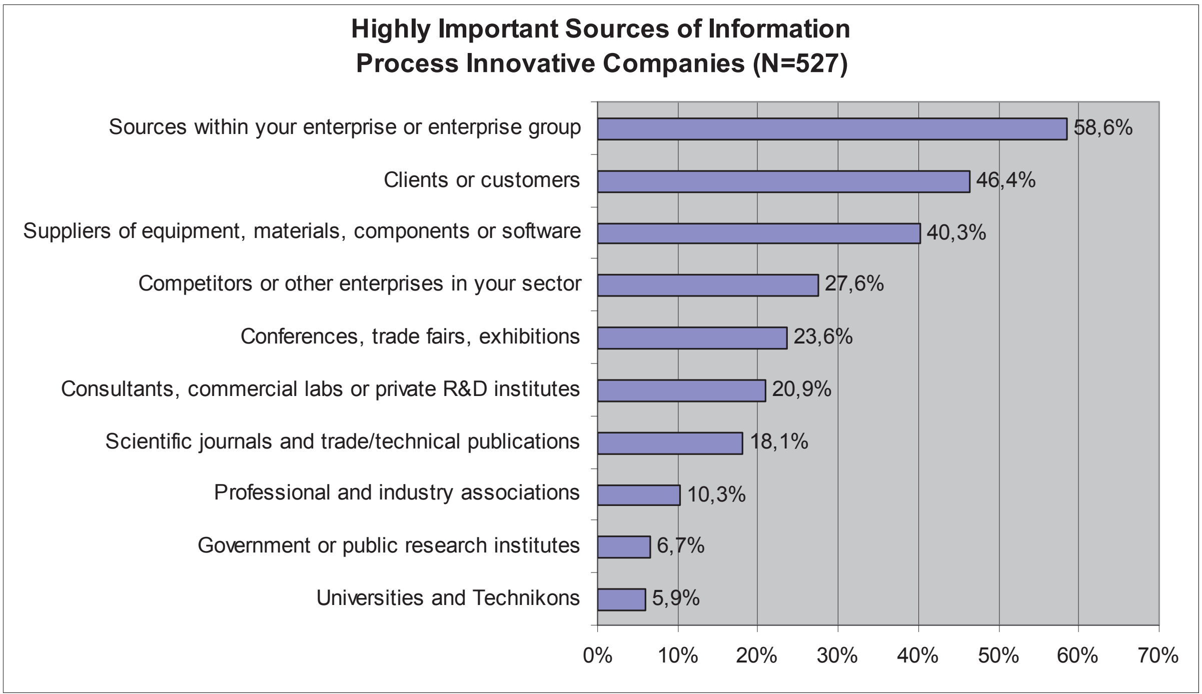


Fig. 20: Highly important sources of information in percentage (innovation active companies only – process innovations)

The effects of process innovations were generally assessed a little less important for enterprises than product innovations: for example, 75,3% of enterprises answered, that a process innovation could improve the quality of their goods and services. Compared to 86,7% of product innovators who stated this effect, a difference between these two groups is more than 11%.

The same applies for effects like “entering new markets” or “increased rage of goods” etc. In consequence, product innovation seems to have a more direct impact on a company’s performance than process innovation.

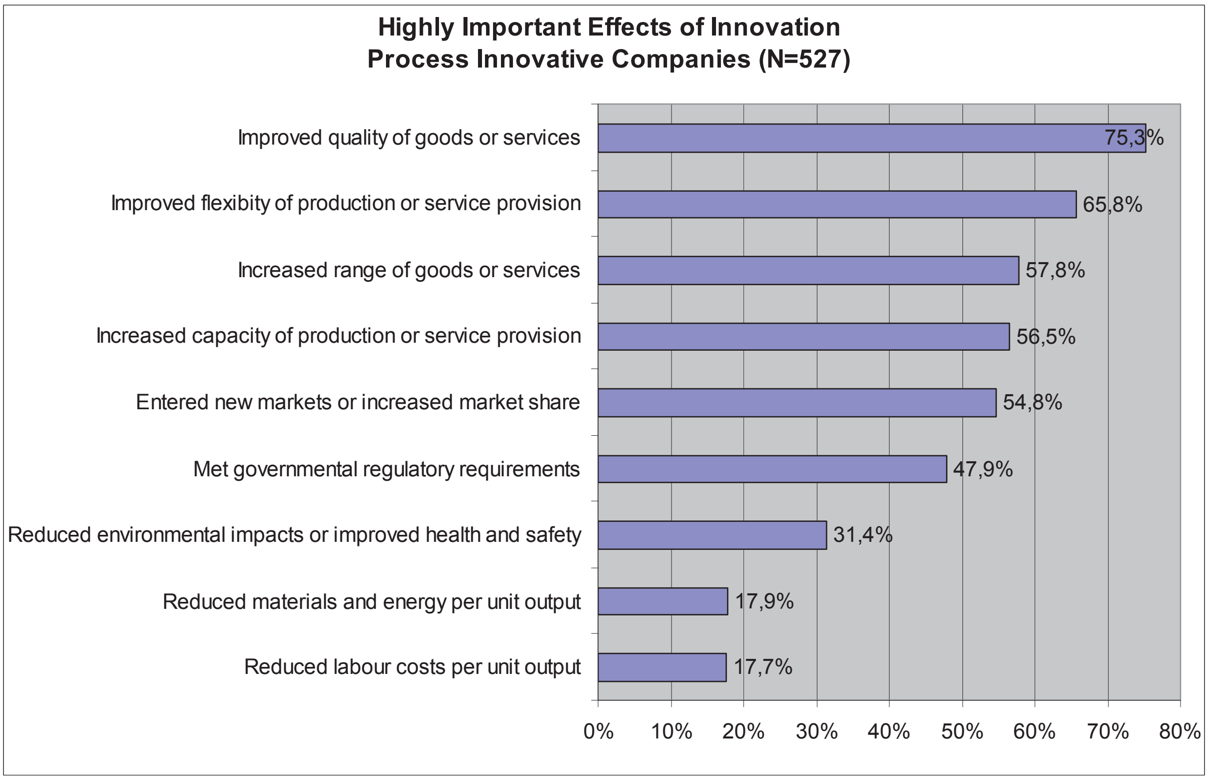


Fig. 21: Highly important effects of innovation in percentage (innovation active companies only – process innovations

3.2.4 Background Information: Prerequisites of Innovation

3.2.4.1 Abandoned and Ongoing Innovation Activities 2005-2007

The following figure reflects the ongoing and abandoned innovation activities during the years 2005 to 2007. Most of the companies seem to be engaged in long term innovation projects, as more than 65% of the innovation active companies answered, that their innovation activities were still ongoing after the end of the year 2007. Only 18% of the enterprises abandoned innovation efforts within this timeframe.

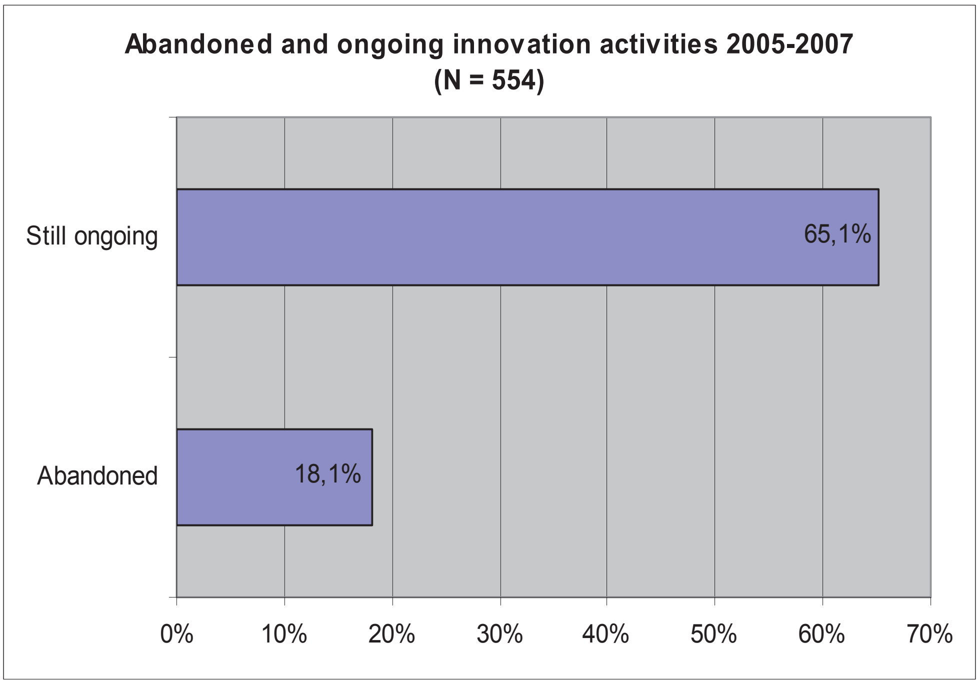


Fig. 22: Abandoned and ongoing innovation activities 2005 – 2007 in percentage (innovation active companies only)

3.2.4.2 Types of Innovation Activities 2005-2007

Enterprises were asked, in which kind of innovation activities they were engaged during the years 2005-2007. The following analysis describes the results of this question first for innovation active enterprises and second for all enterprises.

The answers to the question about type or nature of innovation efforts points out that the majority of enterprises is active in efforts related to the acquisition of new machinery, equipment or software (see Fig. 23). The second and third most common types of innovation activities are training and in-house R&D. As expected, only 31,5% (Extramural R&D) and 32,4% (Acquisition of external knowledge) of all innovation active enterprises are cooperating with external partners like other enterprises or R&D institutions in order to implement innovation activities.

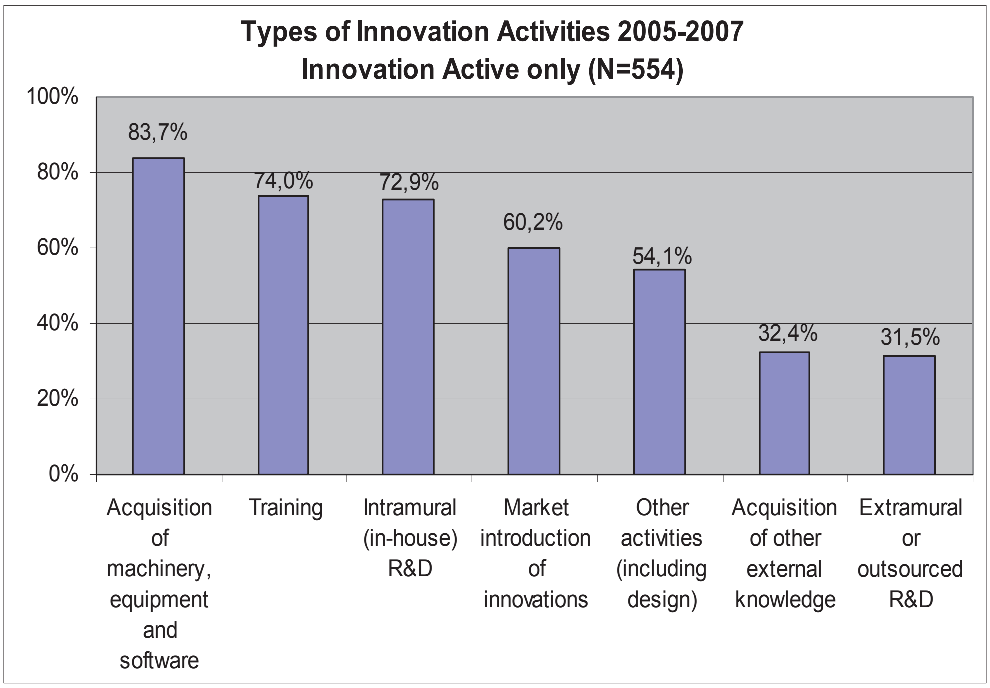


Fig. 23: Types of innovation activities 2005-2007 in percentage (innovation active companies only)

When looking at the answers to the same question of all companies, which participated in the study, the picture doesn't change significantly: most of the companies are acquiring new machinery, equipment and software in order to implement innovation activities, least common activities are the acquisition of external sources of innovation.

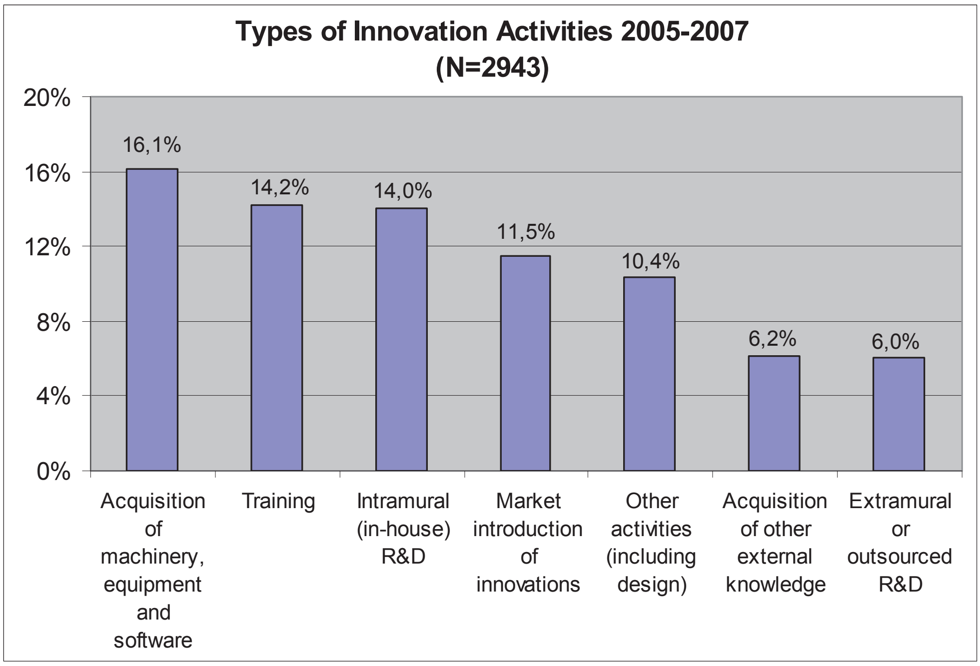


Fig. 24: Types of innovation activities 2005-2007 in total percentage (all companies)

3.2.4.3 *Public Financial Support for Innovation Activities 2005-2007*

Financial support from public authorities or institutions is an important prerequisite in order to motivate and encourage innovation activities in companies. Between the years 2005 and 2007 only a very small ratio of all companies involved in the study have received any kind of financial support from public institutions. 0,75% received support from national funding agencies, and another 0,75% received financial aids from foreign government or funds. Municipalities and Governorates seem to be almost inactive in financing corporate innovation. This indicates that official Egyptian efforts in supporting research and innovation in companies are still improvable, especially at local level.

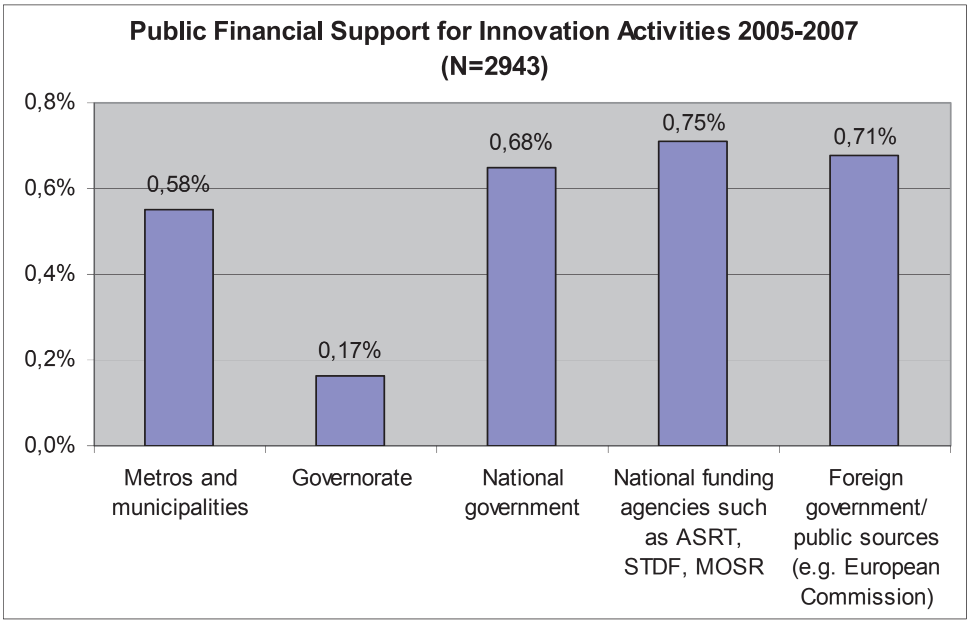


Fig. 25: Public financial support 2005-2007 in percentage (all companies)

When taking a closer look at the answers of innovation active companies only, the picture looks more promising. Fewer than 4% received support by national funding agencies, the Egyptian government and international governments. Nevertheless, foreign funding sources are almost equally used as Egyptian support instruments, which indicated a weak national system of innovation support programs and company support.

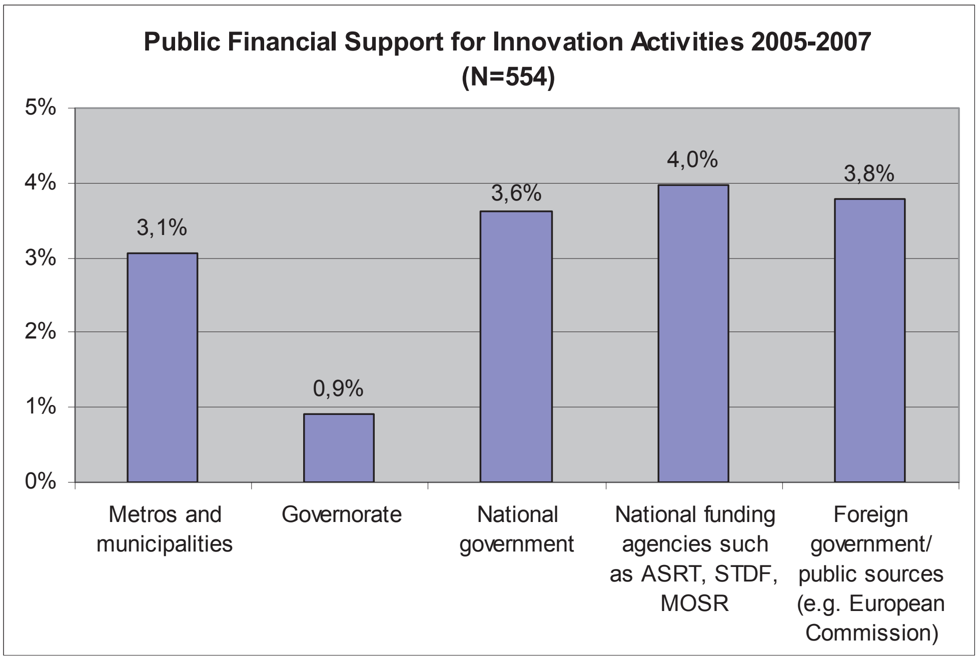


Fig. 26: Public financial support 2005-2007 in percentage (innovation active only)

3.2.4.4 *Barriers to Innovation*

Beyond resource considerations (as indicated by skills and expenditures), the academic literature is increasingly concerned regarding the extent of perceived barriers to innovation which hinder innovative activities. At this point, perceptions are more important than any objective measurement of constraints. If firms perceive any difficulty, they are likely to react to it regardless of its objective basis. To date, much of the debate (often focused upon smaller firms) has been concerned with the existence of financial constraints to innovation. However firms seem to be in fact 'know-how' constrained, rather than financially constrained. The access to adequately qualified personnel may be the principal barrier to innovation for most firms. Data from the CIS allows us to explore these issues.

The analysis for Egypt clearly shows that the decision not to innovate is made due to financial reasons. Lack of funding by their own enterprises or their enterprise groups is one of those reasons. Additionally, the innovation costs are considered as too high.

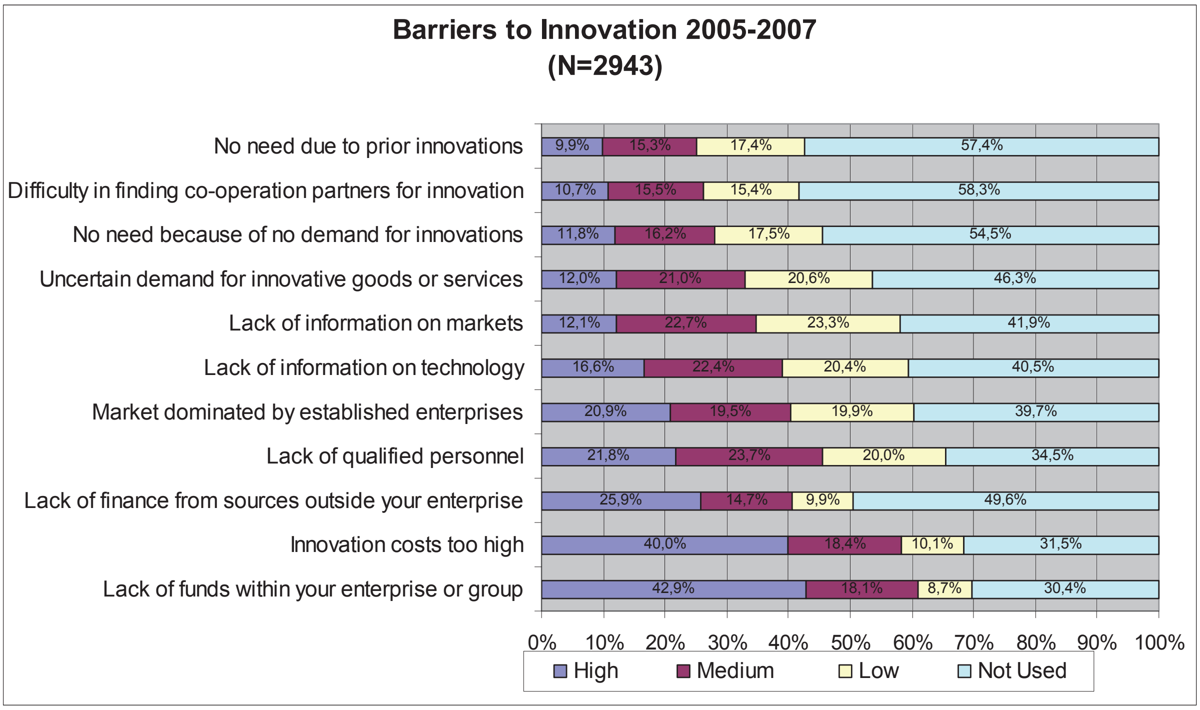


Fig. 27: Factors hampering innovation activities 2005-2007 (all companies)

Very low impacts on negative innovation decisions have factors like 'difficulties in finding partners for innovation' or 'uncertain demand and market situations'. An issue, which is not yet clearly outlined but does have a slight impact, is the lack of qualified personnel.

The following figure only shows the highly important factors, which hampered innovation in all companies.

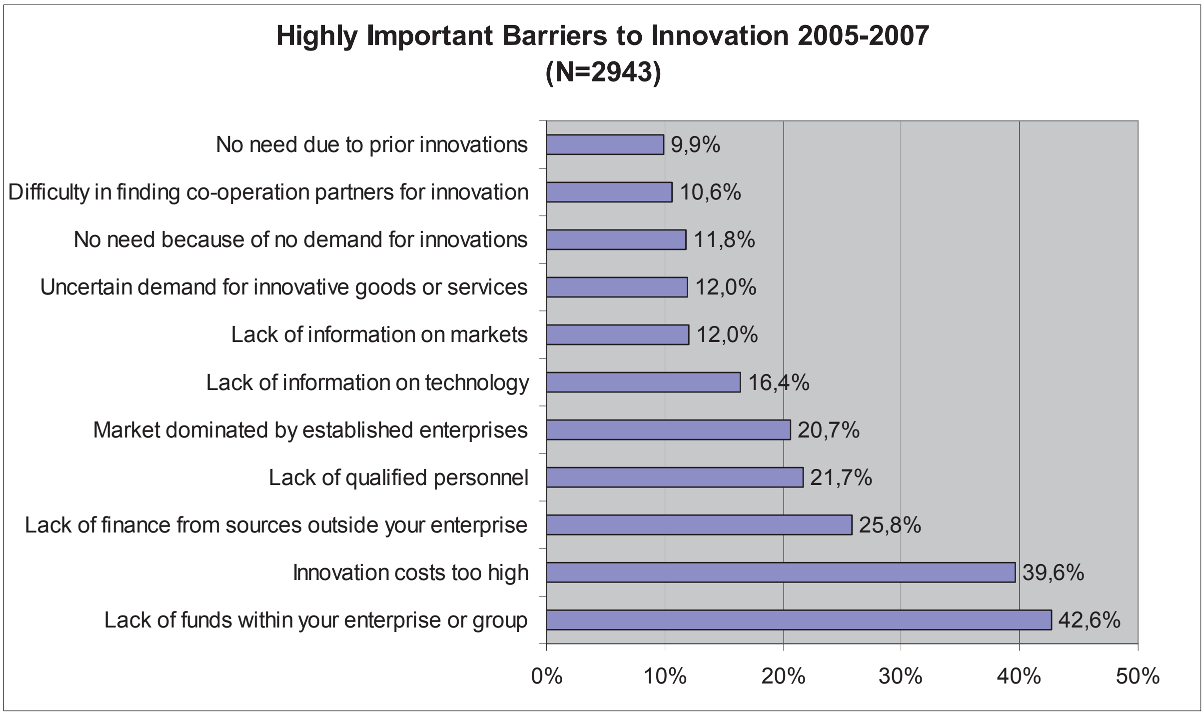


Fig. 28: Highly important factors that hampered innovation 2005-2007 in percentage (all companies)

The subsequent figure shows the answer to the question on highly important barriers of innovation only for innovation active companies. Within this group, the high costs for innovation are the most important barrier to innovation, the second factor is the lack of funding from the own enterprise. Consequently, innovation is mainly hampered by financial reasons.

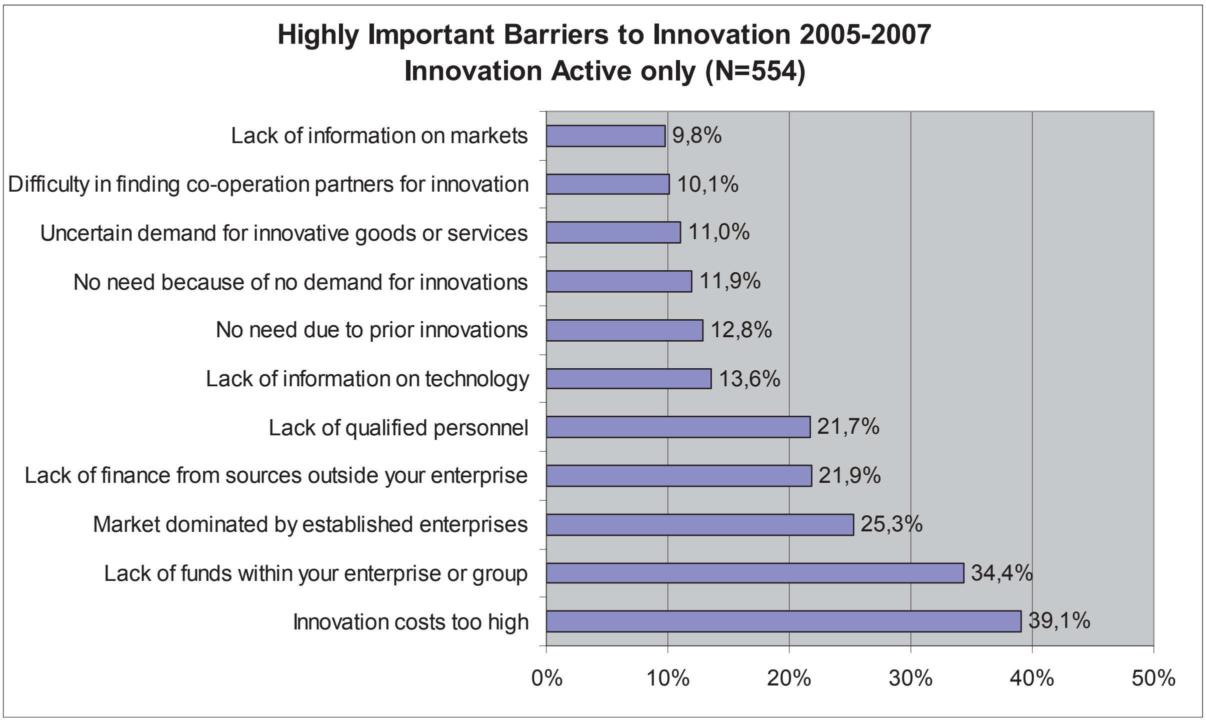


Fig. 29: Highly important factors that hampered innovation 2005-2007 in percentage (innovation active companies only)

The group of non innovative companies almost shows the same picture: lack of funds from the own company, from other companies and high innovation costs are the three main reasons, not to start innovation activities at all. On the other hand, the lack of qualified personnel, finding the right cooperation partners or the absence of innovation demand are less important barriers.

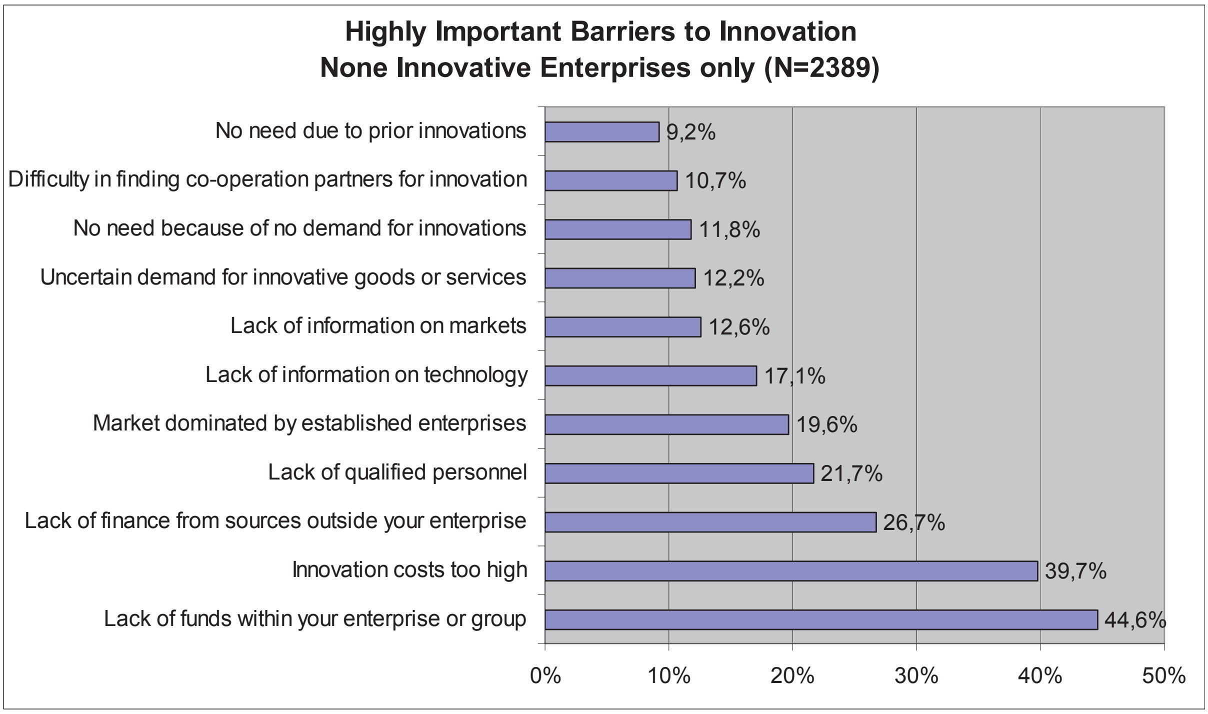


Fig. 30: Highly important factors hampering innovation in percentage (none-innovation active companies only)

3.2.4.5 IPR Issues

Traditionally, Egyptian companies are very retentive in applying for patents or making use of their IPR rights in general. The study shows, that at least 580 from all 2943 companies have registered a trademark during the past years. While 226 registered an industrial design and 111 claimed a copyright for their innovations, only 64 companies applied for a patent in Egypt. Even less companies are active on the international market and applied for a patent outside the country.

This last result corresponds to the results from questions about the responsibility as well as the origin of innovations (see sections 3.2.3.1 and 3.2.3.2). Here both, product and process innovators, stated that they are mostly active in the Egyptian market.

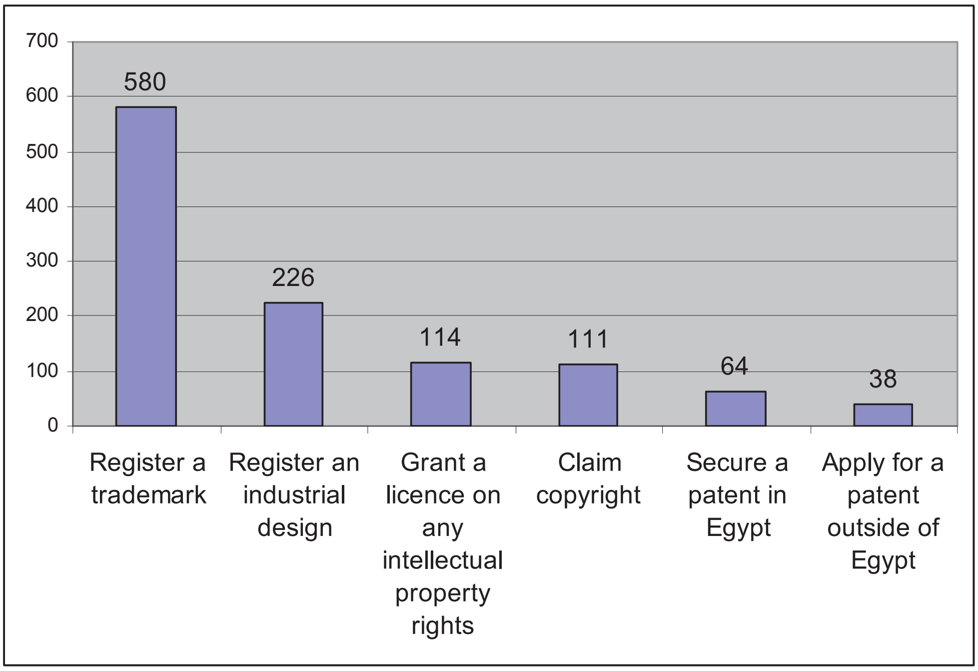


Fig. 31: Did your enterprise apply for or register one of the following options (all companies)?

3.2.4.6 *Organizational and Marketing Innovation*

In recognition of the fact that technical innovation (i.e. innovation in products and processes only) may capture only a small group of innovation outputs, the CIS included questions relating to the so called 'wider' innovation. It appears, that technical innovation to certain sectors, particularly services are less relevant. By exploring a wider set of technological change activities (in the broader sense of knowledge of tools and crafts, rather than concerning physical artifacts), it is hoped that the CIS may more adequately represent innovative activity in all the surveyed sectors. Unfortunately, the question relating to wider innovation was posed at the end of the questionnaire and therefore it is more difficult to relate these responses to other questions like sources of information or effect of innovation. Nonetheless, the following figure explores some of these issues.

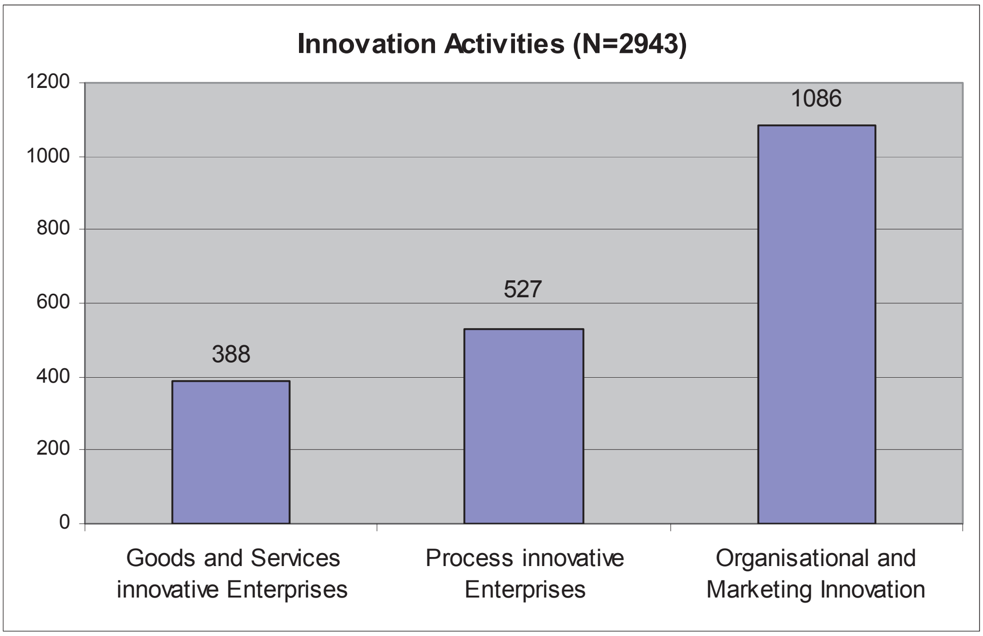


Fig. 32: Number of companies performing different types of innovation in total numbers (all companies)

Keeping the figure in mind, around 18% of all Egyptian companies are actively performing innovation activities in terms of process and product innovation. A total number of 40,9% is reached in the analysis if the answers concerning wider innovation activities are included in the analysis.

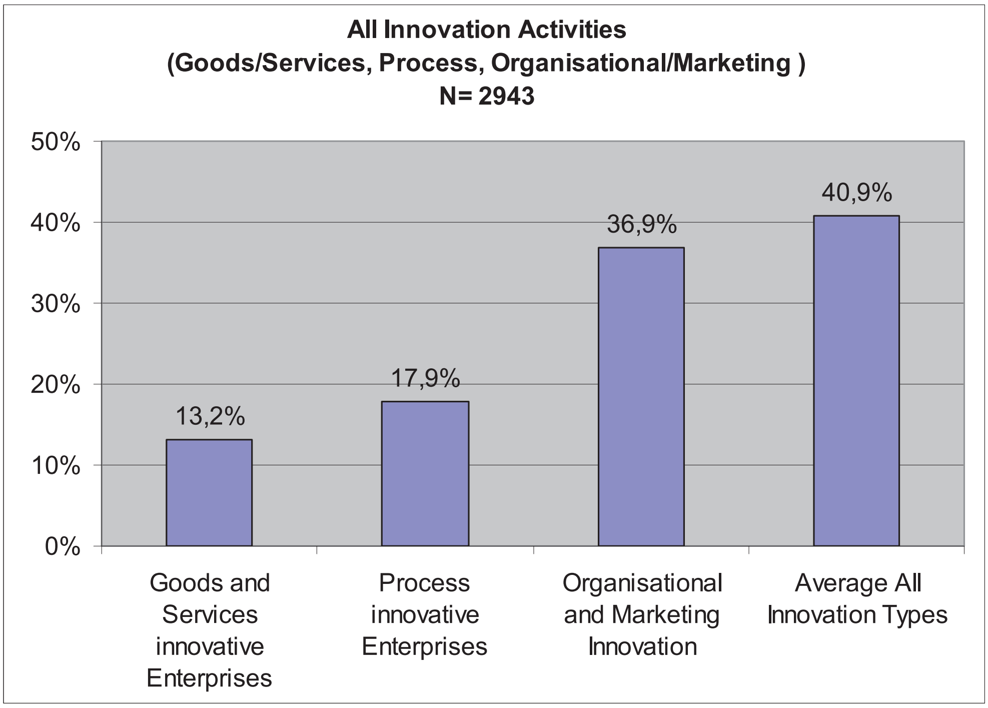


Fig. 33: Overview on innovation activities including organizational and marketing innovation (all companies)

Wider innovations include the following activities:

- New or significantly improved knowledge management systems for better use or exchange information, knowledge and skills within your enterprise
- Major changes to the organization of work within the enterprise, such as changes in the management structure or integrating different departments or activities
- New or significant changes in external relations with other firms or public institutions, like through alliances, partnerships, outsourcing or sub-contracting
- Significant changes to the design or packaging of a good or service
- New or significantly changed sales or distribution methods, such as internet sales, franchising, direct sales or distribution licenses.

Looking at the share of enterprises indicating one of these activities, the distribution is rather stable (see Fig. 34). Improved relations to externals like clients, customers or other institutions are the most common organizational improvements, while new distribution and sales methods are less usual.

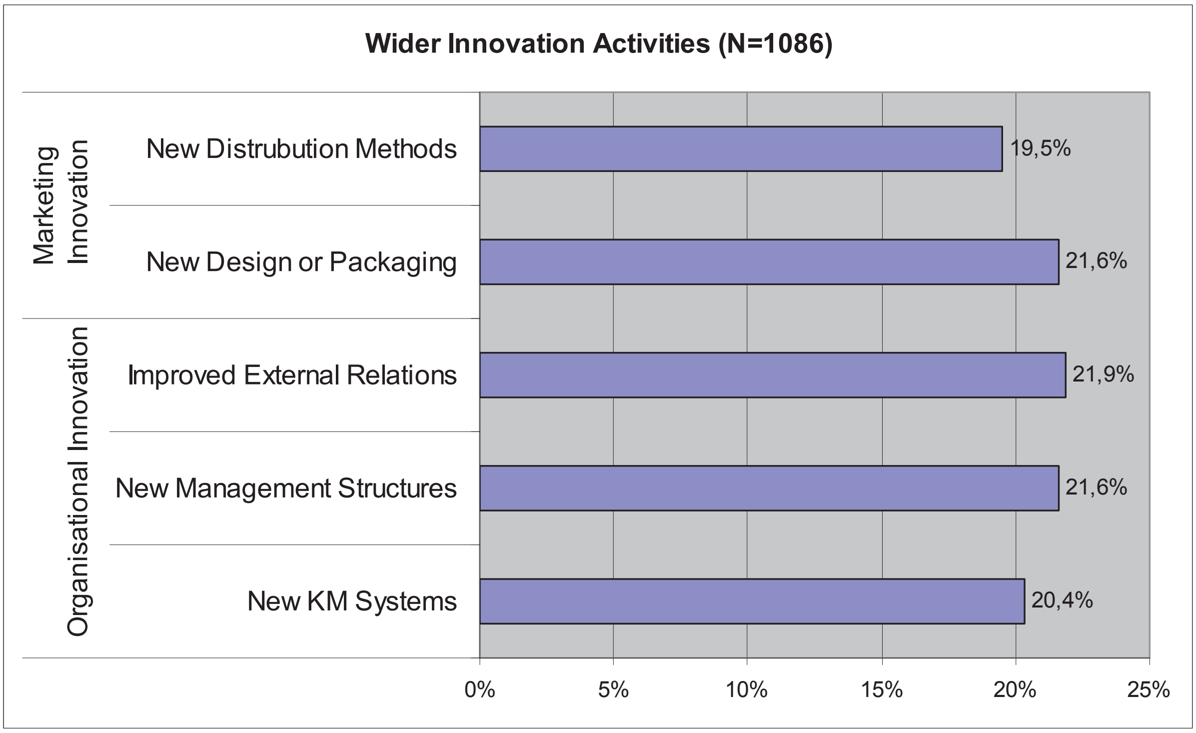


Fig. 34: Wider innovation activities in detail (innovation active companies only – marketing and organizational innovation)

Comparing the ratio per company size between all innovation types including wider innovation reveals a difference in the importance of the type of wider innovation. The bigger the company, the less innovation in terms of organizational structures is being introduced. Within companies above 1000 employees, the ratio between process, service, product and wider innovation is almost equally distributed (25%). Within smaller companies, the importance of service innovations seems to be rather low, while the importance of process innovations grows with the growth of company size.

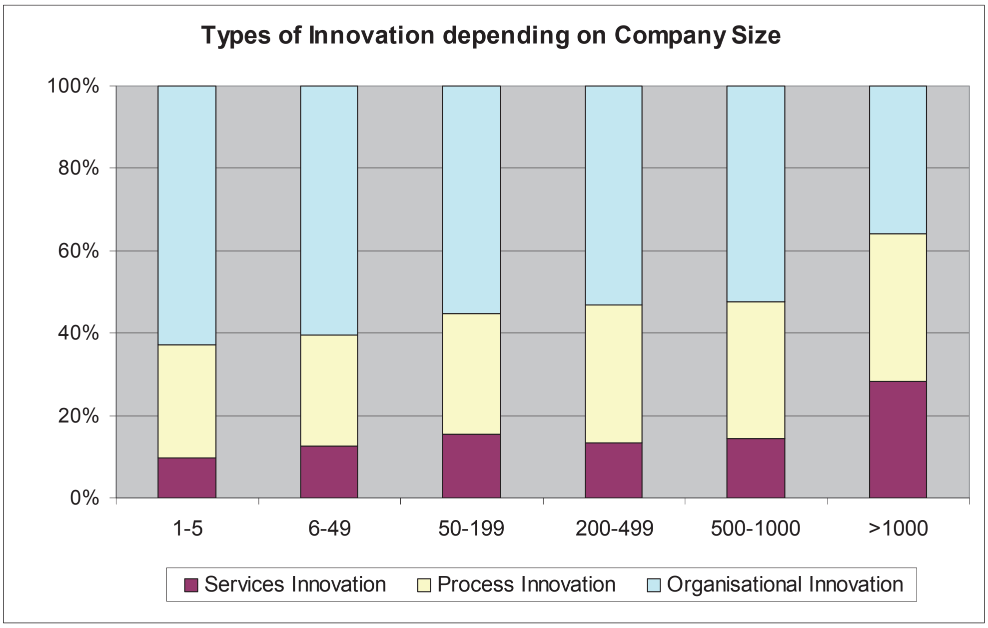


Fig. 35: Types of wider innovation per company size

Having a look at those companies, which are inactive in product or process innovation shows, that a respective part is either active in organizational or marketing innovation. It signals, that those companies are open for change and consider internal improvements as important for their future success.

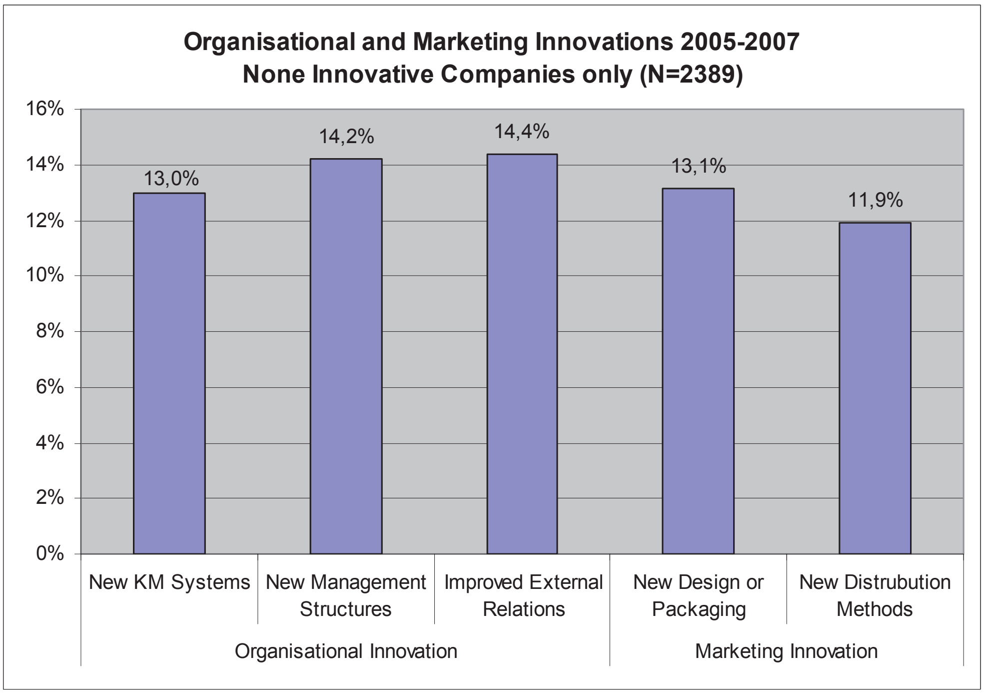


Fig. 36: Organizational and marketing innovation 2005 – 2007 in percentage (non innovation active companies only)

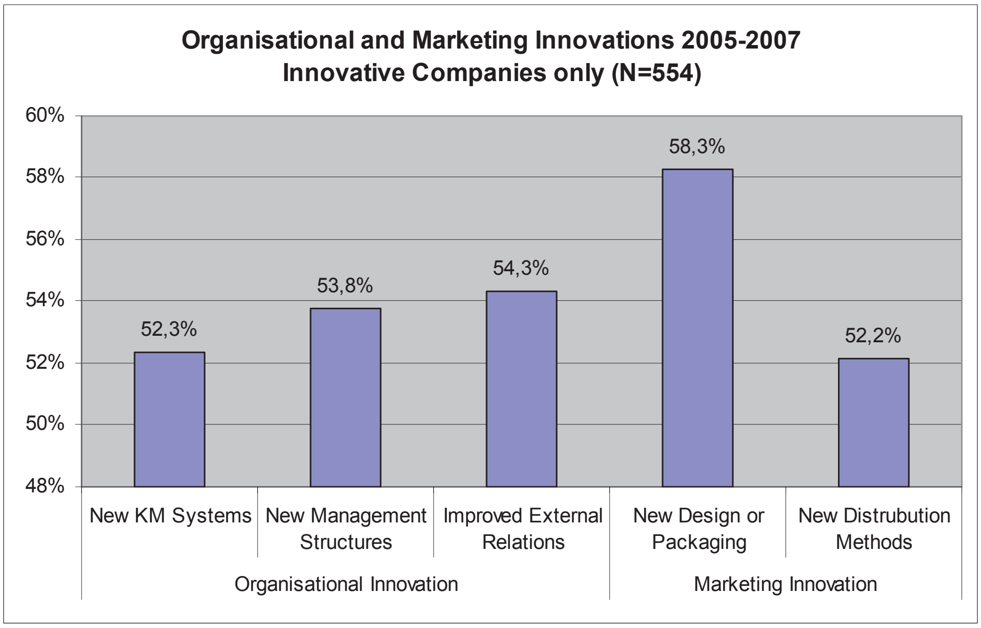


Fig. 37: Organizational and marketing innovation 2005-2007 in percentage (innovation active companies only)

4. Work Package 3 – National SRT Performance

As part of the whole project (Phase 1) work package 3, "National SRT Performance" based on R&D Indicators for Egypt will be described in the following section of this final report.

In order to assess the previous and present performance of Egypt's SRT system, first of all an R&D indicator analysis was conducted by the Egyptian Ministry of Higher Education and Scientific Research in Cairo. The data given in this report is mostly based on the research efforts and indicator calculations of the Ministry. This analysis will facilitate the identification of future perspectives and strategic goals, which have to be concentrated on.

Therefore the project in total will provide a detailed view on the present situation of R&D in Egypt as well as its future perspectives regarding the development of the Egyptian science and technology system.

4.1 Special Objectives of this Work Package

The R&D indicator analysis pursues in a narrower sense the following objectives:

- Assessment of Egypt's R&D capability
- Analysis of the Egyptian position in terms of R&D in relation to its economy
- Cost-effectiveness of Egypt's R&D
- Identification of specialized fields of science in Egypt
- Assessment of Egypt's R&D performance by international comparison with selected foreign and MENA countries
- Assessment of the concordance between scientific activities and specific industrial needs

4.2 Methodology and Structure of this Report

The R&D indicator analysis encompasses a number of tools, which have been considered as necessary in order to achieve useful results:

- Desktop Research (national/international statistics, documents, databases)
- Indicator Analysis in Egypt
- International Benchmarking (mostly by selected UNESCO, OECD and MENA countries).

Based on the results of the indicator analysis a synthetic assessment is derived in the conclusion section that comprises the following features:

- Assessment of the role of high-tech in the Egyptian industry
- Assessment of the matching of research, development and production activities
- Assessment of the efficiency of R&D in Egypt

4.3 Selection of R&D Indicators

Within the scope of this analysis, a range of important and commonly applied R&D indicators was considered and selected in terms of the availability of data and the relevance of results for this project.

4.3.1 Overview of Important R&D Indicators

The following gives an overview of important R&D indicators that can be found in the literature (e.g. Grupp, H. 1997; OECD 1993; OECD 1997).

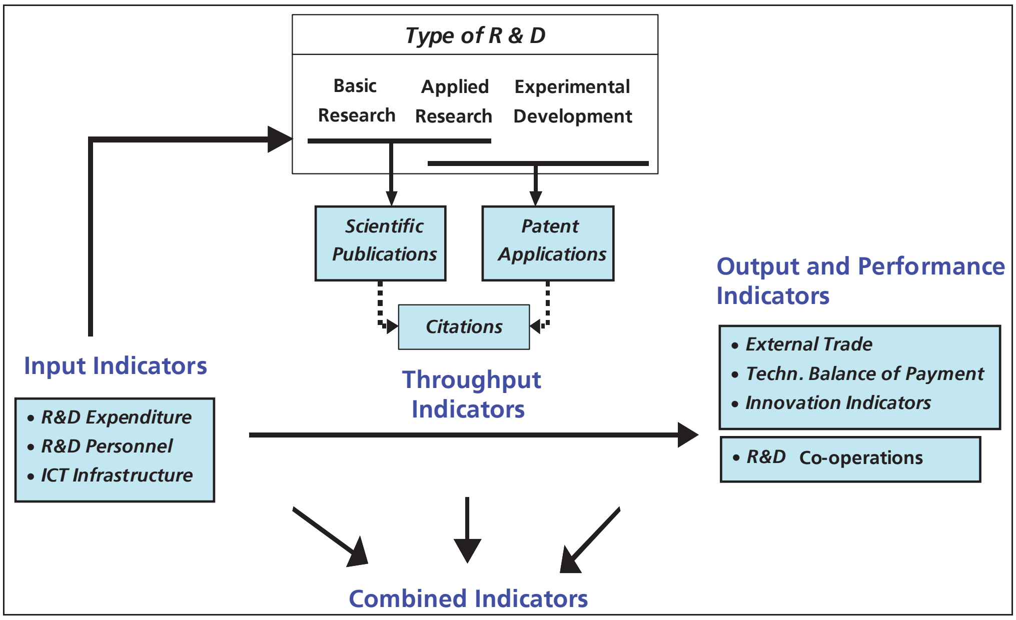


Fig. 38: Overview of important R&D indicators

R&D indicators are typically divided into input, throughput and output indicators.

Selected input indicators are:

- R&D Expenditure:
- Gross Domestic Expenditure on R&D
- R&D Intensity (R&D expenditure / GDP)
- R&D Personnel (total R&D personnel, total scientists and engineers)

Selected throughput indicators (scientific output indicators) are:

- Bibliometric Indicators:
- Number of scientific articles and citations (total and by selected fields of science)
- Citation rates
- Patent Indicators

Selected output indicators (technological and economic output indicators) are:

- External Trade in High-Tech Products (imports / exports)

4.3.2 Data Requirements and Available Sources

R&D performance in Egypt was studied considering the following delimitations:

- Maximum observation period of 3 years
- Data used for comparison from national and international level
- Considering different fields of science
- Considering different classifications of R&D activities
- Considering different industrial classifications

4.4 R&D Indicator Analysis

The world devoted 1,7% of gross domestic product (GDP) to R&D in 2002. In monetary terms, this corresponds to 830 billion US$, according to estimates by the UNESCO Institute for Statistics (December 2004). These global distributions conceal huge discrepancies. They reflect the enormous divide in terms of development, prosperity, health and participation in the world economy but also in world affairs in general.

The question is, what is the role of the Arab states, especially Egypt, concerning R&D production in the world and what are the challenges for Egypt on the way towards a knowledge economy?

It will take a handful of indicators to answer these questions. Looking at several indicators, there is no doubt that there are wide margins between the scores of regions or countries.

Distinctions can be identified between several regions. Only a few countries in the world are producing science and are benefiting from it. To give an overview of the scientific activities worldwide, it is useful to compare the GERD/GDP-ratio for several countries and areas. The following figure presents gross domestic expenditure on R&D (GERD) as a percentage of the gross domestic product (GDP).

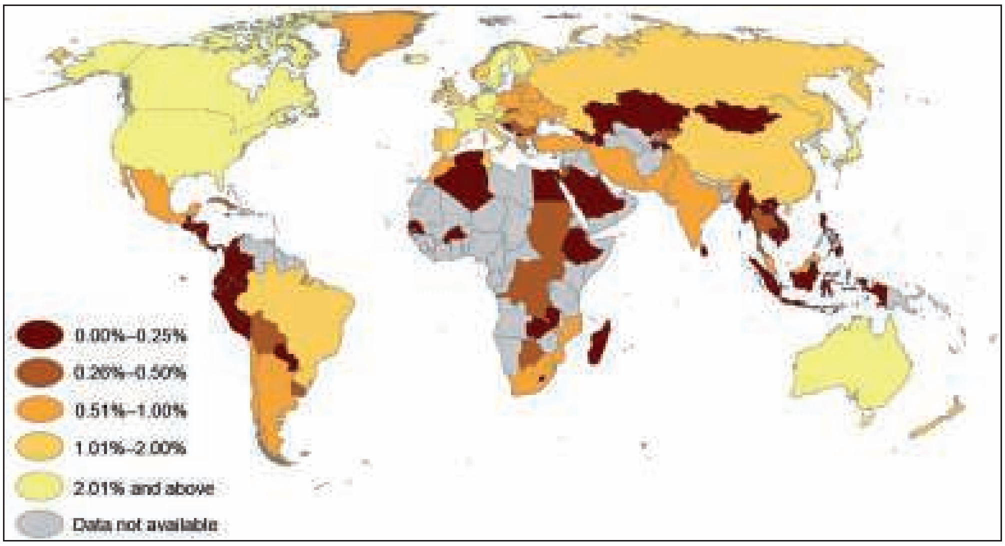


Fig. 39: Gross domestic expenditure on R&D as a percentage of GDP, 2007 or latest available year

Source: UNESCO Institute for Statistics estimates, September 2009

The UNESCO Institute for Statistics estimates an increase of the world R&D expenditure from 2002 to 2007 by 44% in absolute terms. In relative terms, 1,7% of the world's GDP was devoted to R&D also in 2007. Nevertheless, the gross expenditure on R&D as a percentage of GDP in Egypt is still on a rather low level with 0,2% only.

To give some more details on the current situation in Egypt in terms of GDP as well as of the GERD as percentage of GDP, the following analysis was performed by the Egyptian Ministry for Higher Education and Scientific Research.

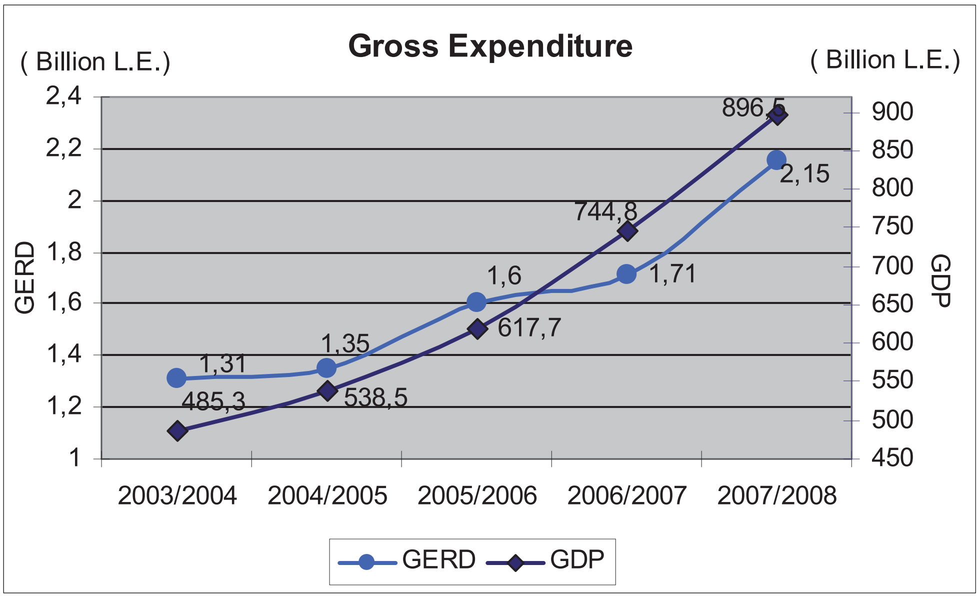


Fig. 40: Gross expenditure on R&D

It can be seen, that the GDP has increased tremendously from 485.2 billion Egyptian Pounds in 2003/2004 to 896.5 billion Egyptian Pounds in 2007/2008. This indicates a growth rate of 85% within 4 years. In terms of the gross expenditure on R&D the expenditures increase from 1.31 billion Egyptian Pounds in 2003/2004 to 2.15 billion Egyptian Pounds in 2007/2008, which equals a growth rate of 60% based on the calculations and statistics of Egyptian Ministry for Higher Education and Scientific Research.

In terms of the GDP at market prizes and the current total expenses of the state the following figure indicates that in 2003/2004 the total expenses of the state counted 146 billion Egyptian Pounds compared to 244.1 2007/2008, which is an increase of about 67%. Compared to the growth of the GDP of 84% between 2003/2004 and 2007/2008 and the growth of the total expenses of the state are smaller. In one of the next paragraphs it will be explained and shown, that the same kind decline stands for the public expenditures on R&D as well as for the gross expenditures on R&D.

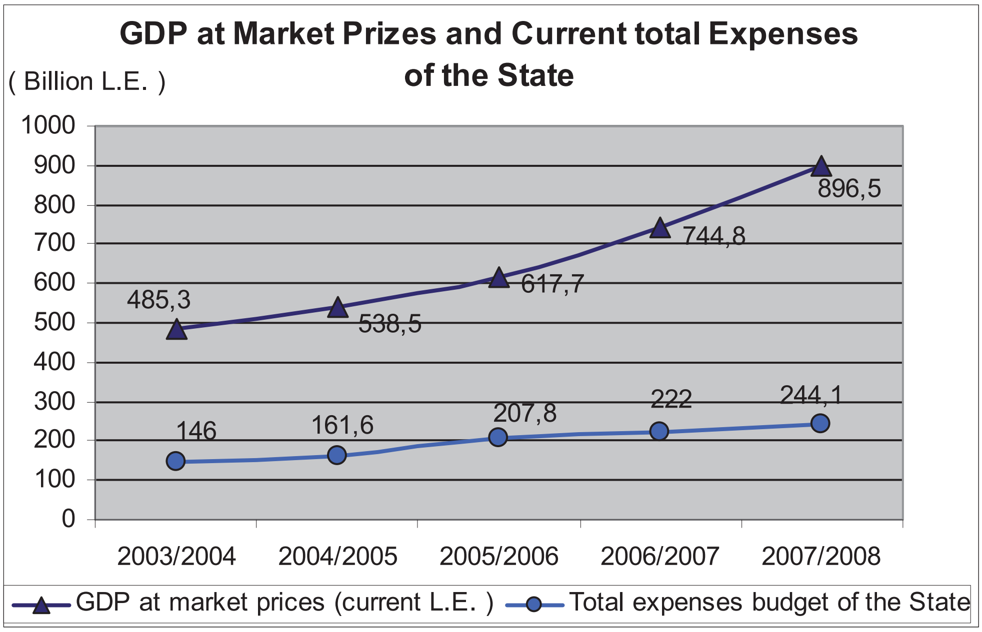


Fig. 41: GDP at market prizes and current total expenses of the state

The next figure also shows the analysis of differences among selected countries in terms of the Egyptian GDP compared to some MENA countries (Middle East and North Africa).

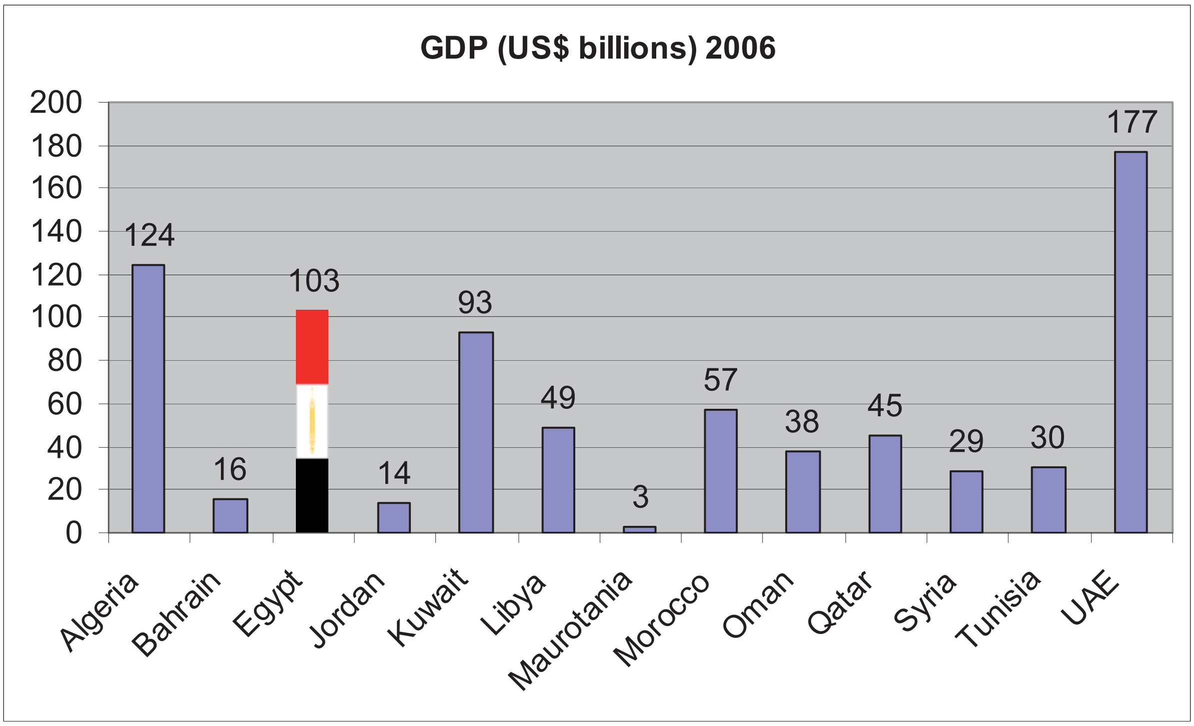


Fig. 42: Egyptian GDP compared to MENA countries

Compared to the other selected countries, Egypt's gross expenditures on R&D is rather small. Hence, less than 2% of the national GDP is spent on R&D.

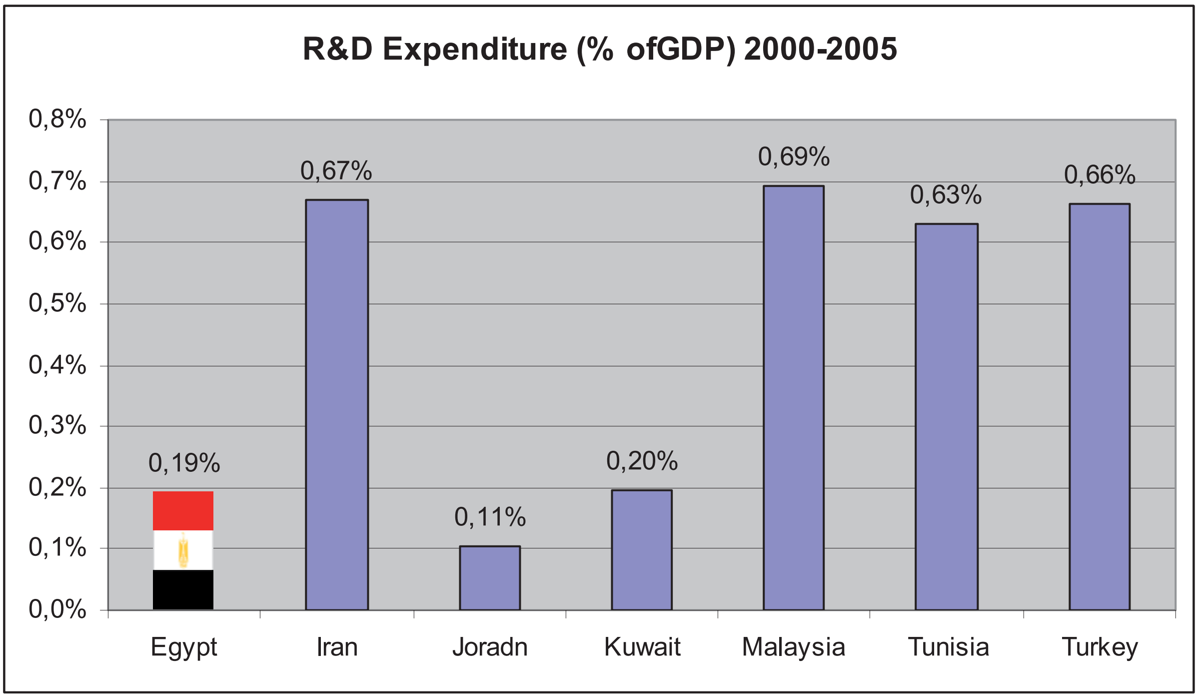


Fig. 43: Egyptian gross expenditure on R&D (2000-2005) compared to other countries

A further analysis comes to a similar result. Globally, in 62 out of 106 analyzed countries, the percentage of GDP devoted to R&D has significantly increased. The following figure illustrates this trend in R&D expenditure between 1996 and 2007 for those countries with a R&D-intensity below 1.5% in both years. ***It can be seen that in terms of Egypt the R&D expenditures are still on a rather low level, but stable.***

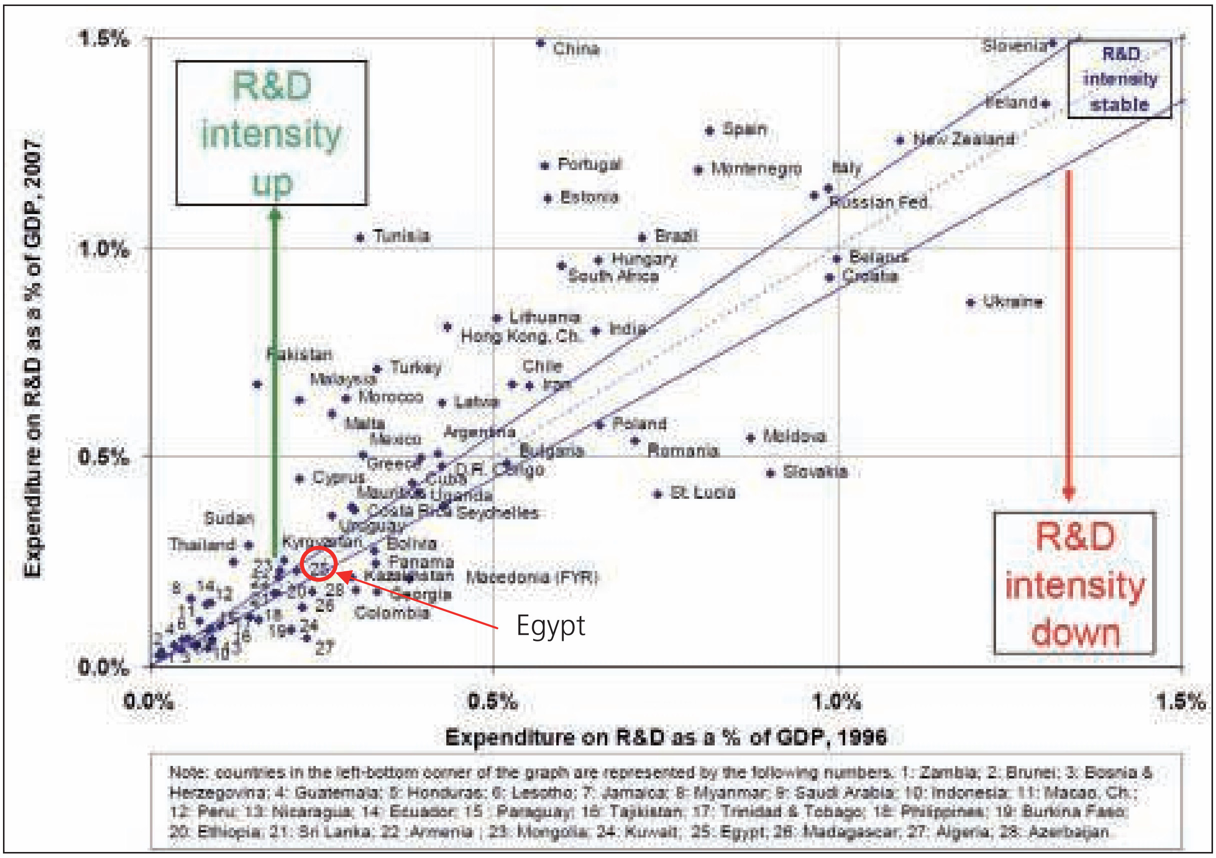


Fig. 44: GERD as a percentage of GDP, 1996 (or earliest available year) and 2007 (or latest available year), countries with R&D intensity below 1.5% in both years.

Source: UNESCO Institute for Statistics estimates, September 2009

To give some more details on R&D key indicators, the following figure indicates the world gross domestic product (GDP), population, gross expenditure on R&D (GERD) and personnel in 2002.

KEY INDICATORS ON WORLD GDP & GERD	GDP (in billions)	Population (in millions)	GERD (in billions)	GERD % world	GERD / GDP %	GERD per inhabitant
World	**47 599.4**	**6 176.2**	**829.9**	**100.0**	**1.7**	**134.4**
Developed countries	28 256.5	1 195.1	645.8	77.8	2.3	540.4
Developing countries	18 606.5	4 294.2	183.6	22.1	1.0	42.8
Less-developed countries	736.4	686.9	0.5	0.1	0.1	0.7
Americas	**14 949.2**	**849.7**	**328.8**	**39.6**	**2.2**	**387.0**
North America	11 321.6	319.8	307.2	37.0	2.7	960.5
Latin America and the Caribbean	3 627.5	530.0	21.7	2.6	0.6	40.9
Europe	**13 285.8**	**795.0**	**226.2**	**27.3**	**1.7**	**284.6**
European Union	10 706.4	453.7	195.9	23.6	1.8	431.8
Comm. of Ind. States in Europe	1 460.0	207.0	17.9	2.2	1.2	86.6
Central, Eastern and Other Europe	1 119.4	134.4	12.4	1.5	1.1	92.6
Africa	**1 760.0**	**832.2**	**4.6**	**0.6**	**0.3**	**5.6**
Sub-Saharan countries	1 096.9	644.0	3.5	0.4	0.3	5.5
Arab States Africa	663.1	188.2	1.2	0.1	0.2	6.5
Asia	**16 964.9**	**3 667.5**	**261.5**	**31.5**	**1.5**	**71.3**
Comm. of Ind. States in Asia	207.9	72.6	0.7	0.1	0.4	10.3
Newly Indust. Asia	2 305.5	374.6	53.5	6.4	2.3	142.8
Arab States Asia	556.0	103.9	0.6	0.1	0.1	6.2
Other Asia	1 720.0	653.7	1.4	0.2	0.1	2.1
Oceania	**639.5**	**31.8**	**8.7**	**1.1**	**1.4**	**274.2**
Other groupings						
Arab States All	1 219.1	292.0	1.9	0.2	0.2	6.4
Comm. of Ind. States All	1 667.9	279.6	18.7	2.2	1.1	66.8
OECD	28 540.0	1 144.1	655.1	78.9	2.3	572.6
Selected countries						
Argentina	386.6	36.5	1.6	0.2	0.4	44.0
Brazil*	1 300.3	174.5	13.1	1.6	1.0	75.0
China	5 791.7	1 280.4	72.0	8.7	1.2	56.2
Egypt*	252.9	66.4	0.4	0.1	0.2	6.6
France	1 608.8	59.5	35.2	4.2	2.2	591.5
Germany	2 226.1	82.5	56.0	6.7	2.5	678.3
India*	2 777.8	1 048.6	20.8	2.5	0.7	19.8
Japan	3 481.3	127.2	106.4	12.8	3.1	836.6
Mexico	887.1	100.8	3.5	0.4	0.4	34.7
Russian Federation	1 164.7	144.1	14.7	1.8	1.3	102.3
South Africa	444.8	45.3	3.1	0.4	0.7	68.7
United Kingdom	1 574.5	59.2	29.0	3.5	1.8	490.4
United States of America	10 414.3	288.4	290.1	35.0	2.8	1005.9

* GERD figures for Brazil, India and Egypt are all for 2000.
Note: For Asia, the sub-regional totals do not include China, India or Japan.

Fig. 45: Global R&D Indicators

Source: UNESCO Institute for Statistics estimates, December 2004

The shares of North America and Europe in world GERD are on a gently downwards sloping path. **North America** was responsible for 38,2% of world GERD in 1997 but 37% in 2002. For **Europe**, the corresponding indicators are 28,8% in 1997 and 27,3% in 2002.

The most remarkable trend is to be found in **Asia**, where GERD has grown from a world share of 27,9% in 1997 to 31,5% in 2002. As for the remaining regions, **Latin America and the Caribbean**, **Oceania** and **Africa**, these each account for just a fraction of the total, at respectively 2,6% (down from 3,1% in 1997), 1,1% (stable) and 0,6% (stable).

Another remarkable fact is, that all Arab States together were only responsible for 0,2% of world GERD in 2002. This is a first indicator that the Arab States are faced with great challenges to become a value-based knowledge economy. This counts for Egypt as well.

To unearth, where the interesting dynamics are taking place and where there is a genuine cause for concern, we need to go into detail.

In **North America**, there are some discrepancies and these are naturally of some concern to local and state governments. R&D is concentrated in a small number of states: in the USA, for example, 60% of all R&D is carried out in just six states, with California alone accounting for 20%.

With 25 Members since the accession of ten new countries from Central, Eastern and Southern Europe in May 2004, the **European Union (EU)** now accounts for 90% of European GERD. No doubt the ten new member countries will 'catch up' by attracting greater investment in R&D and generating higher levels of income. It is a natural process and does not imply a trend simply towards de-concentration. R&D budget of the EU represents just 5% of public expenditure and demonstrates there is no such thing yet as a truly European R&D market.

As far as **Asia** is concerned, it is now clear that the so-called Newly Industrialized Asian economies, together with **China** and, to a lesser extent, **India** have become serious contributors to world GERD and to the stock of knowledge. In 2002, **China** contributed 8,7% of world GERD, up from 3,9% in 1997. This compared with 6,4% for the Newly Industrialized Asian economies, up from 3,9% in 1997, even if the percentage remained stable between 1997 and 2000. **India** contributed 2,5% to world GERD in 2000, up from 2% in 1997. The complicated political scene and slowly broadening technological base – now firmly rooted in information and communications technology (ICT), space, pharmaceuticals and biotechnology – are moving India slowly upwards.

By looking at the public expenditure on education as percentage of GDP in Egypt and selected countries, the picture for Egypt is different compared to the gross expenditure on R&D, as shown in the following figures.

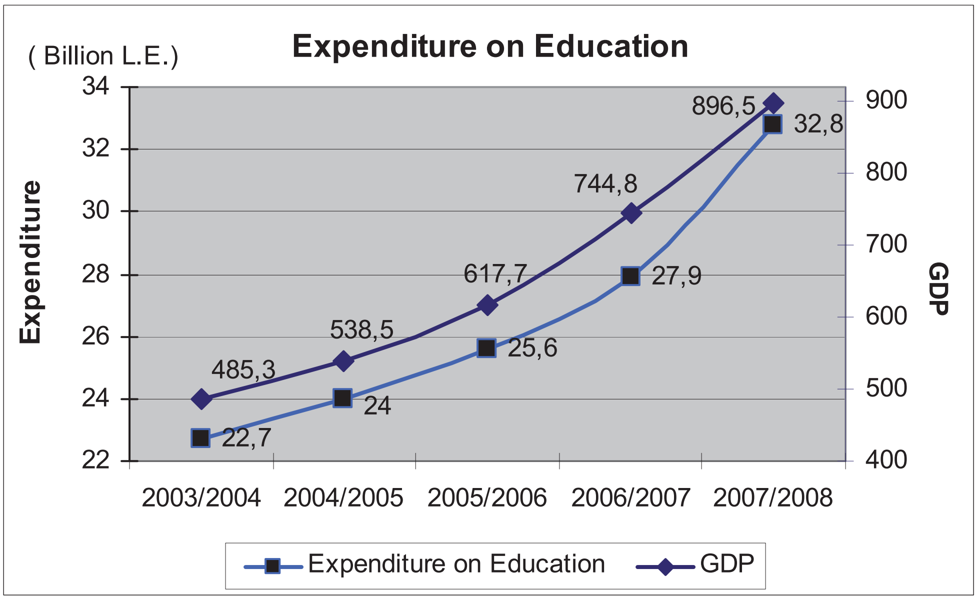


Fig. 46: Egypt's expenditure on education

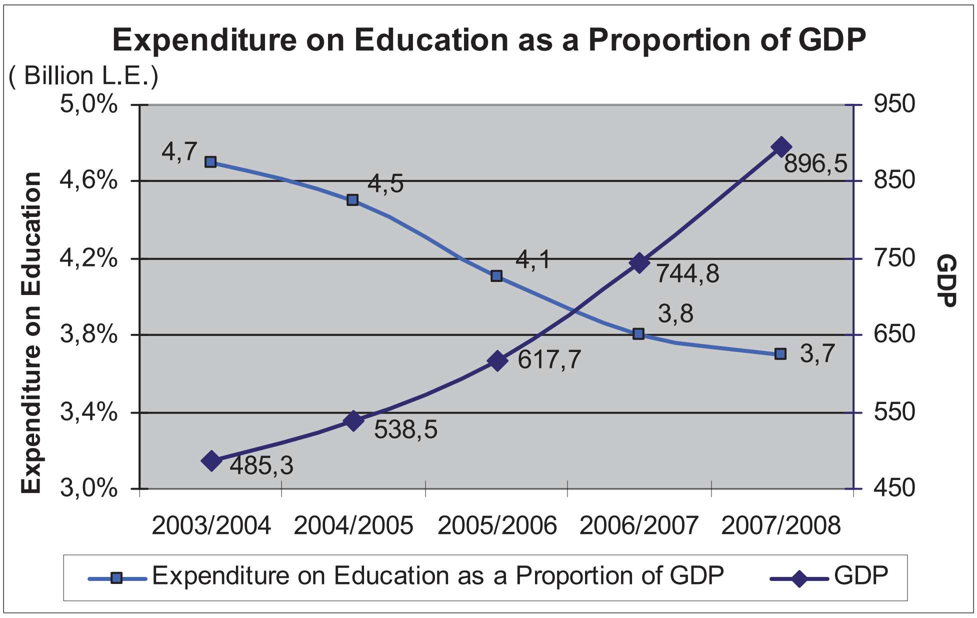


Fig. 47: Expenditure on education as a proportion of GDP

The expenditure on education was continually increasing during the last years from 22.7 billion Egyptian Pounds in 2003/2004 to 32.8 billion Egyptian Pounds in 2007/2008. This is an increase by more than 44% within 4 years.

Nevertheless, by comparing the growth of GDP from 485.3 billion Egyptian Pounds in 2003/2004 to 896.5 billion Egyptian Pounds in 2007/2008 (>84%), the ratio of expenditures on education as a proportion of GDP did decrease from 4.7 % in 2003/2004 to 3.7% in 2007/2008.

The overall public expenditures on education as a percentage of the gross domestic product (GDP) are illustrated in the following figure together with a comparison to other countries in MENA. It can be seen, that in 2005 the ratio was 4.5%.

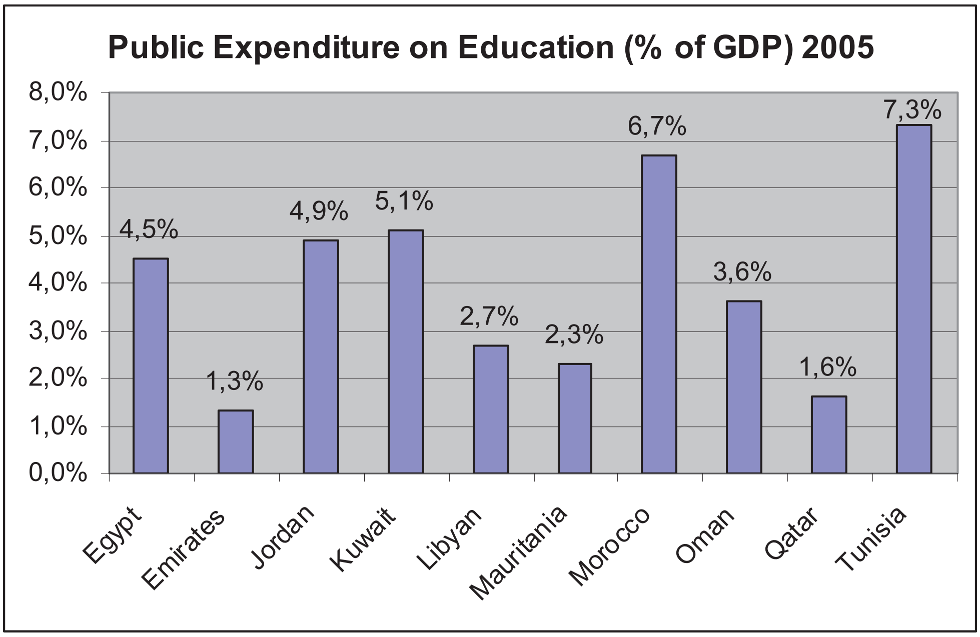


Fig. 48: Egyptian expenditure on education (% from GDP) compared to MENA countries

The trend in the number of researchers paints a similar picture to that of financial investment in R&D. Not surprisingly but still indicative of the new era we live in, there were more researchers in China in 2002 than in Japan, and more in the Newly Industrialized Asian economies as a whole than in Germany.

WORLD RESEARCHERS, 2002	Researchers (thousands)	% world researchers	Researchers per million inhabitants	GERD per researcher (US$ thousands)
World	**5 521.4**	**100.0**	**894.0**	**150.3**
Developed countries	3 911.1	70.8	3 272.7	165.1
Developing countries	1 607.2	29.1	374.3	114.3
Less-developed countries	3.1	0.1	4.5	153.7
Americas	**1 506.9**	**27.3**	**1 773.4**	**218.2**
North America	1 368.5	24.8	4 279.5	224.5
Latin America and the Caribbean	138.4	2.5	261.2	156.5
Europe	**1 843.4**	**33.4**	**2 318.8**	**122.7**
European Union	1 106.5	20.0	2 438.9	177.0
Comm. of Ind. States in Europe	616.6	11.2	2 979.1	29.1
Central, Eastern and Other Europe	120.4	2.2	895.9	103.4
Africa	**60.9**	**1.1**	**73.2**	**76.2**
Sub-Saharan Countries	30.9	0.6	48.0	113.9
Arab States Africa	30.0	0.5	159.4	40.9
Asia	**2 034.0**	**36.8**	**554.6**	**128.5**
Comm. of Ind. States in Asia	83.9	1.5	1 155.0	8.9
Newly Indust. Asia	291.1	5.3	777.2	183.7
Arab States Asia	9.7	0.2	93.5	66.6
Other Asia	65.5	1.2	100.2	20.9
Oceania	**76.2**	**1.4**	**2 396.5**	**114.4**
Other groupings				
Arab States All	39.7	0.7	136.0	47.2
Comm. of Ind. States All	700.5	12.7	2 505.3	26.7
OECD	3 414.3	61.8	2 984.4	191.9
Selected countries				
Argentina	26.1	0.5	715.0	61.5
Brazil*	54.9	1.0	314.9	238.0
China	810.5	14.7	633.0	88.8
France	177.4	3.2	2 981.8	198.4
Germany	264.7	4.8	3 208.5	211.4
India*	117.5	2.1	112.1	176.8
Japan	646.5	11.7	5 084.9	164.5
Mexico*	21.9	0.4	217.0	159.7
Russian Federation	491.9	8.9	3 414.6	30.0
South Africa	8.7	0.2	192.0	357.6
United Kingdom*	157.7	2.9	2 661.9	184.2
United States of America*	1 261.2	22.8	4 373.7	230.0

* India 1998, United States 1999, United Kingdom 1998, Brazil 2000, Mexico 1999.

Fig. 49: Global indicators on R&D capacities

Source: UNESCO Institute for Statistics estimates, December 2004

The leading **Asian** economies share a strong commitment to S&T: the Republic of Korea, Singapore and Taiwan of China devote more than 2% of GDP to R&D. As for China, it is well on the way to realizing its goal of a 1,5% GERD/GDP ratio by 2005. Meanwhile, India has set its own sight on crossing the 2% threshold in the coming years.

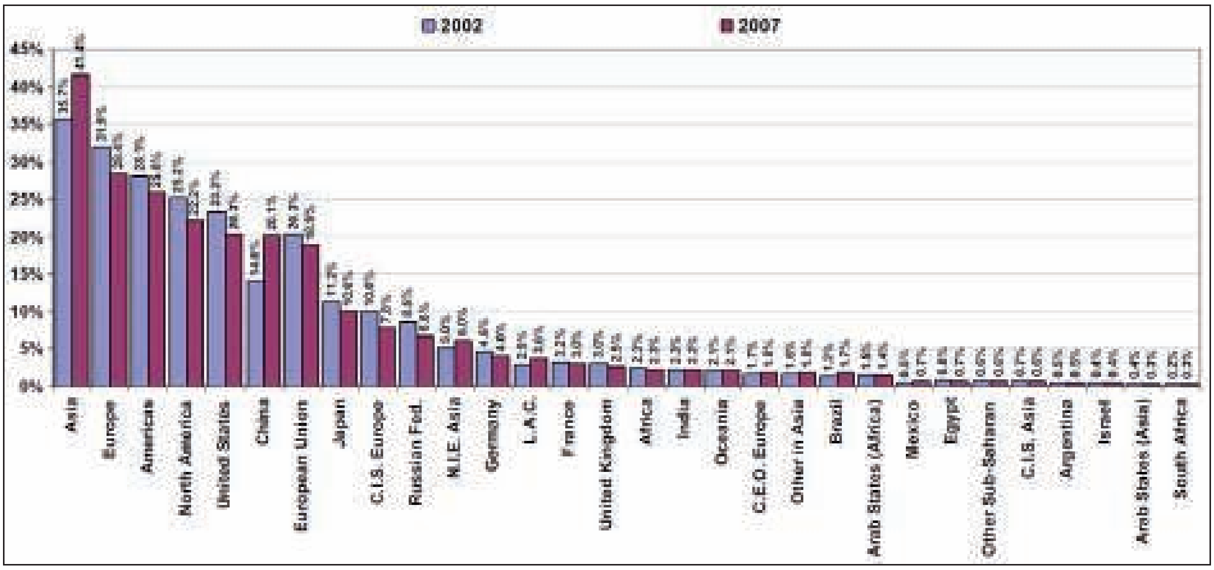


Fig. 50: Shares of world researchers by principal regions/countries, 2002 and 2007

Source: UNESCO Institute for Statistics estimates, September 2009

Taking a bird's eye view of the dynamics of S&T production obliges us to deal separately with the **Community of Independent States (CIS)**, made up of the countries of the former Union of Soviet Socialist Republics (USSR) in Europe and Asia. Under Soviet rule, most of these now independent states had built up strong R&D systems, albeit unbalanced ones from an economic perspective.

Since the disintegration of the **USSR** more than a decade ago, the R&D systems of all these states have become a shadow of their former selves, yet their size still stands out. The proportion of GDP spent on R&D by the Russian Federation, for example, still stands at 1,3%. Moreover, the number of researchers in Russia, 3,400 per million inhabitants, is the third-highest in the world, after Japan (5,100) and the USA (4,400). The downside is that expenditure per researcher amounts to a pittance in the Russian Federation, translating into low salaries and negligible expenditure on equipment, housing and consumables. Nowhere in the world is GERD per researcher as low as here, at just US$ 8,900, compared with US$ 200,000 in many developed states and US$ 30,000 in the Russian Federation. Nor are there any signs that the situation is improving in these states.

Unlike in Asia, there is no discernible steady upturn in R&D in **Latin America and the Caribbean**. On the contrary, there actually seems to be a downturn. The region's share in world GERD has fallen back from 3,1% in 1997 to 2,6% in 2002. Moreover, three countries – Brazil, Mexico and Argentina – account for 85% of the region's GERD, leaving the remainder with average expenditure of no more than 0,1% of GDP – with the small but notable exception of Cuba, at 0,6%.

The situation in **Africa** is even bleaker. The GERD/GDP ratio is already low, for both the sub-Saharan countries and the **Arab states of Africa**, at 0,3% and 0,2% respectively, but even that paints a picture that is rosier than reality: South Africa is responsible for 90% of GERD in sub-Saharan Africa and Egypt and to a lesser extent Tunisia, Morocco and Algeria carry out practically all R&D in the Arab states of Africa. Certainly, there are encouraging signs in a number of countries but, after a prolonged period of disruption; many countries are struggling simply to get back to where they were in the 1970s and early 1980s.

In terms of the number of researchers in R&D per million capita, the most recent analysis and statistics of the Egyptian Ministry of Higher and Scientific Research shows a higher number of researchers compared to the analysis of the most recent analysis of UNESCO. Nevertheless, in comparison to other MENA countries Egypt is still ranking in the midfield.

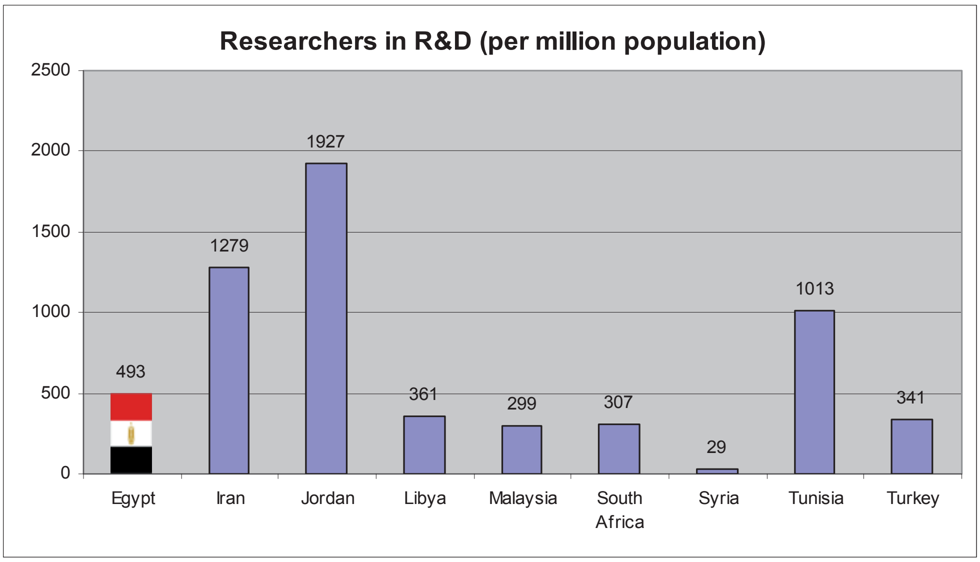


Fig. 51: Number of researchers in R&D (1990-2005) per capita in million

What is true for the Arab states of Africa also holds for the Arab states of Asia, albeit to a somewhat lesser degree. A handful of countries account for most of the sub-region's GERD, among them Jordan, Kuwait and Saudi Arabia. Some might argue that the reason for the dismal performance from even the fossil fuel-rich countries lies in their relatively high income per capita.

One could counter this argument by saying that the fossil fuel-rich countries could afford to spend much more on R&D but are apparently not sufficiently convinced of the need to invest in a knowledge economy. Yet, no country will be able to achieve and durably maintain prosperity and a high quality of life without using the results of research and ensuring a well-educated population.

The challenges for the Arab World are defined by the World Bank as follows: "The Arab world has strong potential for growth and development, but it remains poorly integrated into the global economy apart from the oil sector. It has the highest unemployment among developing regions, as well as the lowest economic participation by women. The region's poor and rich countries alike suffer from such problems as water scarcity, lack of economic diversity, weak public accountability, and conflict."

Research and Development in the Arab countries:

The most recent study of UNESCO, the Science Report 2005, indicates the following R&D activities for the Arab countries. In terms of full time equivalent (FTE) researchers, in 1999 the distribution in Arab countries shows that the majority, around 44%, converges on agricultural research, mainly due to the fact that most Arab countries rely heavily on the agricultural sector. **Egypt for instance, allocated almost half of its FTE workforce in this field, a total of 10,744 or 56%.** There are only three Arab countries whose main area of research concentration is different, namely **Bahrain, Jordan and Qatar**, respectively with a focus on economics, industry and education.

The following figure (UNESCO Science Report 2005) shows the number of FTE researchers in 1999 in the Arab countries, distributed across specific areas of R&D. It is worth noting that research on petroleum-related topics, being the main source of income for many Arab countries, hosts a relatively low number of researchers. In 1999, only 6% to 8% of FTE researchers in Kuwait, Oman, and Saudi Arabia were dedicated to petroleum, and 11% to 15% committed their research to energy.

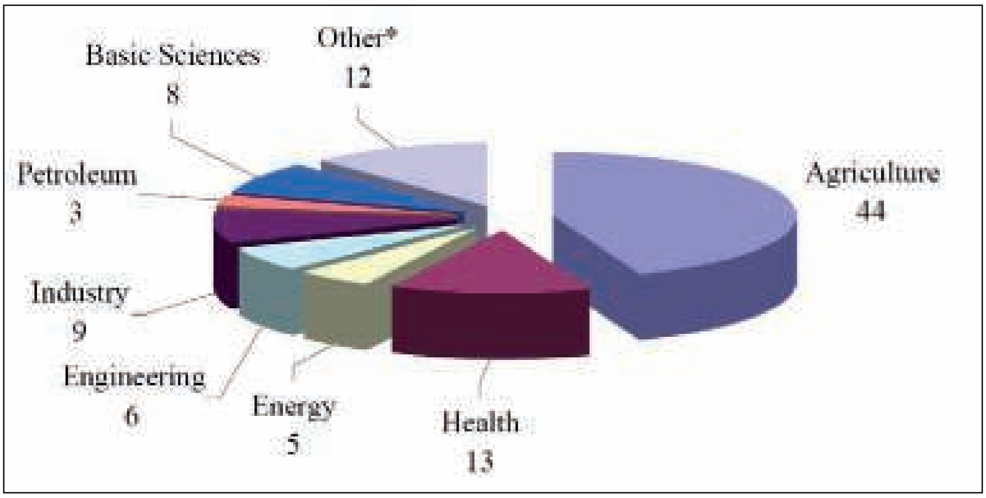


Fig. 52: FTE researcher in the Arab countries in specific R&D areas (1999)

There were 876 researchers, scientists and engineers (RSE) per million inhabitants worldwide in 2000, but the number dropped down from 985 in 1997. This overall decline is explained by the rapid population growth in the developing countries, for which the number of RSE fell from 347 to 313 per million between 1997 and 2000. The indicator remains unchanged in the developed regions over the same period. **We are seeing a very low presence of RSE in the Arab States** and, above all, in Africa.

In terms of the distribution of R&D units by R&D area, the UNESCO Science Report 2005 indicates, that the most recent numbers of 1996 show 322 R&D units in the Arab countries, 55 of which operated in the agriculture sector. **Once again, Egypt led the Arab countries with a total of 64 R&D units, mostly dedicated to health, industry and agriculture.** It is noteworthy that a presumably important area for R&D efforts, namely water, attracted the interest of a rather small number of institutions, namely 17 units.

It can be assessed that there is still a huge gap in terms of the number of FTE researchers in the Arab countries as well as in strategic research fields especially for coping with local challenges.

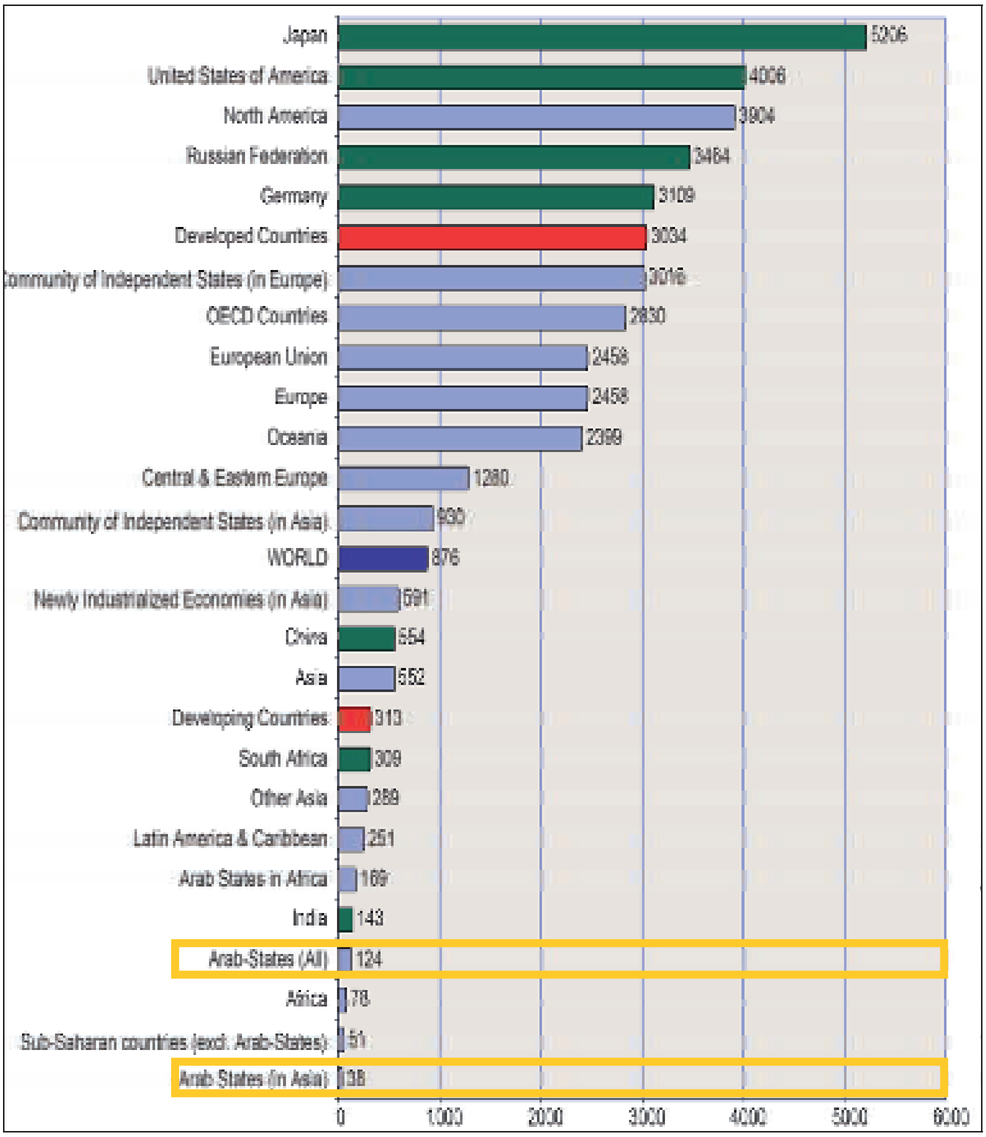


Fig. 53: Researchers per million population by region/principal countries (2000)

Source: UNESCO Science Report 2005

Besides the number of FTE researchers, the gross expenditure on research and development (GERD) of a country or a region is another important ***input indicator*** for measuring the capacities of R&D. In recent years the Arab States' already small contribution to world GERD has declined in relative terms from 0,4% to 0,2%, whereas a small expansion can be observed in the CIS, from 1,5% up to 1,8%, essentially underpinned by the recovery of the Russian Federation after a decade of absolute decline or, at best, stagnation.

Nearly 85% of overall Arab GERD were performed in the following seven countries in the late 1990s: *Egypt*, Jordan, Kuwait, Morocco, Saudi Arabia, Syria and Tunisia, the fifteen remaining states of the Arab League together accounting for the remainder.

The detailed comparison of GERD per region and country is given in the following figure. The Arab States (Africa/Asia combined) devote only 0,2% of their resources to R&D. This low figure merits a more detailed look to ascertain to what extent the overall Arab GDP is inflated by the values of important petroleum production figures (although not all the states concerned are oil producers). However, the presence of researchers from the Arab region, albeit negligible by international standards, is still about three times higher (0,6%) than the region's share of world GERD.

Fig. 54: GERD as a percentage of GDP by region/principal countries (2000)

Source: UNESCO Science Report 2005

The picture is quite similar when looking at typical ***output indicators*** of an innovation system, that is the number of patents granted to selected countries (see following figures). In the following figure the need for a logarithmic scale alone highlights the deficiency of the MENA countries in patenting activity. Between 1992 and 2001, Economic & Social Commission for Western Asia (ESCWA) member countries registered between 1 and 42 patents, with the exception of Saudi Arabia, which has been granted a total of 117 patents.

Summing up the number of patents granted to each ESCWA member country between 1992 and 2001 barely amounts to 4% of the total number of patents granted to e.g. Israel. Nevertheless, patenting has steadily been on the rise in the region as a whole. In 1992, 15 patents were granted to the ESCWA region, whereas the number grew to 36 in 2001.

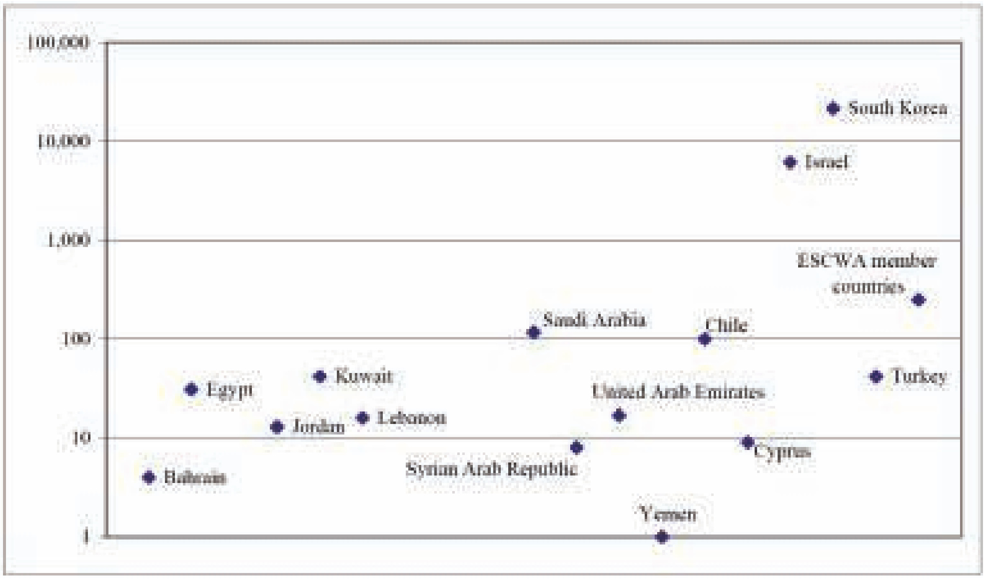


Fig. 55: Cumulative number of patents granted to selected countries (1992-2001)

Source: United States Patents and Trademark Office

Several of the most R&D-intensive Arab States are geographically situated on the African continent, like Egypt, and their R&D is strongly supported by public finance as already shown before. In the past 10 to 15 years, R&D resources dropped severely in the countries of ‘median Africa’. And where little R&D is being performed, it is essentially project-financed by international agencies, NGOs and, in exceptional cases, by industrial corporations from abroad.

Another most recent analysis performed by the Egyptian Ministry for Higher Education and Scientific Research gives similar results (see next figure).

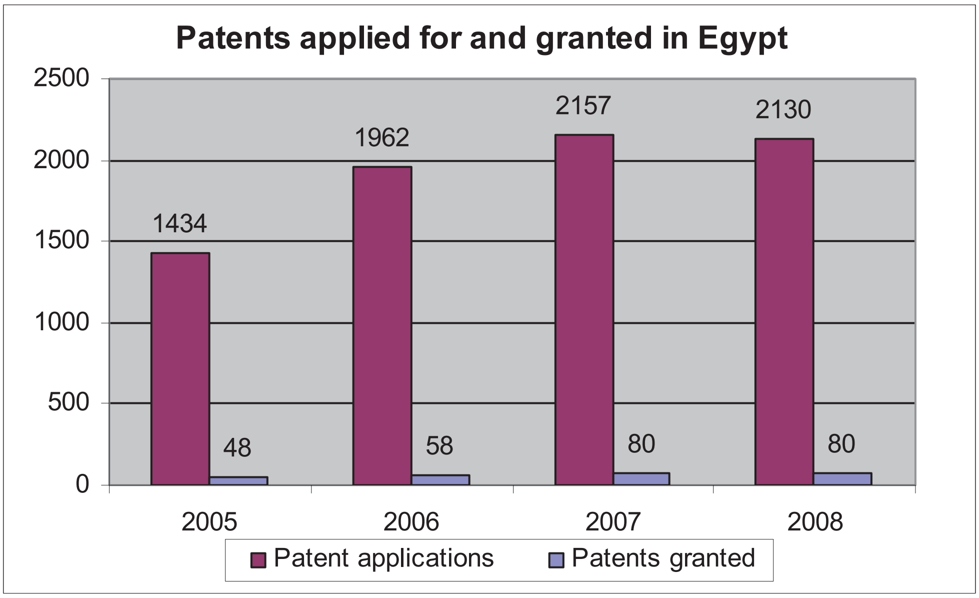


Fig. 56: Patents applied for and granted in Egypt

Although the number of patents granted at the Egyptian Patent Office was increasing by almost 70% from 48 patents granted at the Egyptian Patent Office in 2005 to 80 patents granted at the Egyptian Patent Office in 2008, the overall number is still lacking behind similar other developing countries respectively countries in transition. Nevertheless, the following picture indicates, that the global importance of the Egyptian patents is on quite high level by having nearly one third of the Egyptian patents granted internally.

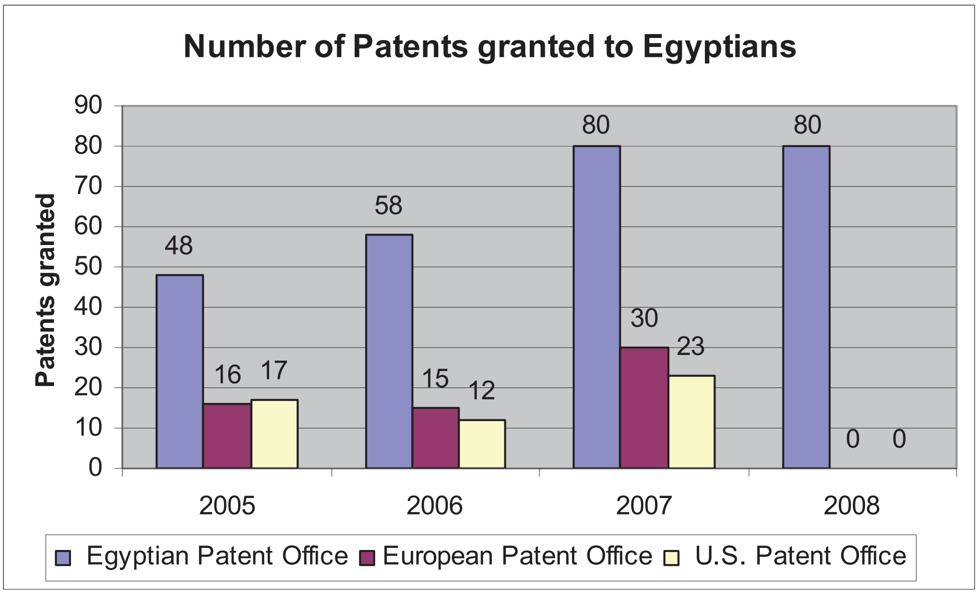


Fig. 57: Number of patents granted to Egyptians

Further analysis performed by the Egyptian Ministry for Higher Education and Scientific Research in the area of patent applications show that the patent application activities compared to other selected MENA countries are on a quite high level. Especially compared to other North-African countries, Egypt is performing very well by having 428 patent applications by Egyptian residents between 1997 and 2005.

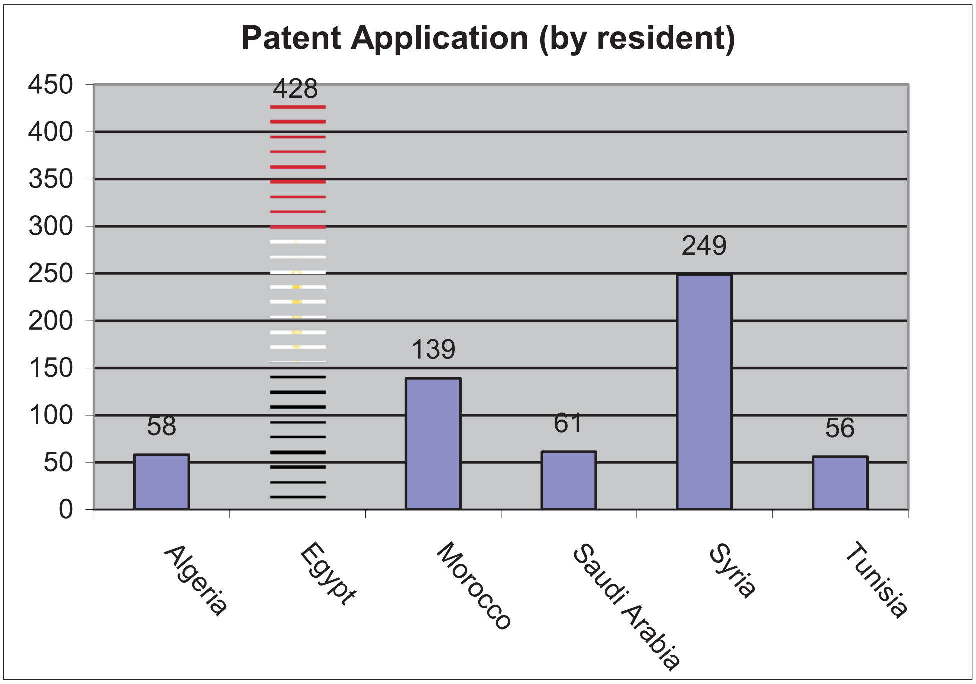


Fig. 58: Patent applications in Egypt compared to selected MENA countries (1997 – 2005)

Nevertheless it has to be clearly stated that although the comparison with selected North African countries gives a quite positive picture, the further comparison with other selected MENA and Asian well as with South-American countries demonstrates a gap in the Egyptian performance in terms of patents granted (see figure above about cumulative number of patents granted to selected countries (1992-2001).

By looking at the specialization fields of the patent applications in Egypt (see next figure) between 2003 and 2008 it can be seen that most of the patent applications are in the fields of Humanitarian Needs, Restructuring Operations and Transport as well as in the field of Chemistry and Metallurgy. Other fields like Textile and Paper, Established Buildings, Mechanical Engineering, Physics and Nuclear as well as Electricity and Communications do not play an important role in terms of patent applications.

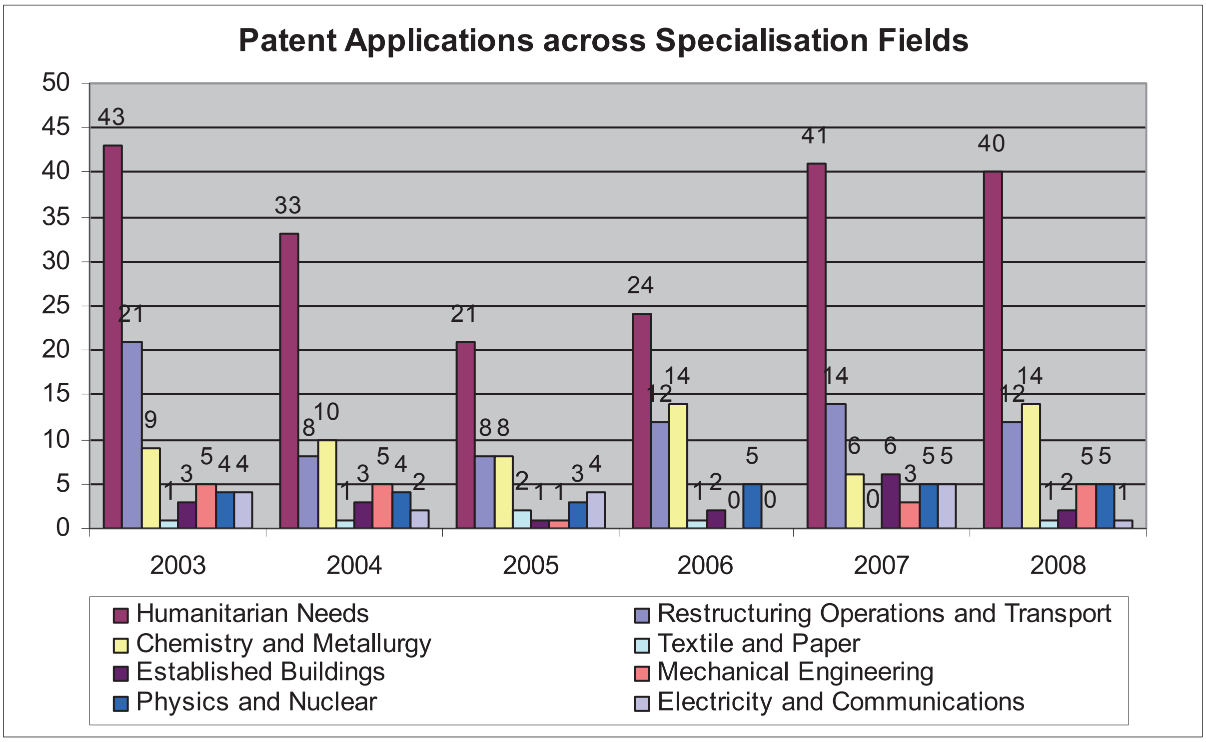


Fig. 59: Patent applications across specialization fields

Besides the patent applications another main characteristics of the countries that have achieved a **high human development index** is the impressive ratio of **technology exports to the total export of goods**, representing an average of over 70% of their exports (see following figure). Some Arab countries show respectable figures in this indicator, namely: Tunisia, 71%; Morocco, 34%; and Egypt, 33%. The bulk of these figures represent low technology exports (52%, 22% and 24% for Tunisia, Morocco and Egypt respectively) and medium technology exports (16%, 12% and 7% respectively). For Arab countries better positioned in the human development index, either their technology exports represent a small percentage of the total exports (ranging between 7% and 9%) or even less. The same situation applies to the rest of the Arab countries.

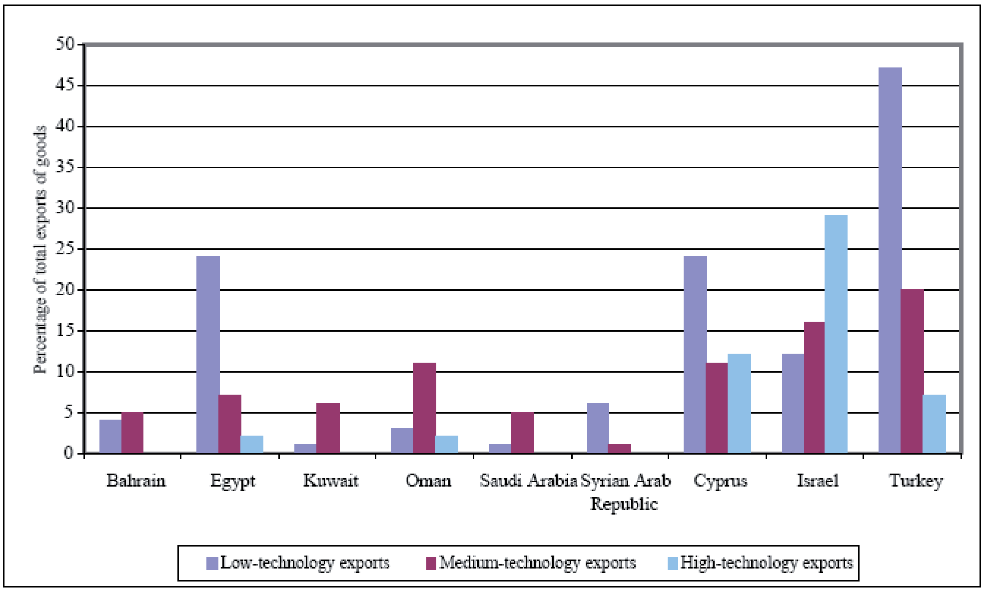


Fig. 60: Low, medium and high technology exports from selected ESCWA member countries compared with selected neighboring countries (1999)

Source: UNDP – Human Development Report 2001

All the above mentioned indicators as well as the assessment of the current situation in the Arab World in general in terms of **R&D input and output indicators show a need for change and improvement.**

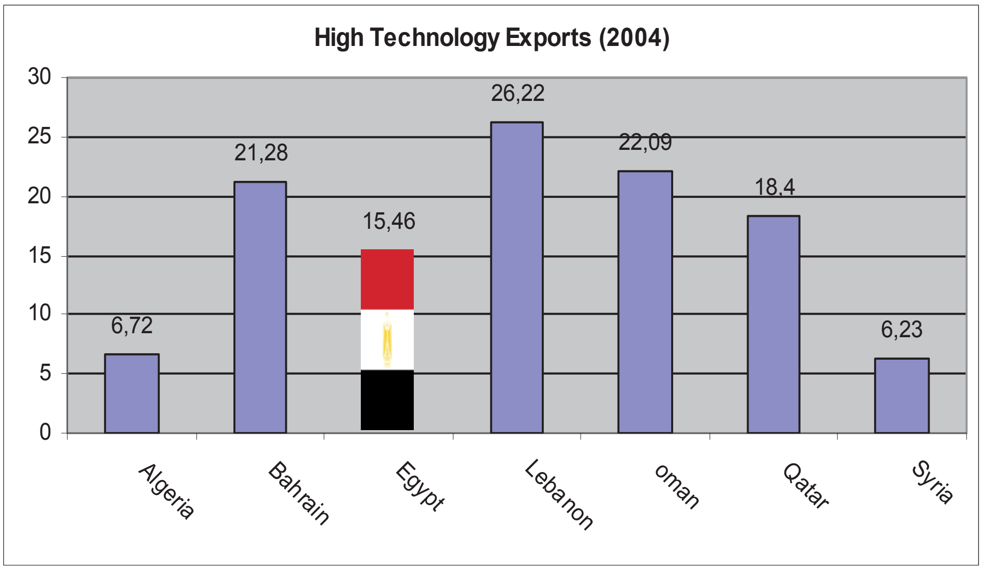


Fig. 61: Egypt's high-technology exports 2004 compared to selected MENA countries

A further most recent analysis of the Egyptian Ministry for Higher Education and Scientific Research gives further details ion the Egyptians high-technology exports 2004 compared to selected MENA countries (see figure above). Based on this analysis even in terms of high-tech exports Egypt is ranking behind oil-rich countries like Oman, Qatar and Bahrain. Such economies are mostly depending on oil and gas exports are not famous or well-known for their high-tech sectors.

Other typical ***output indicators*** of an innovation system are related to the number of articles and publications as well as to the citations of articles and publications.

In terms of the number of articles published in scientific and technical journals, Egypt achieved a quite substantial amount. Between 1996 and 2005 an analysis performed by the Egyptian Ministry for Higher Education and Scientific Research counted 27.237 articles published in scientific and technical journals (see next figure). The comparison with other selected MENA countries gives the result that the Egyptian researchers are performing very well in this area.

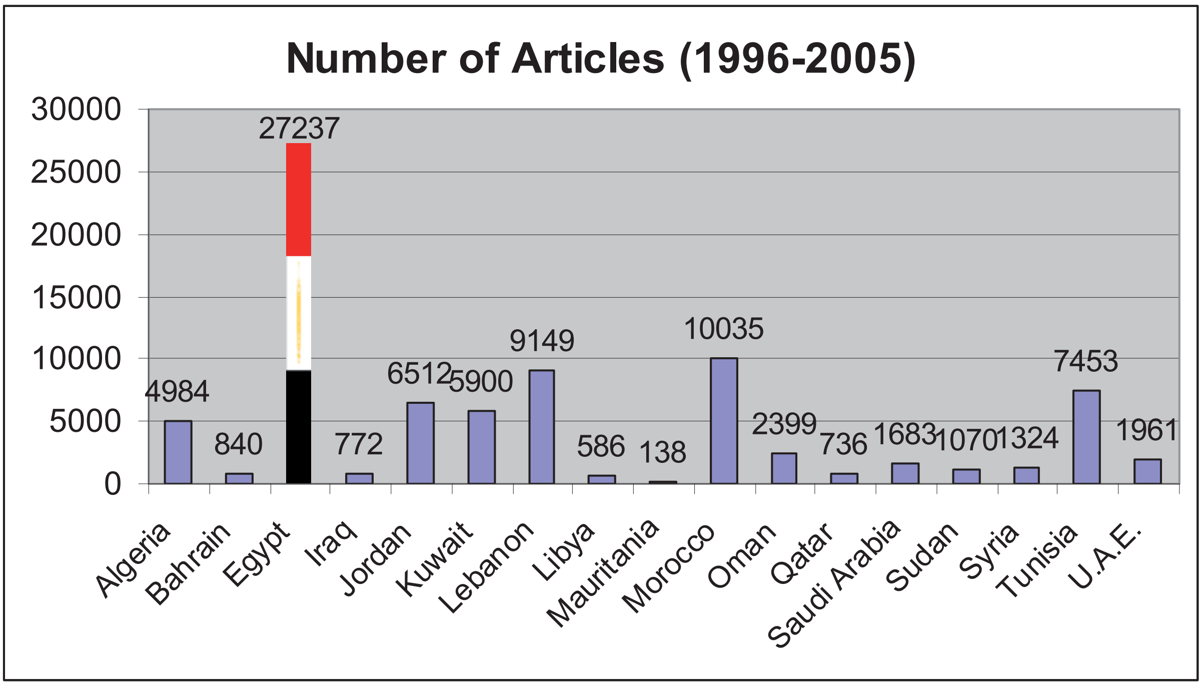


Fig. 62: Scientific and Technical Journal Articles (1996-2005)

By looking just at the number of researchers who were publishing articles in the Egyptian print media (see next figure) the number declined from 7.162 in 2005 to 3.706 in 2007. By knowing, that Egypt is having around 40.000 researchers (see figure further above: researchers in R&D per mill. capita) it has to be stated that although the overall number of articles published in scientific and technical journals seems to be quite high, whereas the performance per researchers can still be improved.

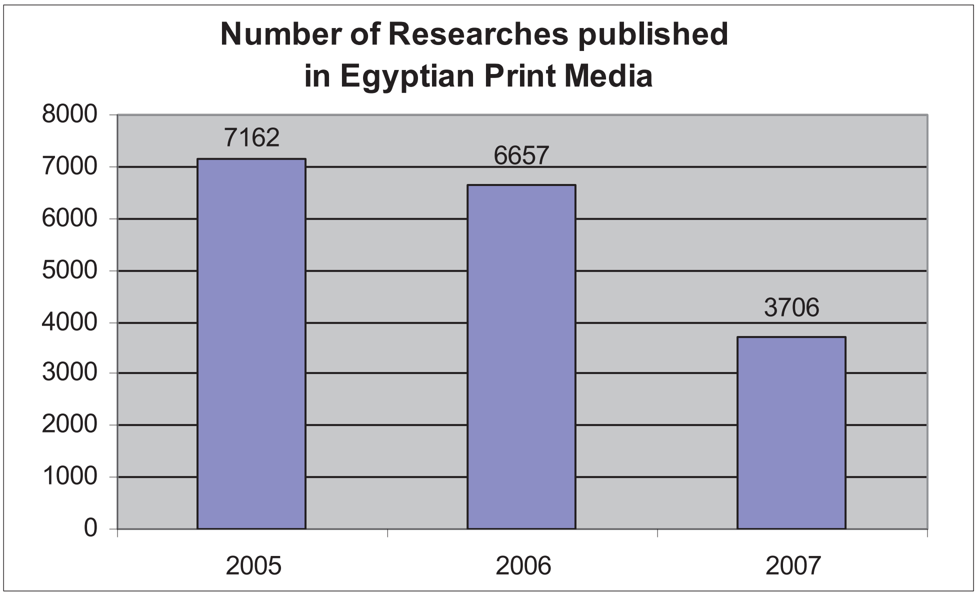


Fig. 63: Number of researchers published in Egyptian print media

Fig. 64: Research articles published in international magazines according to their specialization (1998 – 2007)

By looking in more detail at the scientific and technical fields of specialization of research articles published in international magazines between 1998-2007 it can be seen in the figure above, that most of the research articles are published in science. Based on this analysis performed by the Egyptian Ministry of Higher Education and Scientific Research more than 50% of the overall number of articles is published in the scientific and technical fields of specialization of natural science (14.043), followed by engineering (5.671) and medicine (4.308).

A further analysis of output indicators of the Egyptian innovating system is about the citation index of Egyptian publications across all scientific fields. A citation index is an index of citations between publications, allowing the analyst to easily establish which later documents cite which earlier documents.

In terms of the Citation Index of the Egyptian publications across all scientific fields the following figure shows that the number of Egyptian publications cited did increase continuously from about 1.000 in 1996 to more than 8.000 in 2007. This analysis performed by the Egyptian Ministry of Higher Education and Scientific Research illustrates, that although the number of researchers who are publishing articles is decreasing over the last years (as shown further above), the **quality of the publications is continuously and even disproportionately increasing**.

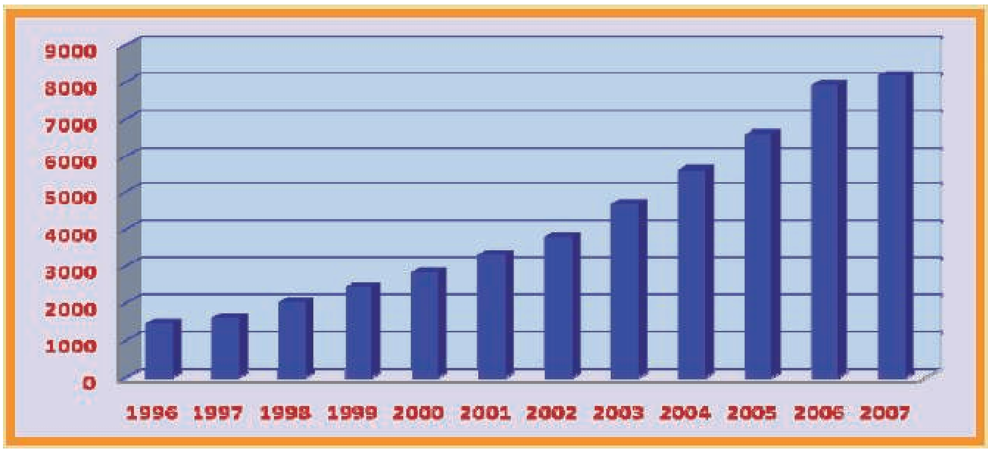


Fig. 65: Citation Index – Egyptian publications across all scientific fields

5. Work Packages 4 and 5 – Performance of University Research and of Research Centers

5.1 Introduction

Along with the evaluation of the innovation performance within the Egyptian industry, the Egyptian Ministry of higher education has been running an evaluation and assessment regarding the performance of universities and research centers. For the future of the national innovation system of Egypt it is vital, that industry as well as research institutions know their strengths and weaknesses in terms of innovation in order to provide suitable measures and programs for the future development and enhancement of innovation capabilities of both sides.

It is the very first time that an evaluation takes place so universities and research centers are not well acquainted with the topic of innovation performance and its surrounding topics. Therefore, many topics of the questionnaire have been misunderstood or were answered in a unexpected manner. Probably this fact will change within the next years as the Egyptian Ministry of Higher Education is planning to repeat the study every two or three years in order to establish a continuous monitoring of the developments in universities and research centers.

5.2 Study Approach

The Fraunhofer-Gesellschaft has developed an evaluation method including 9 success factors and 5 performance criteria to measure the performance of applied research institutes (Kuhlmann, Holland 2005). This procedure was already applied successfully in the assessment of research institutions in Indonesia within the project "Evaluation of the Indonesian Science, Research and Technology System to Strengthen the National Innovation System" (PERISKOP). Considering the success of this project, it seemed reasonable to choose the same method for the evaluation of the Egyptian R&D landscape. Therefore, the methodology was used for the assessment of the performance of the Egyptian universities as well as for the performance assessment of research centers.

Originally, the methodology was designed as an interview-based approach, collecting information needed from personal interviews. The structure of the interview guideline was especially developed for this project.

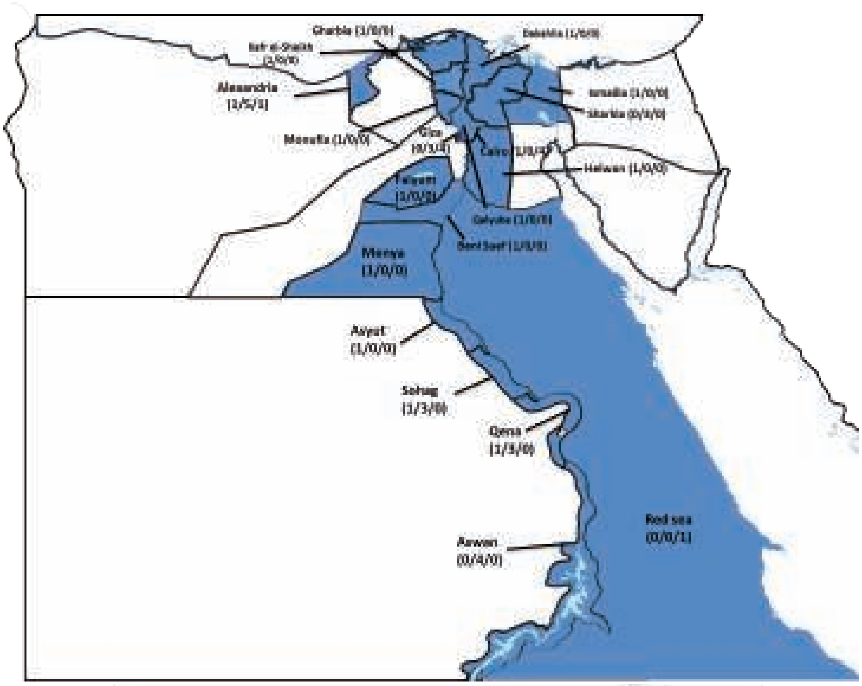
As the study is being done for the first time, the ministry decided that detailed interviews within each faculty or research unit should not be carried out. It seemed to be better to interview just the heads of institutes and research centers answering the questionnaire on behalf of their whole institution. Nevertheless, from a total number of 16 universities who participated in the study, the questionnaire was answered only by the university president in nine cases. In three cases, the president answered the questionnaire and additionally, several faculties returned a completed questionnaire. Three universities only gave the questionnaire to certain faculties, which filled in the questionnaire. De facto from Egypt's 16 universities all institutions returned questionnaires.

Altogether, available data for the analysis was generated by 16 universities and 10 research centers.

Due to the fact, that some universities provided in addition complete questionnaires from some of their faculties, the available data sets for the analysis rises from originally 26 (10 research centers and 16 universities) to 46. This means, that 20 questionnaires were returned from university faculties.

For the university analysis, all questionnaires were included in order to make the results more representative and hence giving them more severity.

Universities and research centers involved in the study are distributed all over Egypt. They amount to a total number or 46. No analysis by governorate had been conducted. because the statistical entities were too small Therefore, a regional analysis has been run on the basis of a regional classification according to Egypt's major regions "Upper Egypt", Lower Egypt" and "Cairo". The figure below shows, that the types of institutions involved in the study are not equally distributed over the country. Thus, in Lower and Upper Egypt the major part of institutions who have been answering the questionnaire are universities (presidents of universities or heads of faculties). In Upper Egypt are situated just universities and faculties (in total 16), in lower Egypt exists one Research Centre and 15 universities and faculties. Whereas almost all research centers involved in this study are located in Cairo. This distribution has to be taken into account when analyzing and interpreting the data from the regional analysis on the following pages.



Governorate (Universities /Faculties/ Research Institutes)

Fig. 66: Regional distribution of institutes taking part in the study

For the evaluation of all institutions, the Fraunhofer-Gesellschaft derived a set of 9 success factors and 5 performance criteria (see Fig. 68) that are vital for the efficiency of universities and research centers. This set facilitates the analysis of the actual and future potential of applied research institutes. As an output of this first evaluation, this set can also be used for self-assessment and development of the institutions in the future.

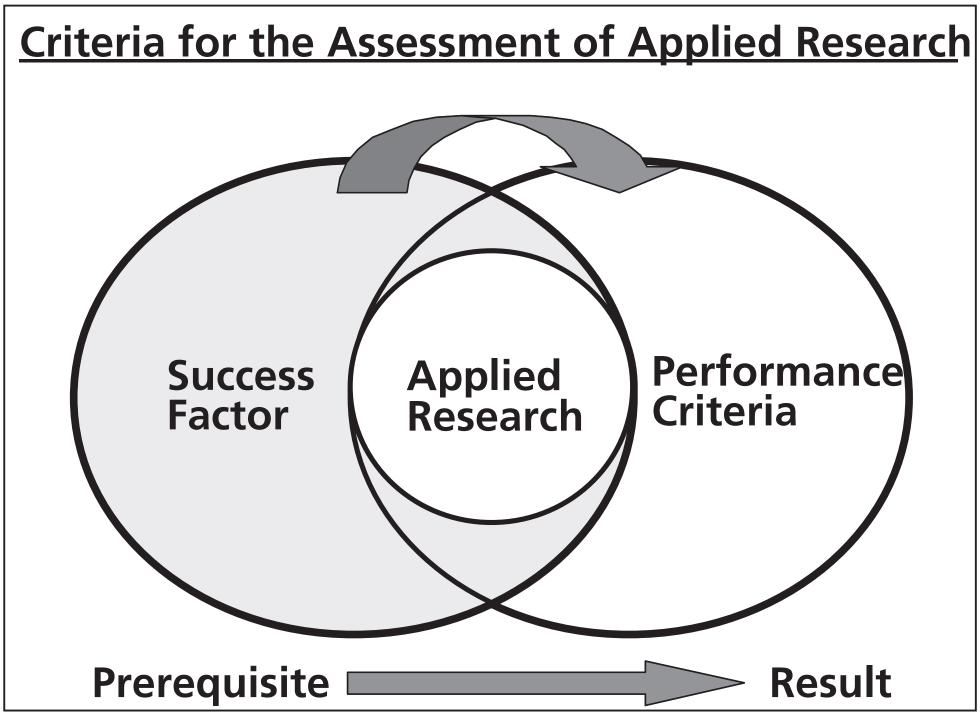


Fig. 67: Criteria for the assessment of applied research institutions

The 9 success factors describe the most important prerequisites for a successful realization of the tasks or for an effective functioning of universities and research centers. The **nine success factors** are listed as follows:

1. Strategic Orientation
2. Technology Management
3. Link to Industry
4. Link to Science
5. Communicative Competence
6. Organization and Management
7. Human Resources
8. Scientific-Technical Equipment
9. Financing Structure

Five Performance Criteria:

1. Coherence of Strategic Business Field Planning and Technological Supporting Needs of Industrial Sectors
2. Science and Technology Competence
3. Success of Economic Problem Solution
4. Profit Situation
5. Human Resources and Scientific-Technical Equipment

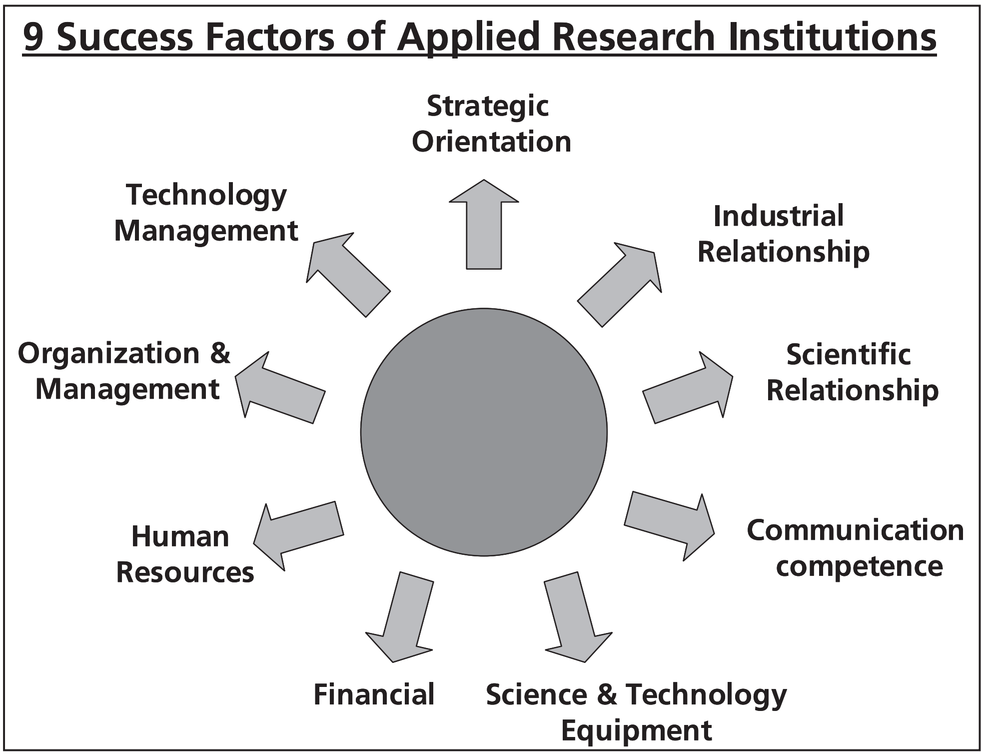


Fig. 68: Nine success factors of universities and research centers

5.3 Background and Main Findings of the Nine Success Factors

5.3.1 General Information

5.3.1.1 Background

In the first part of the questionnaire, designed for the evaluation and assessment of universities and research centers, some general information from the participating institutions was asked. These questions were most of all qualitative thus; survey participants were able to answer freely and could write down opinions and self assessments. The answers to these questions were categorized for the analysis except for some questions, which answers were just too heterogeneous and could not be classified.

5.3.1.2 Main Findings

One of the questions in the section of the general data was posed regarding the reasons for the foundation of the institution. As categories for the analysis, the following issues have been identified: Education, Community services, Establishing a centre of excellence, Performance of basic research, Performing applied research, Technology transfer and assimilation, Providing scientific and technological assistance and consultation, Providing specialized technical trainings and support/ improve national economy national industries.

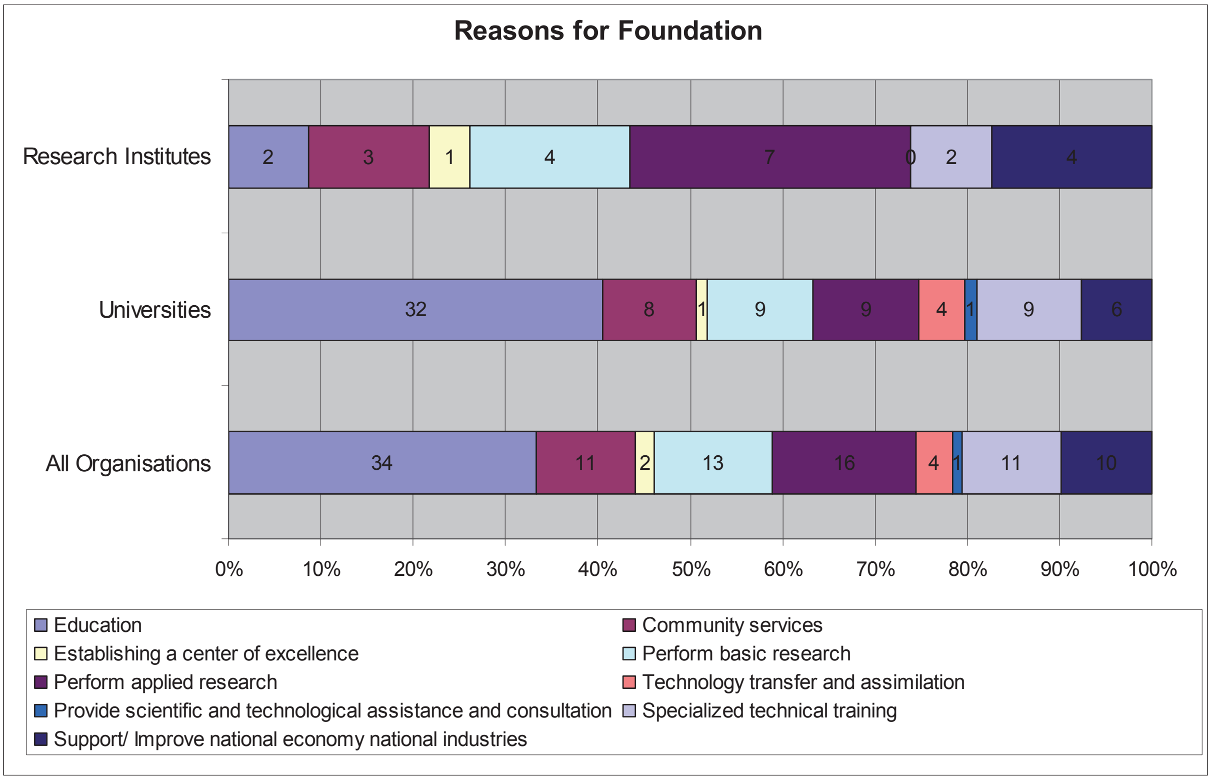


Fig. 69: Reasons for Foundation of the Institutions

Indeed, some of the institutions were not only established for education and research in general, they have been established with the aims, to cooperate with industry of technical research centers in order to do "Technology transfer and assimilation" and to "improve national economy national industries".

Fig. 69 shows the frequencies of single reasons of foundation for universities and research centers. Of course, education is the most significant reason for the existence of universities, but it is less important to research centers. For research centers, the performance of applied research seems to be one very strong reason for their existence (7 out of 10 answers), while technology transfer and assimilation is surprisingly not at all an issue for them. This aspect is rather worked on in the universities to a small degree (4 answers).

The institutions were also asked about their opinion, how the staff would develop within the next years in general. The figure below shows that at a very clear growth tendency is present in all institutions: research and administrative staff will be increasing in almost all institutions, while only two universities out of 36 have indicated to keep the number of employees at a stable level. An interesting fact is that 30% of research centers are expecting a decrease in their administrative staff (3 answers out of 10).

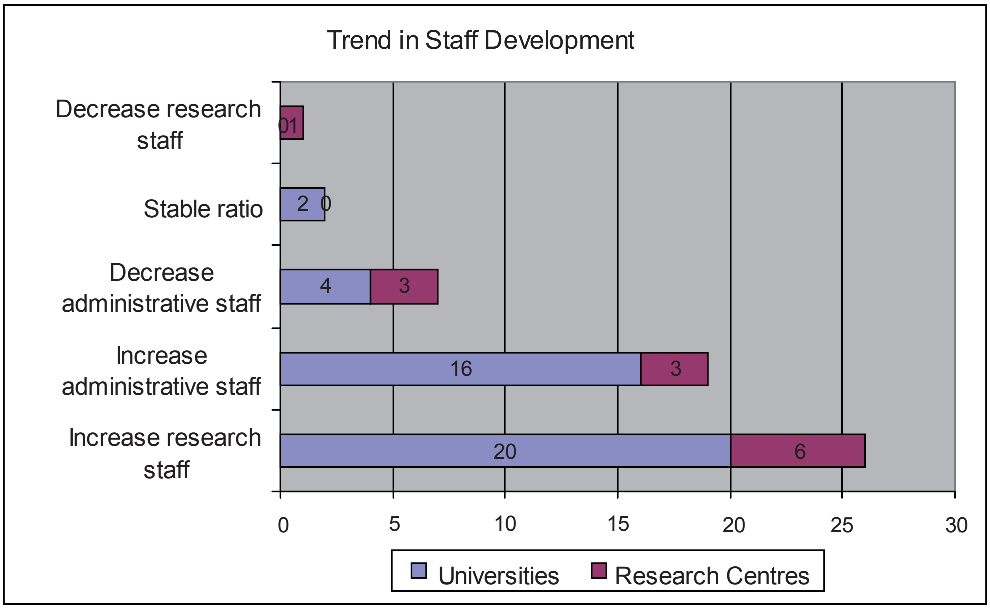


Fig. 70: Trend in Staff Development

5.3.2 Strategic Orientation

5.3.2.1 Background

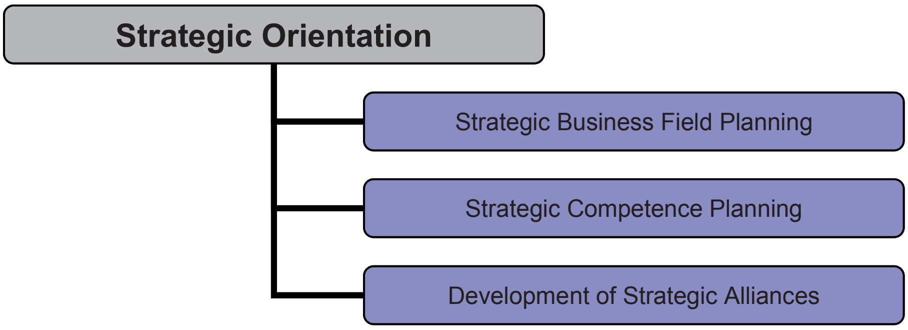


Fig. 71: Elements of the success factor strategic orientation

Within the last decade, economy, science, and technology sectors have continued to change dynamically by an ever-increasing rate. In order to fulfill the current and future demands and needs of industry, the research centers need to adapt to the dynamic situation of their entire environment. Effective innovations require a specific overall lead-time. Therefore, institutes have to focus on a strategy oriented policy and should not only concentrate on the current market-situation. In addition, constantly declining product-life-cycles by simultaneously increasing R&D-durations require a strategic orientation, too.

Hence, besides other main emphases, a reliable strategic field business plan has to be set up in research institutions. Prerequisite for such implementation is a durable and accurate observation of markets and technologies. The strategic competence plan has to be based on a reliable strategic field business plan. Instruments, such as long-term-based personnel plan and personnel development, need to be established to support the creativity and efficiency of staff, which are some of the most relevant resources for R&D.

Moreover, organizational structures play a major role in the development and learning process of personnel. Regarding external processes, successful institutes have to establish multilateral networks (industry-research institute-universities) rather than on a bilateral basis (institute and industry) to find prospective members for strategic alliances.

5.3.2.2 Main Findings

The majority of Egyptian research centers and universities (including faculties) are doing some kind of strategic planning and/or strategic observations of future markets or technology trends. In average 85% of the institutions answered with "yes" regarding this issue (see figure below). More than 50% of universities and research centers are observing the market and technology trends by analyzing the specific demand and supply side in both fields within their specific research area. Therefore the prerequisites for a strategic planning of future research fields and demands from industry are met within most of the institutions. The question is now whether these market or demand observations are also feed back into the actual planning of a universities curriculum or the research fields of a research centre.

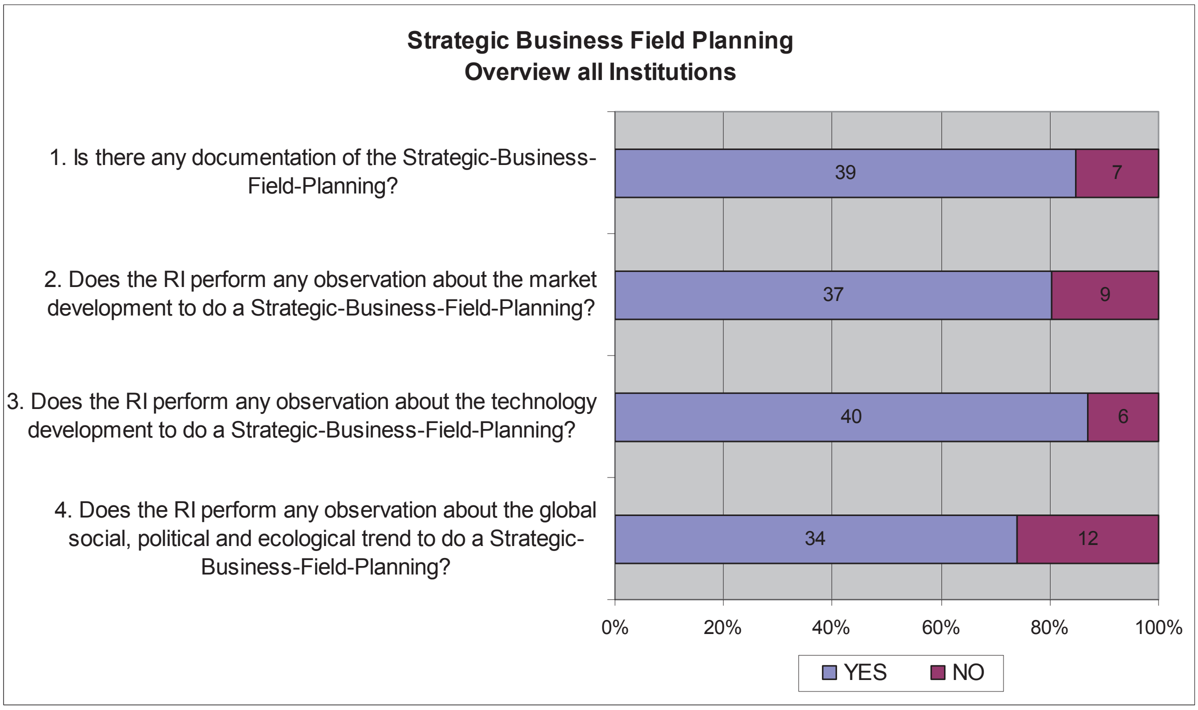


Fig. 72: Activities in strategic business field planning

In the following regional analysis, only the positive answers where considered when running the statistics. Taking this into account, the following figure reveals no major differences in the regions concerning their activity in business field planning. As already stated above, universities (including faculties) as well as research centers are equally active in planning and monitoring their strategies related to future research and activity fields. Only the third question regarding the activities related to the observation of technology developments reveals a slight variation. The institutes are all active in Cairo, whereas the universities and faculties of Lower Egypt are less active in following a strategic observation of technology trends (68,8%).

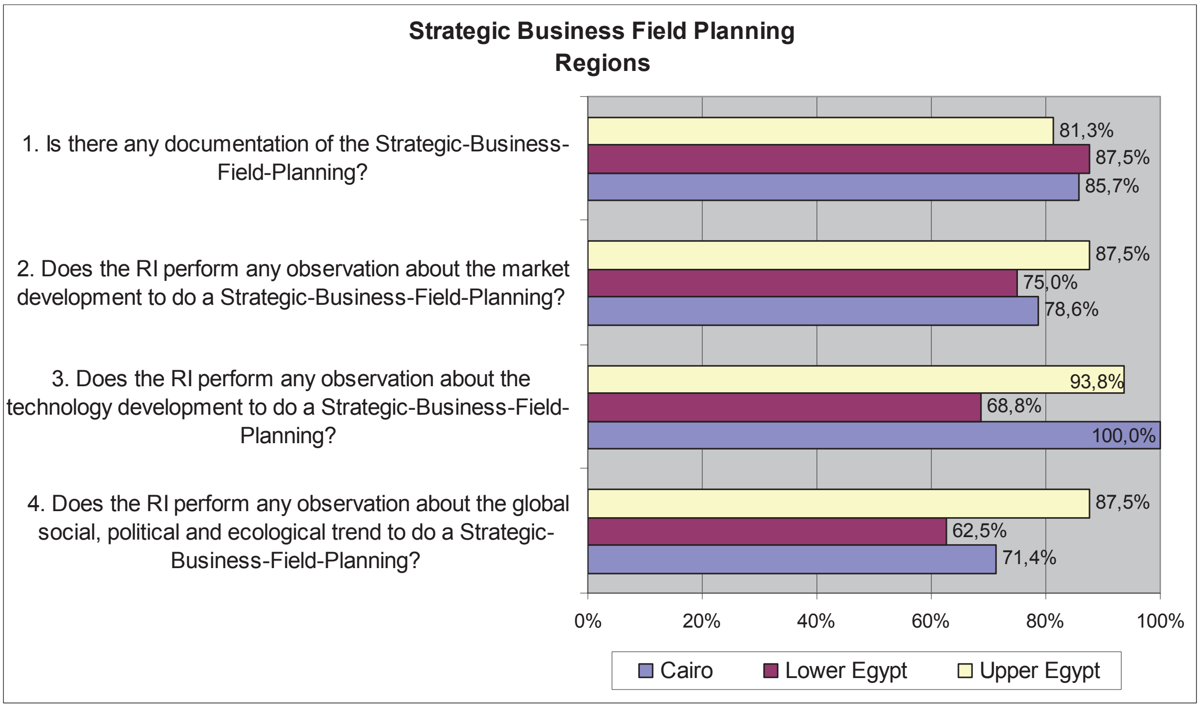


Fig. 73: Regional performance of activities in strategic business field planning

A closer look at the kinds of strategies which the institutions have regarding their future activities shows that the majority of institutions have well-structured ideas about their vision, mission and overall strategies. Besides, it is all written down in documents. Mission and vision normally indicate the more general ideas for the purpose and the future of the institution. When it comes to the more concrete parts of the future planning like long-term, mid-term and short-term objectives, fewer institutions have established or formulated detailed goals for the near future (see Fig. 74). For example, only 18 out of 46 institutions have documented clear mid-term objectives and even a bit less (15 out of 46) documented their short- or long-term objectives.

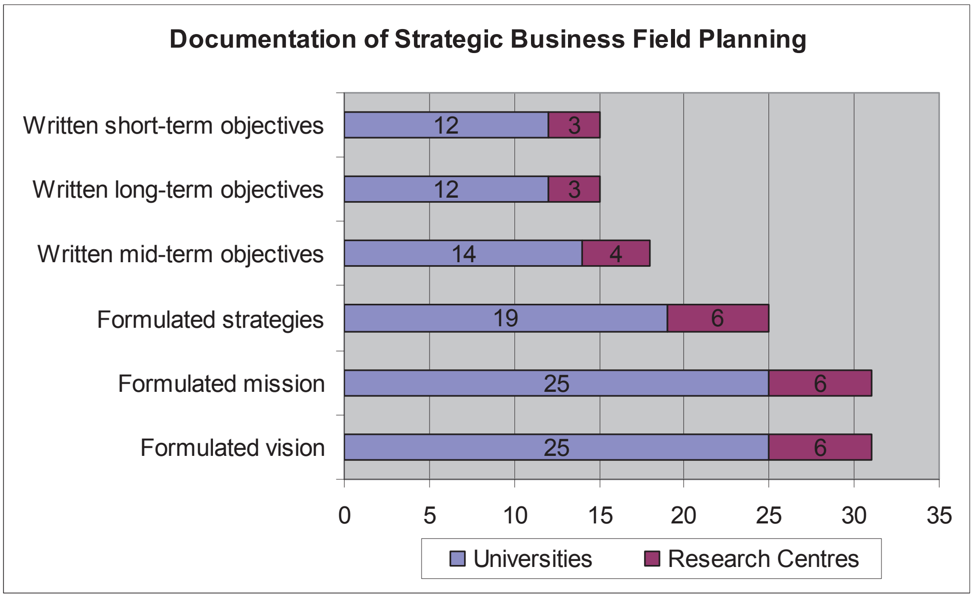


Fig. 74: Which types of strategic plans are implemented and documented?

Looking at the regional distribution of answers further differences in detail can be seen. In general institutes located in Lower Egypt (which are mostly universities except one research centre) are often much more successful in documenting their business strategies. In even more concrete parts of strategic planning, i.e. the mid-term and long-term objectives are set and documented by more than 50% of the institutions in Lower Egypt. On the contrary, institutions in Upper Egypt (which are all universities or faculties) are obviously the least active in documenting short to long-term plans. Cairo universities, faculties and research centers perform a good average in strategic planning.

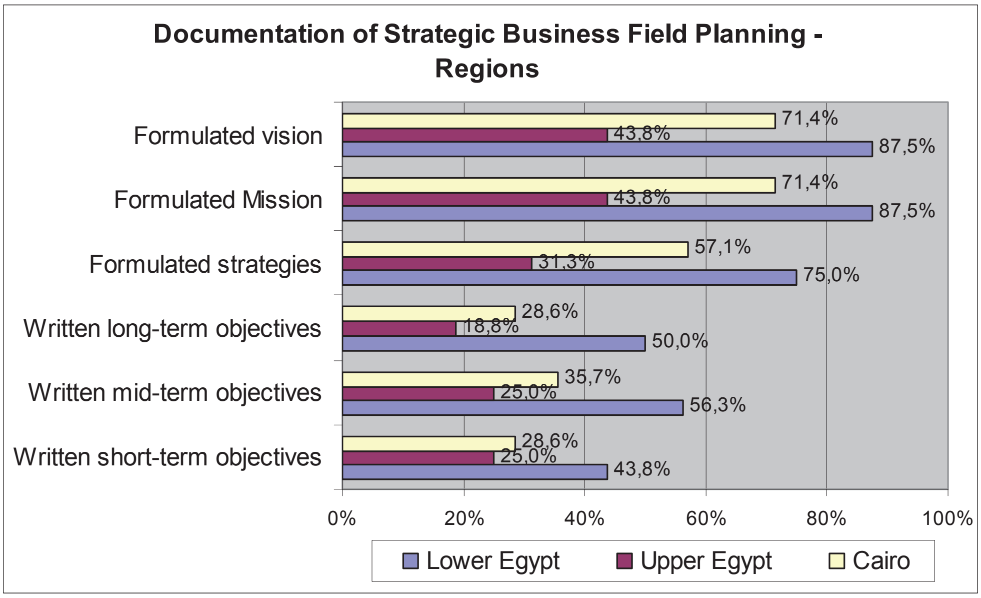


Fig. 75: Regional analysis of implemented and documented strategic plans

In terms of staff development, 40 out of 46 institutions have an internal strategy for developing their staff strategically according to the institutions needs. The strategies and methodologies, which are used, can be seen in more detail in Fig. 69. The most common methods developing human resources are internal trainings and education programs by own experts or experts from the university itself. Only 18 institutions are working with experts coming from the industry to train their staff. Regarding the research centers, about 50% of them are providing education programs or trainings held by experts from the industry.

Fig. 76: Strategies for internal staff development

Looking at the regional differences it becomes clear that the institutions located in Cairo are the most active and experienced ones in developing and training their staff by internal resources. They are running internal education programs and their staff is trained by own experts. Institutions from Lower Egypt are cooperating with experts from other institutions to train their staff. In Upper Egypt this method seems to be less common. The ratio of industry involvement in terms of staff development is almost equally distributed and rather low, as stated above.

Fig. 77: Strategies for internal staff development according to regions

5.3.3 Technology Management

5.3.3.1 Background

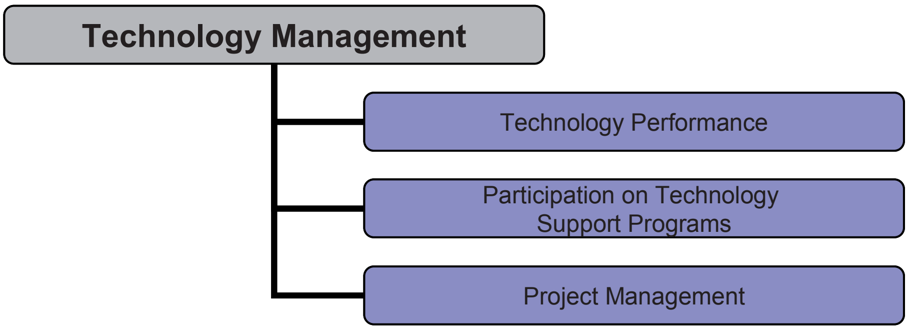


Fig. 78: Elements of the success factor technology-management

Technology Management centers the capability of research institutes to accomplish technology development. Therefore, the core competence of research institutes is their performance in technology development, especially the production of prototypes and demonstration objects. The quantity of applied patents and licenses could be an indicator for activities on technology development, but it would not represent the entire performance of research institutes concerning technology development. An important capability of research institutes is to develop complete system solutions like the combination of different technologies and techniques.

Besides the integration of technologies, a research institute must bring various key players together to fulfill an effective technology development and to cooperate in technology support programs acting as coordinator in such technology support programs or other network projects. This could be the key for the integrative function of these institutes.

In addition to other capabilities, an efficient project management is essential for a successful Technology Management. Particularly, the required interdisciplinary working procedures within projects regarding system solutions or technology interweaving need a well-organized project management.

5.3.3.2 Main Findings

In terms of capabilities in technology management, the performance of universities (including faculties) and research centers is apparently less profound. Almost 30% approximately of all institutions indicated to have no experiences in developing complete technical system solutions or in supporting technology interweaving. Therefore research and development remains specialized and limited to existing fields like specialized research units. There is no incorporation of technologies, which might add, enlarge or complement the research. The same applies to experiences with the development of prototypes and demonstrators. 30% of all institutions have no or just very little experiences in this field. Taking a closer look at the given answers by research centers reveals that nine out of ten have had experiences in the field of prototype construction or related activities like demonstrators. Universities and their faculties are less experienced with technological development and testing.

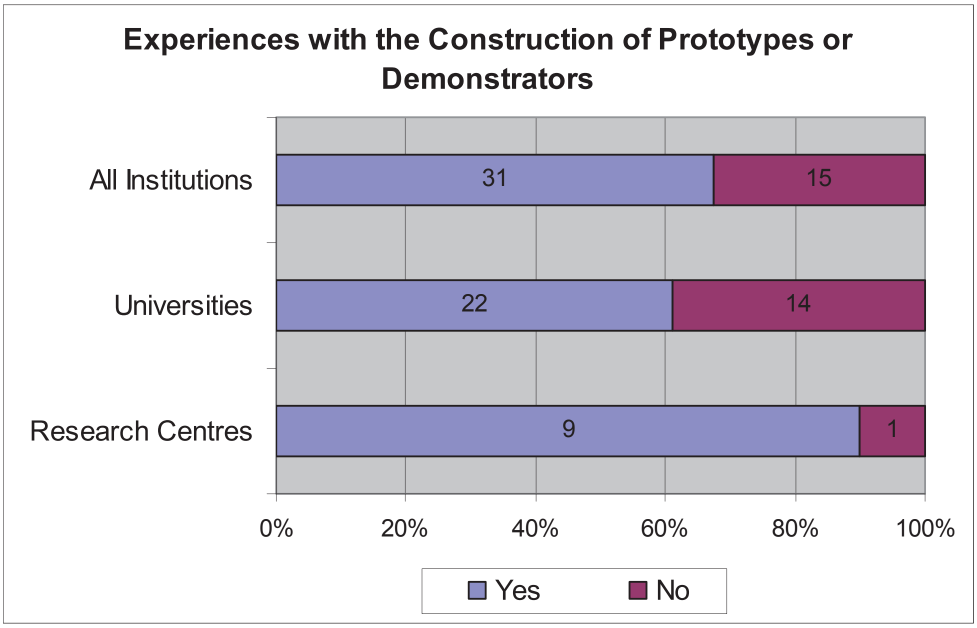


Fig. 79: Does the Institution have any experiences with the construction of prototypes or demonstrators?

A similar picture emerges in terms of patents and licenses. A majority of research centers applied for a patent or a license in the last five years, less than 50% of universities (including faculties) have done the same (see Fig. 80). All in all, less than 50% of all institutions have applied for patents or licenses to secure the results of their research activities. As the application for patents and licenses is generally rather uncommon in Egypt, the result of the R&D survey resembles the results of the industry innovation survey. There, the amount of patent applications for developed products or prototypes was also very low in comparison to other countries.

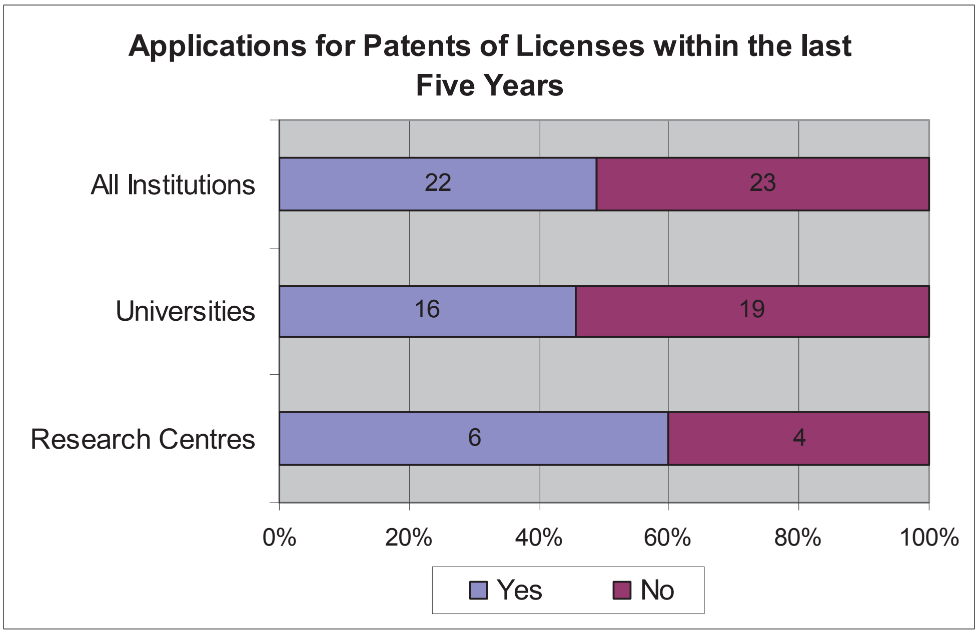


Fig. 80: Application for patents or licenses within the last five years

The regional activities in patent or license applications can hardly be interpreted. The reason why research centers in Upper Egypt indicated 0 % of patent applications is simply due to the fact that no research centers from Upper Egypt were participating in the study. Whereas the result of 100% reflects just the only one research centre located in Lower Egypt, which answered the questionnaire. An interesting fact is that universities in Lower Egypt seem to be the most active ones in patent applications. The greatest part is reached by 16 universities or faculties of universities, which are active in this field as shown in the figure above.

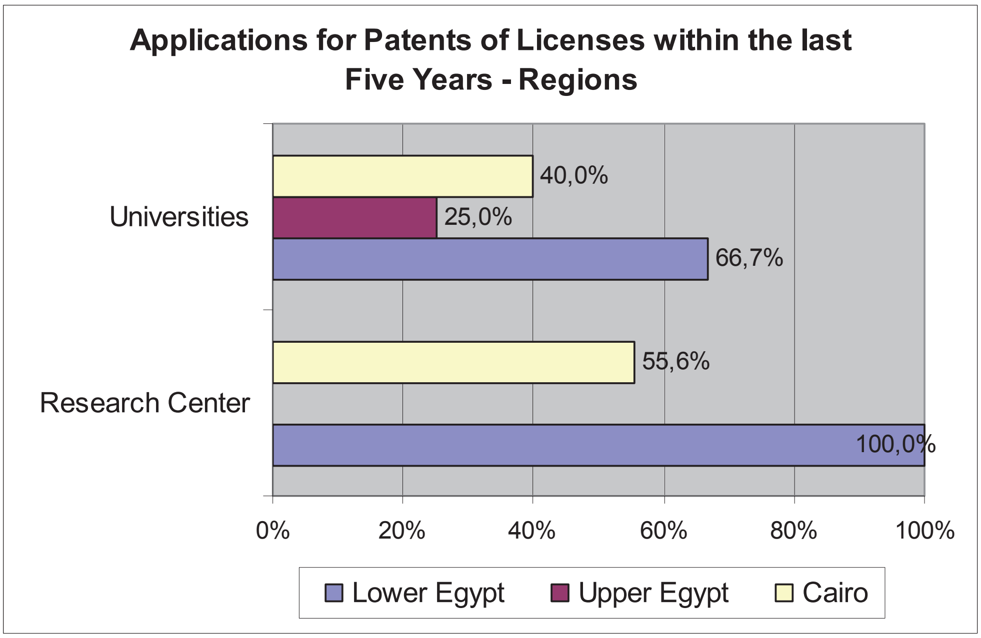


Fig. 81: Applications for patents and licenses in regions

5.3.4 Industry Relationship

5.3.4.1 Background

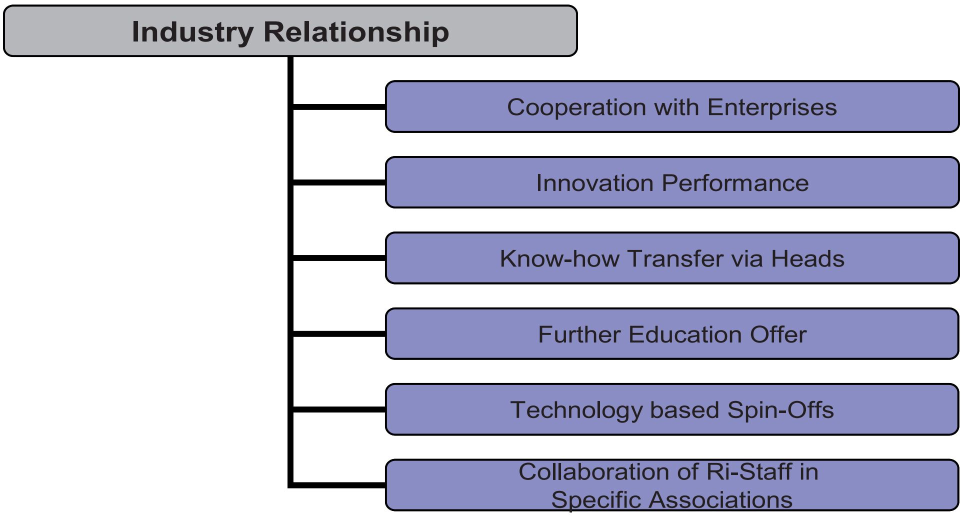


Fig. 82: Elements of the success factor industry relationship

A crucial characteristic of applied research is the close relationship with industry, especially with SMEs, to define the most relevant research needs. Regarding this, the cooperation with enterprises can be seen as the most important instrument.

Another main subject regarding Industry Relationship is the innovation performance of research institutions. This means new products will be launched in cooperation with enterprises. But as defined, innovation normally is the task of the economy and not of research institutes. Research institutes should support and strengthen the innovation process.

In addition to support the project or process, another important factor of Industry Relationship is the bi-directional know-how transfer via heads (staff). On the one hand, experienced employees from research institutes should change their jobs after their research career to industry to use their achieved knowledge in industry research, and on the other hand, researchers from industry should collaborate on specific research projects with research institutes, too.

But especially SMEs, which are struggling to survive in the market every single day can not achieve sufficient knowledge about current research fields and the status of applied research in various areas. Therefore, research institutes must manage a reliable further education offer for SMEs. SMEs must be strengthened to survive in the increasingly competitive markets.

Hence, the Industry Relationship of research institutes must especially focus on SMEs. Furthermore, the amount of technology based spin-offs of research institutes could be seen as the industry orientation of research institutes (industrial networking). Additionally, regarding Industry Relationship, the collaboration of staff of research institutes in regional, national or international bodies of experts, committees or professional associations plays an increasing role.

5.3.4.2 *Main Findings*

The relation and cooperation between research centers, universities on the one hand and industry on the other has to be looked at very carefully in Egypt. The study revealed that there are several ways and types of cooperation between research and industry. For example, chapter 5.3.2.2 outlined that indeed 18 out of 46 institutions are cooperating with industry for the training and qualification of staff. Especially research centers (50%) chose industry for staff development. Fig. 83 shows that 36 out of 46 institutions are cooperating with industry for joint research projects.

Regarding the follow-up activities or joint technical development, the ratio of institutions cooperating with industry is declining: just 50% of the respondents have indicated follow-up orders by their industry partners, and even less stated joint activities in terms of commercialization of results. Certainly, the majority of institutions cooperate with industry for one project but these activities neither lead to long-term partnerships for research and development nor achieve outputs successful enough to be commercialized as a product or technical solution for the market.

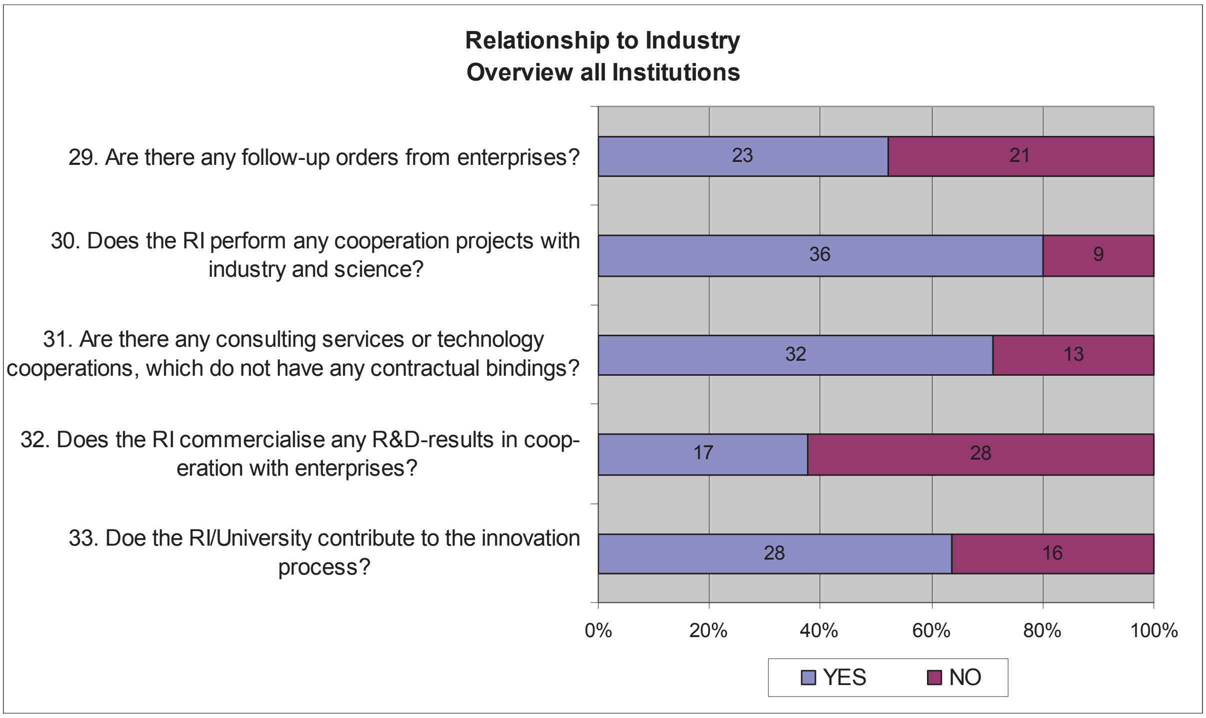


Fig. 83: Relationship to the industry

The regional analysis below shows some differences in the overall analysis. Again, universities and faculties in Lower Egypt as well as the only research institute in Lower Egypt are the institutions with the most frequent industrial relationships. Especially the question 31 regarding consulting services and technology cooperation and question 33 which is posed to ask about the contribution to industrial innovation processes were answered positively more often by institutions in this region. Universities (including faculties) from Upper Egypt are falling a little bit behind in all concerns about industry relationships. Cairo institutions (almost equally distributed between research centers and universities) are performing quite well in average, following up closely behind Lower Egypt.

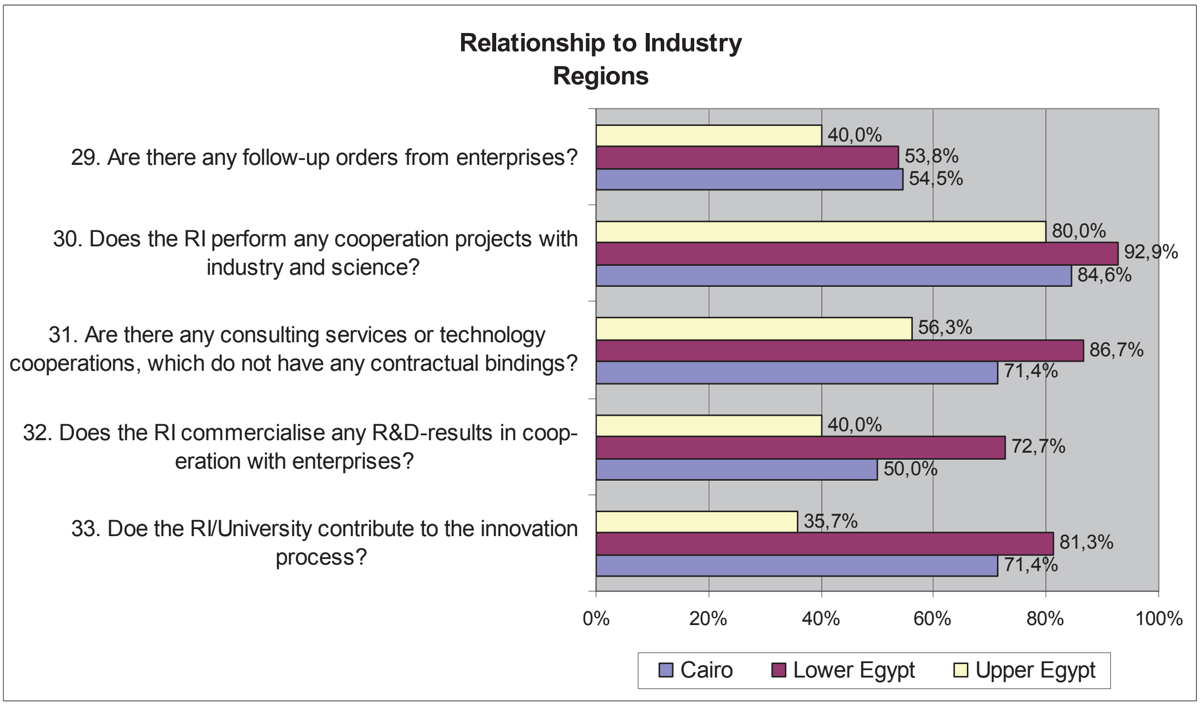


Fig. 84: Relationship to industry in regions

Having a look at the types of cooperation partners the major part of partners for joint projects are coming from industry or public bodies, like governmental institutions. Only a very small part is taken by small and medium-size enterprises. Most of the industry cooperation's deal with bigger enterprises, which are mostly active in technical development themselves and looking for further partners. SMEs are often less experienced with research and development and unable to initiate a suitable partnership for research and development activities. Getting in contact to big research institutions is often too complicated and too expensive.

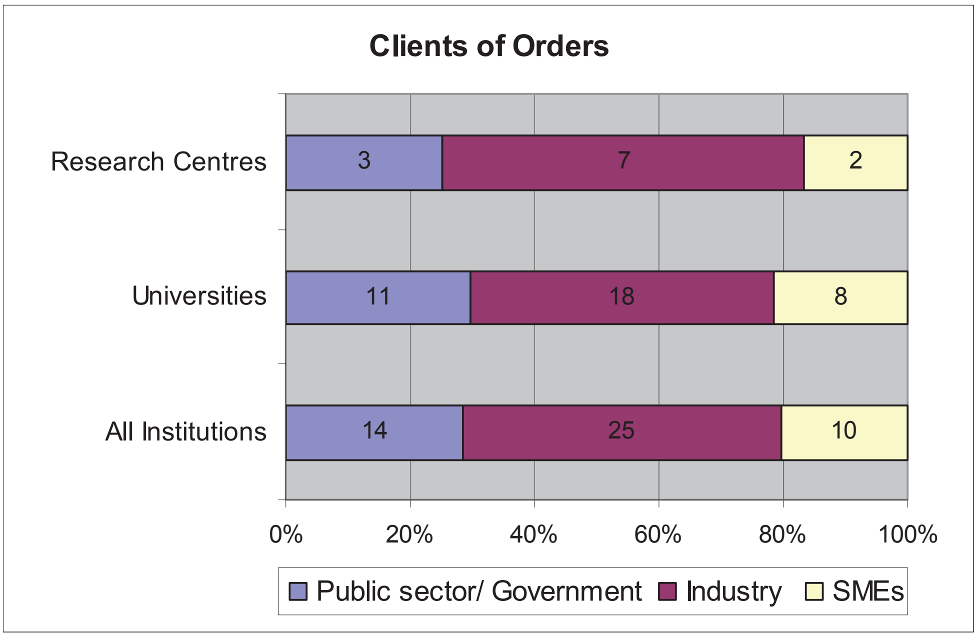


Fig. 85: Who are the clients of orders?

The answers given regarding the regional distribution of clients clearly indicate that Upper Egypt is leading in terms of SME collaborations whereas clients in the public sector seem to be less important. But Lower Egypt's institutions are also strong in collaboration with bigger industries as well as with the public sector. A reason might be that in Lower Egypt the regional concentration of industries is bigger which makes it easier to connect to each other. SMEs are more numerous and active in the region of Upper Egypt and therefore more frequently clients are universities, university faculties and research centers.

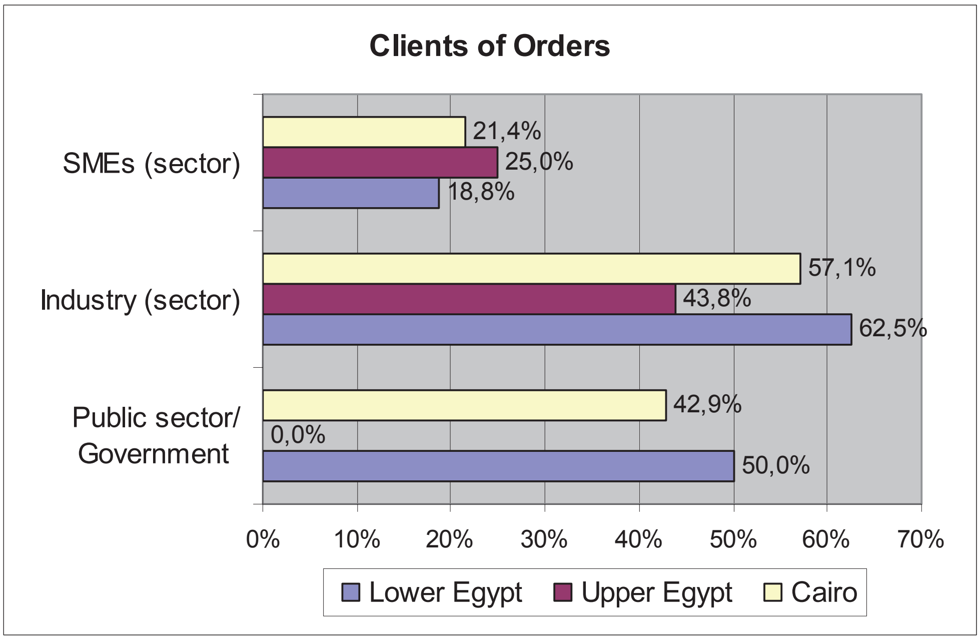


Fig. 86: Who are the clients of orders in regions?

A detailed analysis regarding the rate of SME as cooperation partners in the ratio of all cooperation partners reveals that around 20% of all institutions do not have at all SMEs as clients or partners. The ratio of research centers is even much lower. But at the same time 3 research centers and 3 universities indicated a percentage of SME partners and clients which is above 50% and therefore rather high.

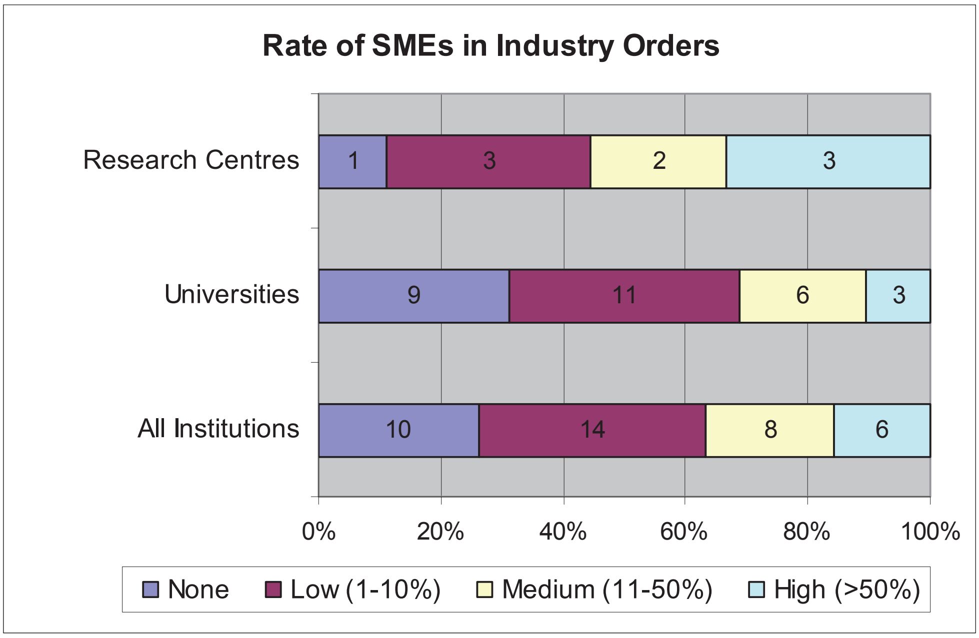


Fig. 87: Percentage of SMEs as clients from all clients

The distribution of industry orders differs within regions as expected (see Fig. 81). Due to the local proximity, different types of cooperation with different kinds of enterprises have been set up between the research institutions, universities and the economy. Especially in Lower Egypt the rate of SMEs from the total amount of orders is the highest compared to other regions.

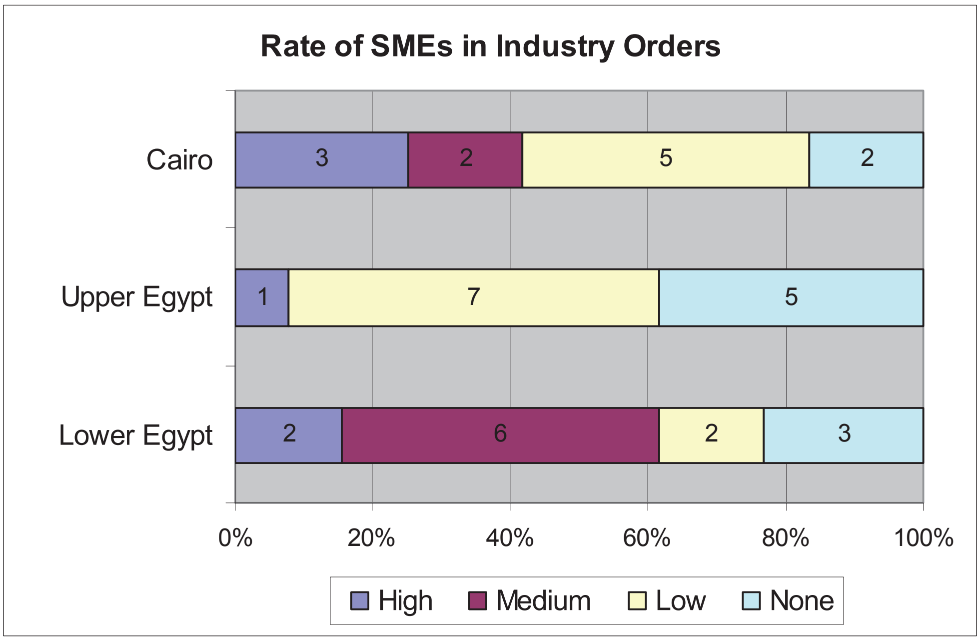


Fig. 88: Percentage of SMEs as clients from all clients in regions

In terms of innovation performance, the majority of institutions provided no answers regarding the type of innovation in which it is active in. Looking at the given answers, the major part stated to be active in the development of products. Surprisingly, this activity does not or very rarely leads to the development of prototypes or the application of patents. The specialties of patenting and licensing in Egypt have been already discussed in proceeding chapters. Also, the low rate of experiences with the development of prototypes and demonstrators has been discussed before. But Fig. 89 clearly indicates that indeed, there are activities in product innovation but these activities don't seem to lead to final products or technical solutions in a common sense. The future challenge would be, to identify why this innovation chain – from product innovation to prototyping to product development and to commercialization – is being interrupted and does only very seldom overcome the stage of product innovation.

This can also be proved by the fact that almost all institutions indicated that there have been no technology-based spin-offs ever. 27 of 46 institutions answered "no" when asked about the existence or their experiences with technology-based spin-offs. Only two institutions answered positively and gave examples of their technological spin-off activity. These cases can serve as best practice examples for the second phase of the project and therefore are analyzed in detail. The spin-offs were operated by one university in Cairo, the second spin-off was realized by one research centre in Lower Egypt in the Governorate of Alexandria.

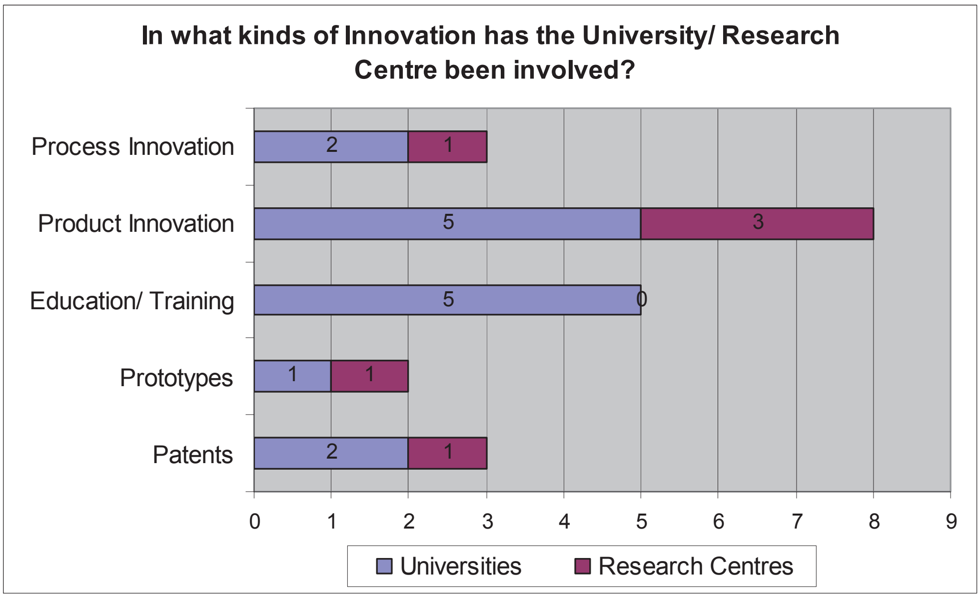


Fig. 89: Contribution to the innovation process

Coming to the point of know-how transfer via heads regarding the transfer of staff between university and research centre on one side and industry on the other seems to be a crucial step in order to effectively transfer knowledge from one side to the other. In most cases the transfer from the research centre/university to industry and the other way around is not being followed systematically. 30% of all institutions do not support at all the transfer between these sides. Those institutions, which support the transfer, do it only on an irregular basis. Just two institutions stated a regular transfer in both directions once a year. If staff is send, then the majority of staff is professors or assistant professors.

Having a look at knowledge transfer to industry and vice versa via events and trainings, the number of answers and activities of all institutions is higher. Almost 50% of all institutions offer seminars, workshops, conferences and technical trainings to industrial or SME clients and partners to transfer scientific and technical know-how. Again, the ratio among research centers is much higher than the ratio of universities (including faculties). Therefore, 7 and 8 out of 10 research centers offer the mentioned events to industrial clients (see Fig. 90). But as in the case of knowledge transfer via heads the frequency of these events is mostly irregular, in few cases annually. In a word, knowledge transfer is not systematically followed and scientific trainings, workshops or other events to industry or SMEs are not offered.

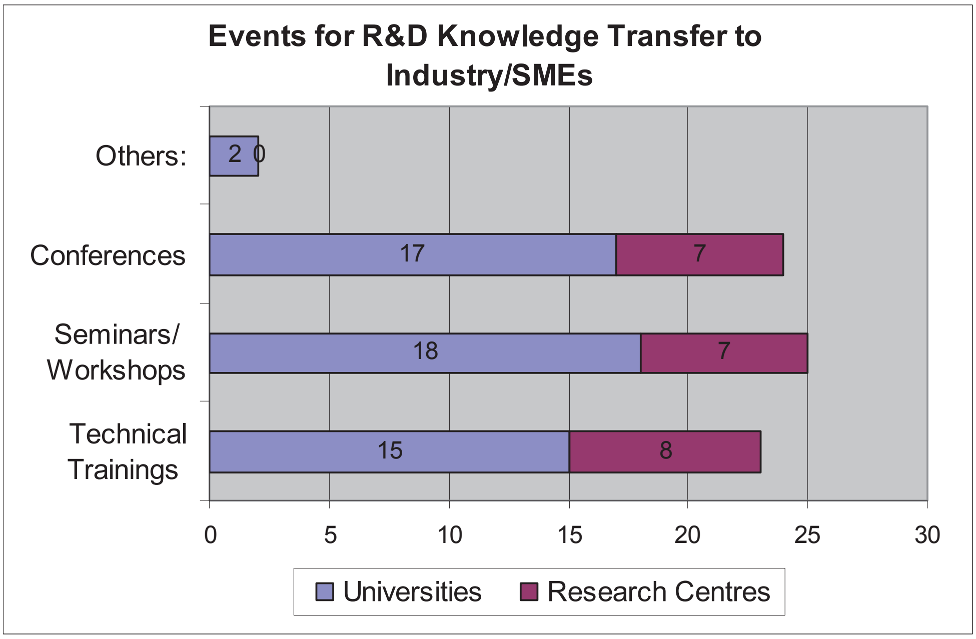


Fig. 90: Knowledge transfer between research and industry via events

Knowledge transfer can also be initiated by the active participation in specific associations. The study revealed that most institutions take actively or inactively part in a large number of associations. Especially scientific associations within the respective research fields of the centers or the faculties are frequently visited and participated in, nationally as well as internationally.

Again the only types of association underrepresented are industrial associations. Only one research centre stated to be member in an industrial association in its specific research area.

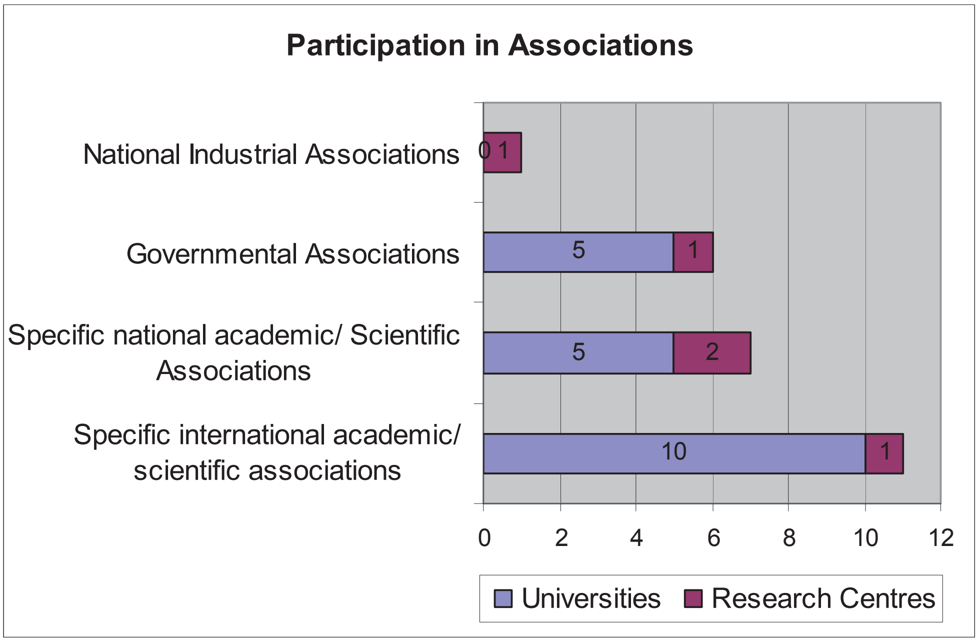


Fig. 91: Types of associations the institution is participating in associations

5.3.5 Relationship to Science

5.3.5.1 Background

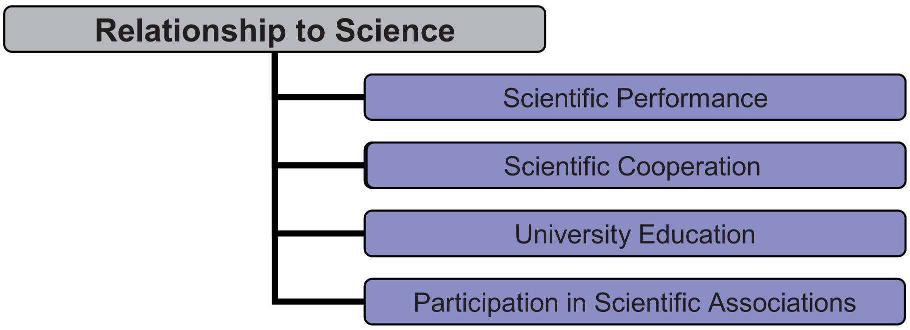


Fig. 92: Elements of the success factor relationship to science

Technological innovations are mainly based on results of scientific research. Applied research institutes act as a linkage between technological development in economy and science.

In this connection, regarding the scientific performance of research institutes, the importance of the Relationship to Science is increasing. It doesn't imply that research institutes should do more basic research, but they should enlarge their relationship as the scientific performance and the gain of reputation is very important to them.

Therefore, research institutes should also regularly take part in scientific projects as well as producing and publishing scientific knowledge. A good opportunity to establish a strong relationship to science is the direct scientific cooperation with universities or university faculties. Moreover, the participation in joint scientific projects together with research institutes or universities will back up the involvement in new science topics. Also, the participation in scientific conferences/seminars as well as the contribution to university education like giving lectures will improve the relation to science. A membership in scientific associations, which are focused on the research fields of the research institutes, can be useful to achieve further knowledge and information about questions of basic research.

5.3.5.2 Main Findings

Scientific Performance is hard to measure and cannot be reflected in numbers or directly indicators. The following analysis gives just a rough overview on some indicators like the number of scientific projects or publications. Nevertheless, these numbers have to be looked at critically in detailed interviews in order to provide a correct interpretation.

Looking at the number of scientific projects which are executed at the universities, meaning their faculties and research centers, research centers seem to have much more projects (finished and ongoing) than universities. Especially the numbers of projects funded internationally and in-house by own resources are significantly higher than those of universities (see Fig. 93).

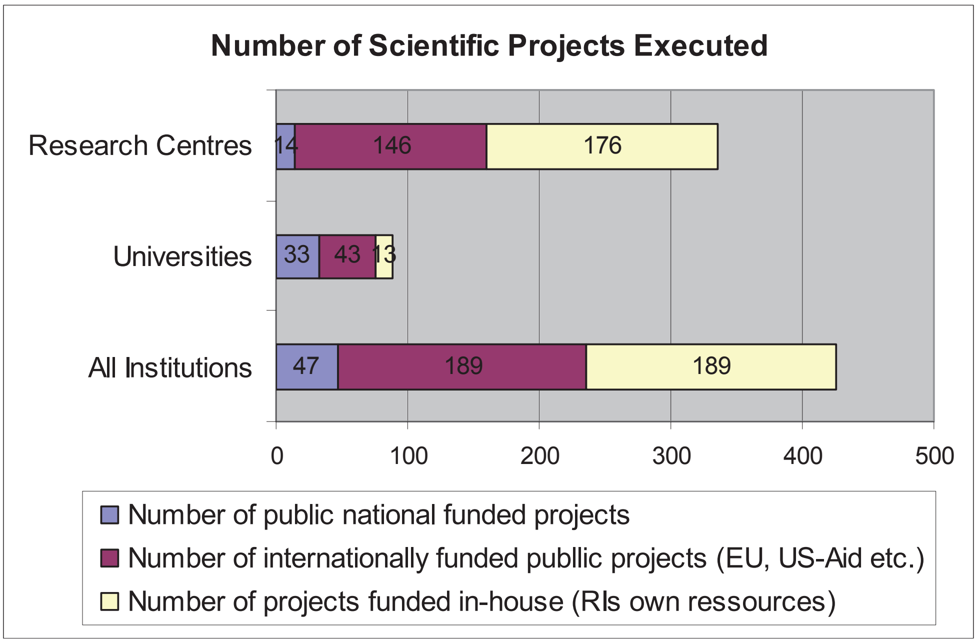


Fig. 93: Number of scientific projects executed by the institution

Also, the number of publications by research centers is much higher than those of universities (including faculties). The number of publications done by research centers altogether counts 2916, while universities published about 2951 articles and papers. Even if these numbers are not correct in detail, they indicate a tendency and ratio. Taking into account, that only 10 research centers took part in the survey compared to 15 universities, where 36 questionnaires were collected from presidents as well as faculty deans (27%), research centers are responsible for almost 50% of the scientific publications counted in this study.

In terms of scientific cooperation, all institutions perform on a very high level.

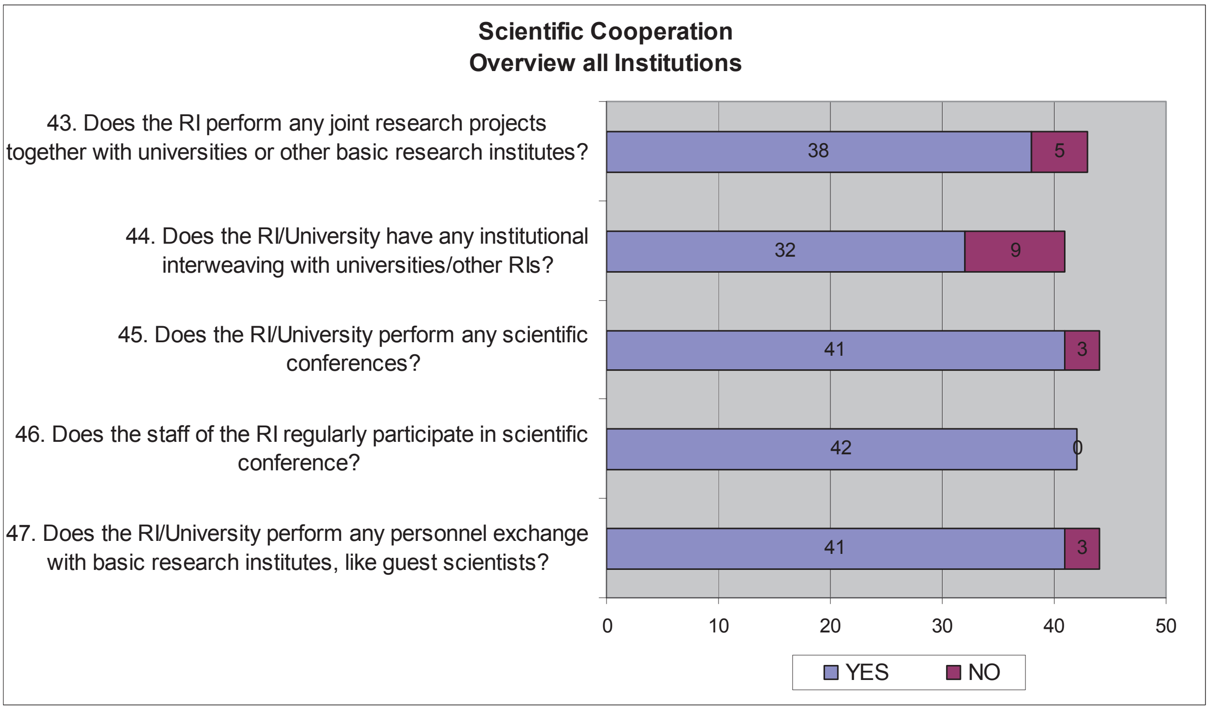


Fig. 94: Questions on scientific cooperation – overview all institutions

Most institutions take actively part in national and international conferences and are also in charge of the organization. They have cooperation projects with other research institutions and exchange scientific staff in order to promote scientific knowledge transfer (guest scientists, PhD exchange programs, guest lectures etc.)

University education is supported actively and most of the institutions have internal programs to support master and PhD degrees scientifically, technically and financially. Only at research centers, there seems to be a limited possibility to receive financial support. Only one research centre in Cairo is offering financial aids to their PhDs and other scientists whereby 12 universities or faculties from different locations are able to also offer financial support.

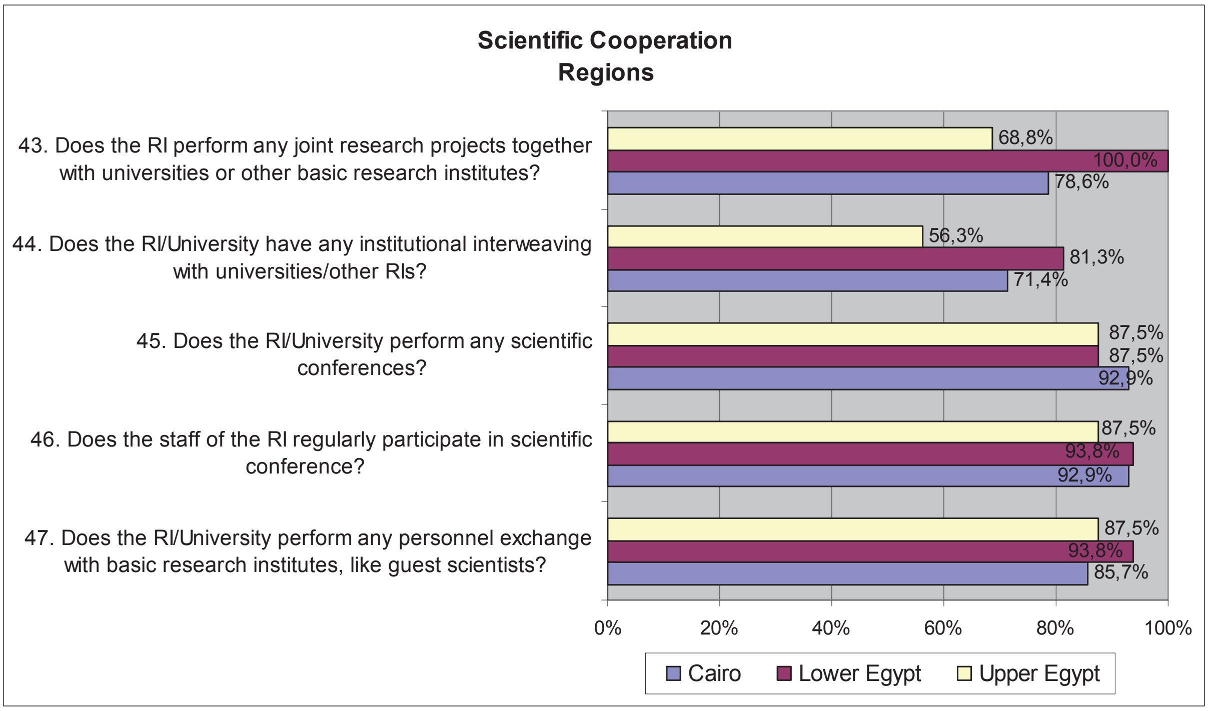


Fig. 95: Questions on scientific cooperation – regional distribution of answers

As the activities in terms of scientific cooperation are very high in general there are no major differences regarding this issue. Only Upper Egypt rarely practices institutional interweaving with other institutions or universities.

5.3.6 Communication Competence

5.3.6.1 Background

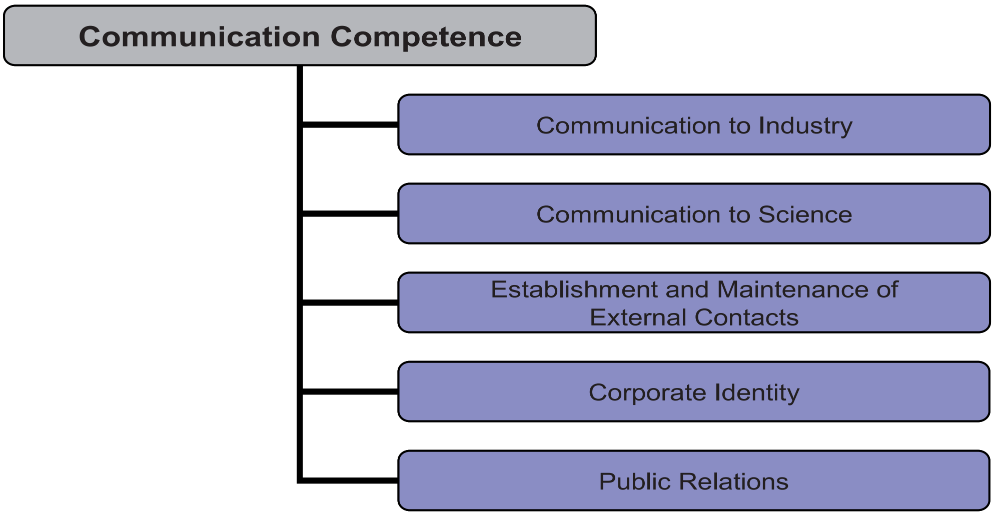


Fig. 96: Elements of the success factor communication competence

Research institutes are playing an intermediate role, as the linkage between basic research and industry, therefore the Communication Competence is especially a decisive success prerequisite. In particular, regarding the success factors Industry Relationship and Relationship to Science, the Communication Competence is of utmost importance.

Therefore, research institutes must set up a wide range of external contacts. Not only the head of a research institute should maintain these contacts but also project managers as well as the staff at the working level should continuously exchange information with the whole environment of research institute.

The view towards public representatives can be positively influenced if the research institute would establish a common corporate identity. In addition to the maintenance of contacts, another major element of the Communicative Competence is the impression, which the research institute is giving to its environment. Externals must have an easy access to the competencies and capabilities of the research institute. Moreover has to be ensured that sufficient information about the overall performance of the research institute except for confidential information will be obtained. This kind of communication can be explained as part of systematic public relations.

5.3.6.2 Main Findings

Concerning public visibility of the institutions, almost all institutions have implemented several activities and measures to communicate their institution and its research activities to the public. Especially brochures and flyers of institutions and/or ongoing projects are regularly published to inform the public about recent activities. These activities and services are often managed decentralized by the respective faculty or research unit. Less common are centralized public relations offices, which are in charge of the profile and representation of the institution as a whole to the public.

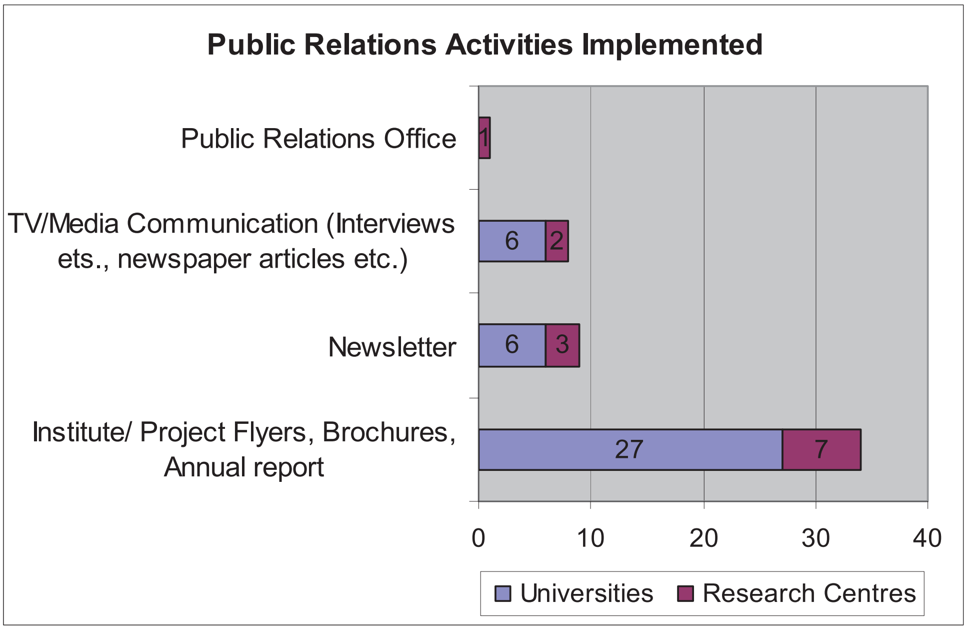


Fig. 97: Activities for public relations

This might be the reason why the majority of institutions do not really have or build up a corporate identity. Of course websites, logos and brochures are all available, but the responsibility is decentralized and therefore single initiatives are not coordinated and further do not follow a common design or standard for the whole institution. This applies especially for universities or university faculties. The majority of research centers have a common website, a common logo or common flyers and brochures (almost 50%). The ratio is even lower at universities and their faculties just 20% approximately of them are providing such common centralized services to their faculties and units.

Regarding the performance of events for the public, the majority of research centers and universities offer different types of events (see Fig. 98). Especially seminars and workshops are offered regularly to inform externals and also possible future clients about the activities and research topics performed at institutions.

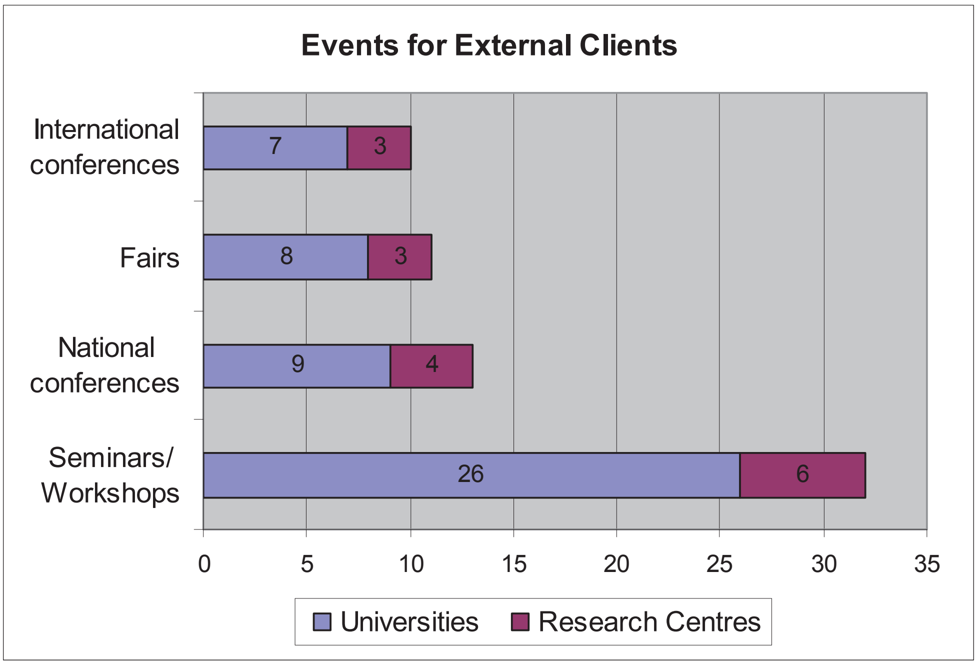


Fig. 98: Events offered for external clients

5.3.7 Organization and Management

5.3.7.1 Background

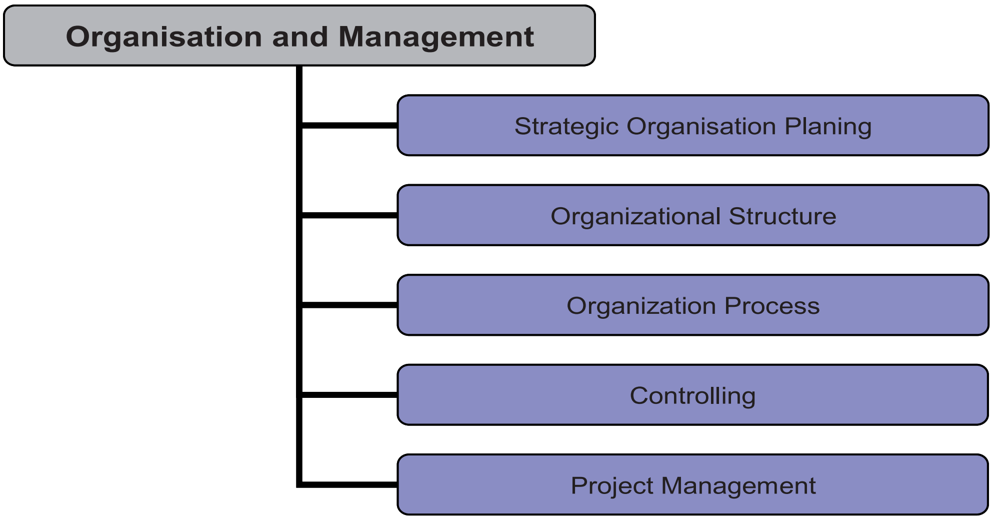


Fig. 99: Elements of the success factor organization and management

Organization and Management can be regarded as the basic success factor for research institutes. Since competition exists also in the sector of research institutes there must be a flexible and effective organization as well as a target oriented management.

Research institutes need a specific surrounding so that their employees have a sufficient scope to be creative. Therefore, the organizational structure must dispose of flat hierarchies and must be adapted to respective circumstances. Furthermore, to manage the mostly very complex assignments, the organization should consist of interdisciplinary working teams. A certain grade of fluctuation is important so that new ideas can slip into research institutes.

The process organization should also be set up with respect to the circumstances of research institutes. A wide spread of responsibility allows free and creative potential. The head of the research institute should rather focus on long-term or mid-term objectives than on the short-term objectives within specific projects.

Another major element of the success factor Organization and Management is the implementation of an effective project controlling. Especially the ability to observe the turnover, the overall budget planning, and the ability to realize an effective budget-control is an important aid for the overall management.

5.3.7.2 Main Findings

Concerning the organizational structures of the institutions, the majority is being organized in a centralized way as a pyramid. Matrix or project structures are less common for the overall organizational structure. Nevertheless, they are used by some institutions; both research centers and universities for specialized subunits or research teams. Especially if new research topics are established, more flexible organization structures are applied in new research subunits.

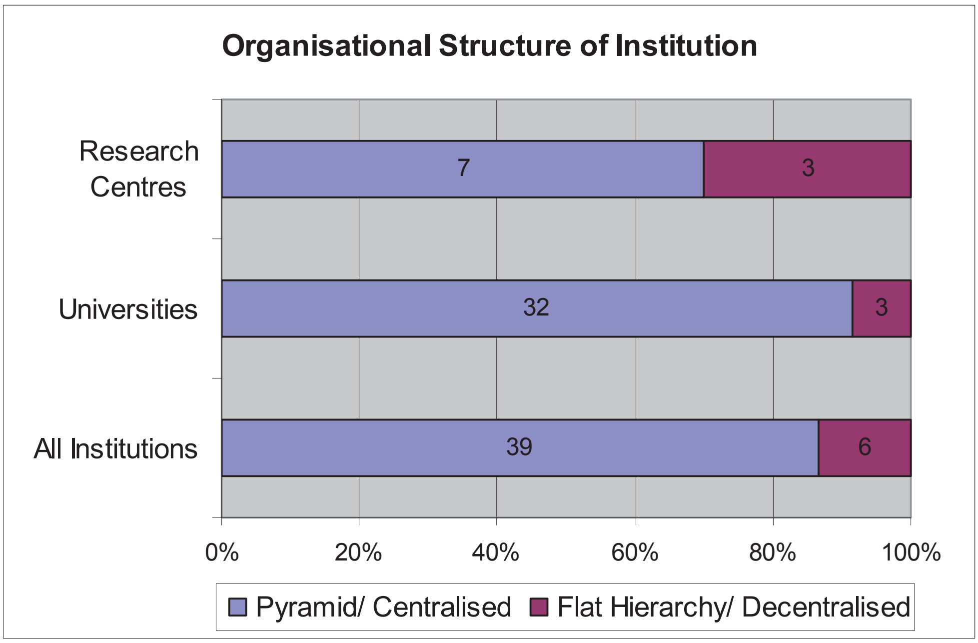


Fig. 100: Organizational structure

In terms of staff planning, the research centers seem to have a higher flexibility. While the staff recruitment and planning process is organized centralized within universities and faculties, more than 50% of research centers are following a decentralized approach in this field. Decentralized personnel planning leaves more space for flexibility and internal demands regarding human resources as well as it can be better aligned with the overall personnel strategy.

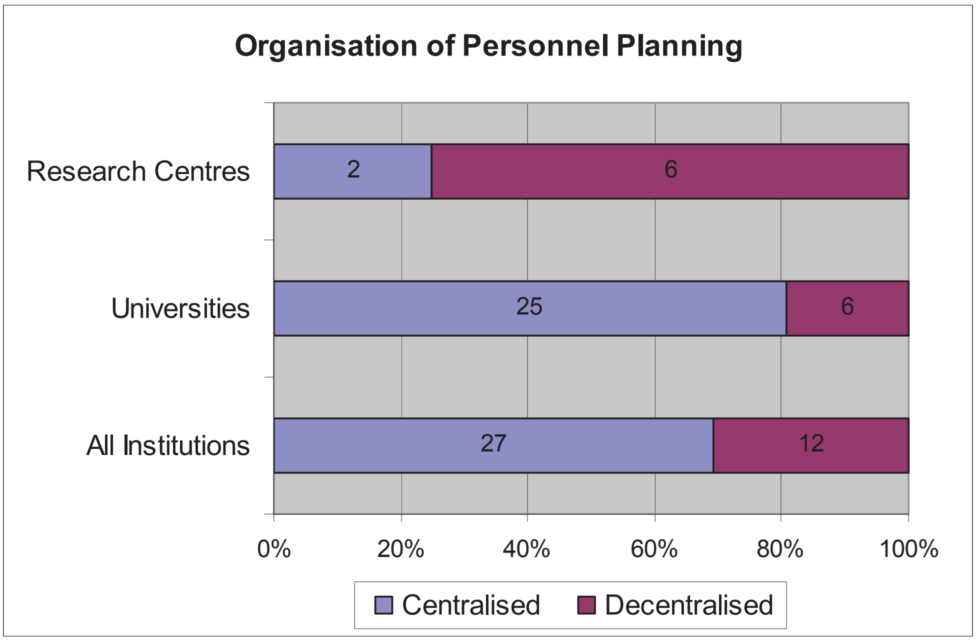


Fig. 101: How is the planning of personnel organized?

Looking at the use of budget controlling tools, the smaller part of institutions has implemented centralized departments, which are responsible for the controlling of project or the overall university budget. Some universities or university faculties have contracted an external agency for this purpose.

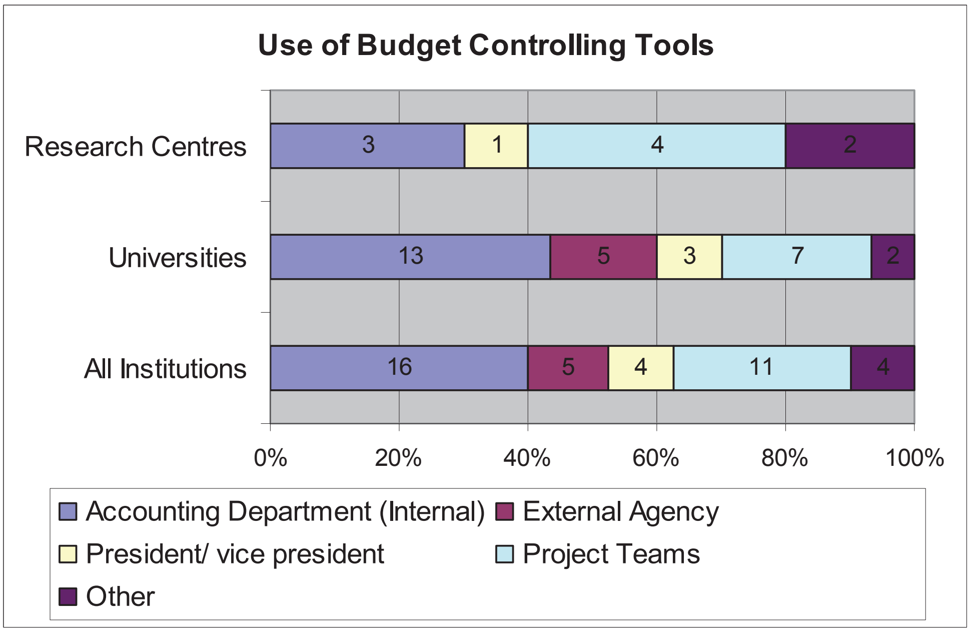


Fig. 102: Types of budget controlling tools implemented.

Almost 50% of the research centers chose a decentralized approach for budget controlling and organize this process within the research or project teams.

5.3.8 Human Resources

5.3.8.1 Background

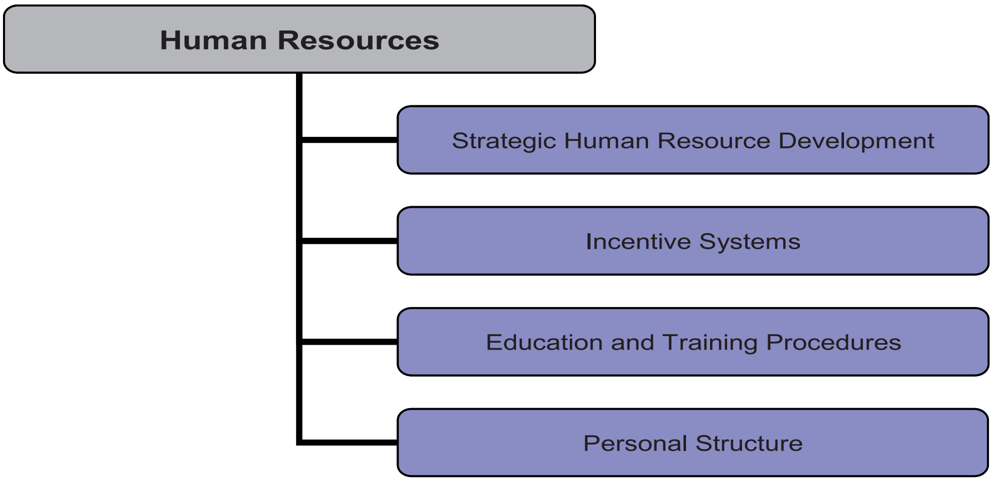


Fig. 103: Elements of the success factor human resources

Human resource management is essential to guarantee a certain grade of productivity and creativity. Employees must be qualified, motivated, and creative to fulfill the purpose of research institutes. Therefore, the set up, the maintenance, and the development of Human Resources must be another major task of each research institute.

As mentioned before, the structure of personnel in a research institute must assure the creation of interdisciplinary working teams. This means to have an effective rate between professionals (scientists, engineers), technicians and assistances, a specific internal flexibility in staff-planning, a well-balanced age structure of staff, and a well-balanced renewal rate of staff.

Furthermore, an effective human resource management should also contain incentive systems to stimulate the motivation of staff.

The implementation of education and training procedures is another key element for the management of human resources. Such training procedures have to focus on both professional training and individual trainings.

5.3.8.2 Main Findings

Although the majority of personnel planning is organized centralized within the institutions, the flexibility in staff planning seems to be seen as suitable and the existing qualification matrix works out well within the majority of institutions. The remaining problem seems to be the achievement of a well balanced age structure. 30% of the institutions do not have a strategy to find a good ratio between experienced research staff, professors and young scientists.

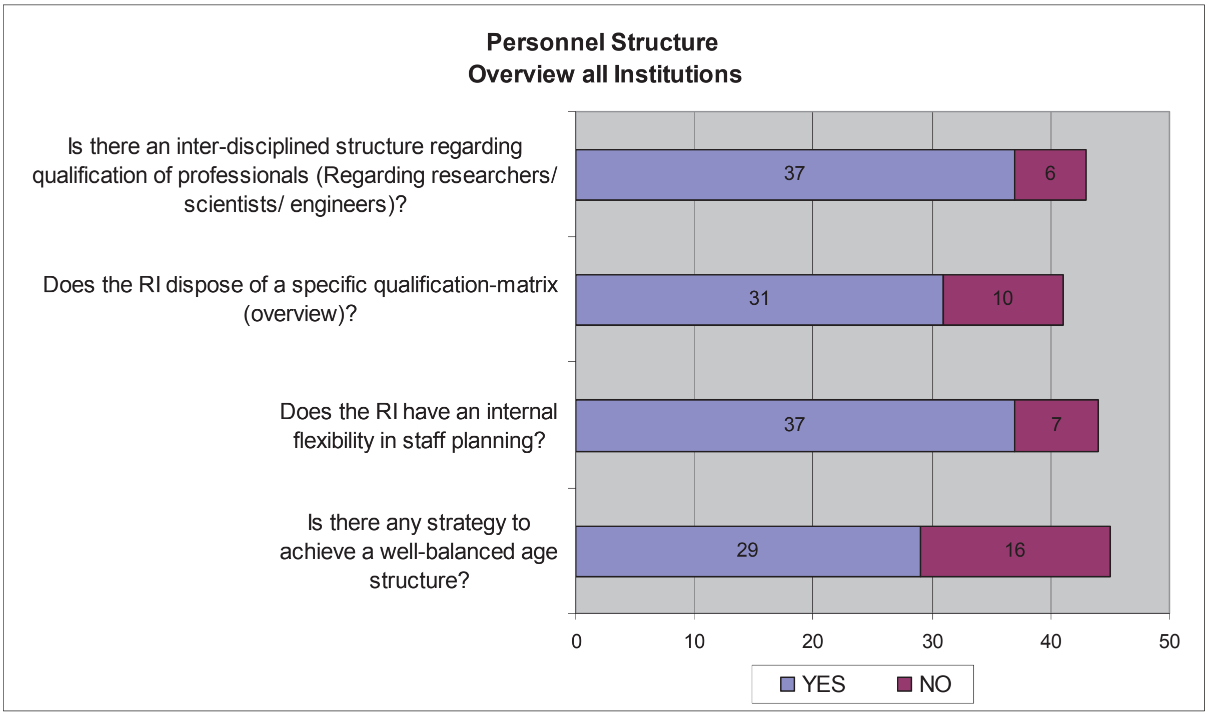


Fig. 104: Answers regarding personnel structure

Looking at the differences in personal structure in the regions, institutions – in this case all universities (including faculties) – are exceptionally successful in building up an inter-disciplined structure of professionals. However, Lower Egypt institutions seem to be less active in personnel planning and have less frequently implemented a specific qualification matrix.

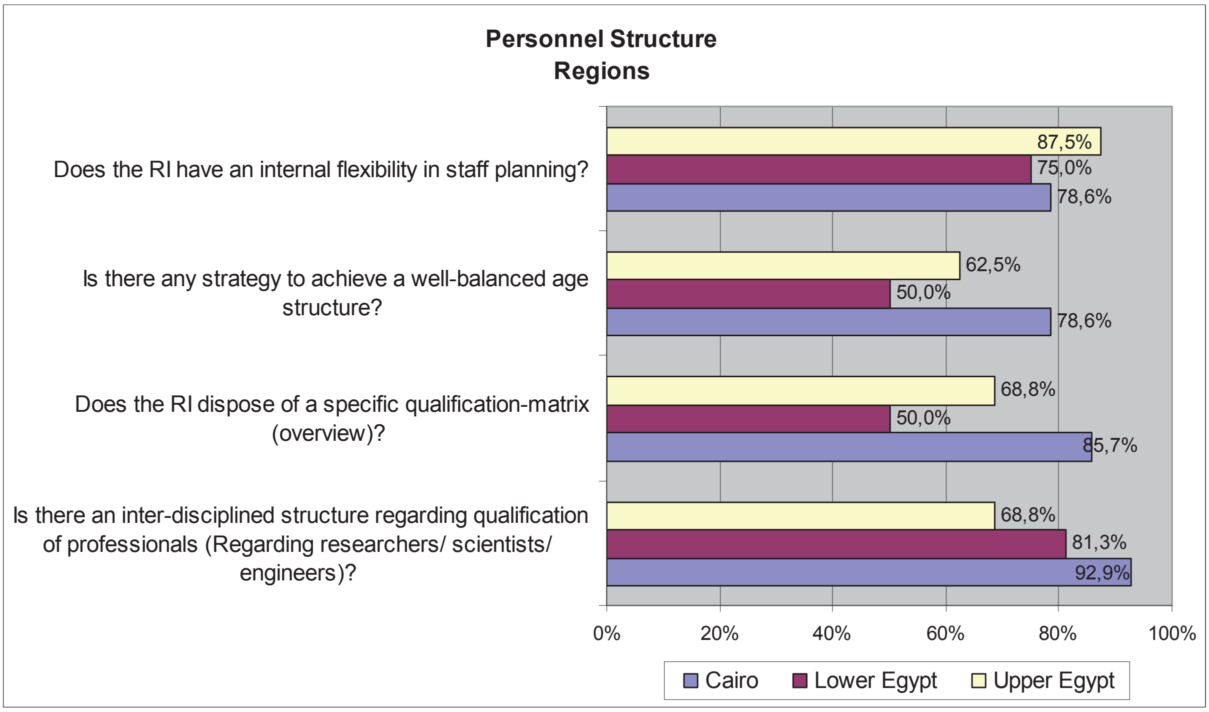


Fig. 105: Answers regarding personnel structure in regions

The most common strategy for the recruitment of new staff is the recruitment of graduates who finished their degree at the university itself. This means that new staff is employed already well acquainted with the place of work and the working procedures when starting the new job. Only very few universities hire new staff from outside of the institution. If so, then staff is employed through fellowships, exchange programs or simply announcements in newspapers or specialized scientific magazines and periodicals.

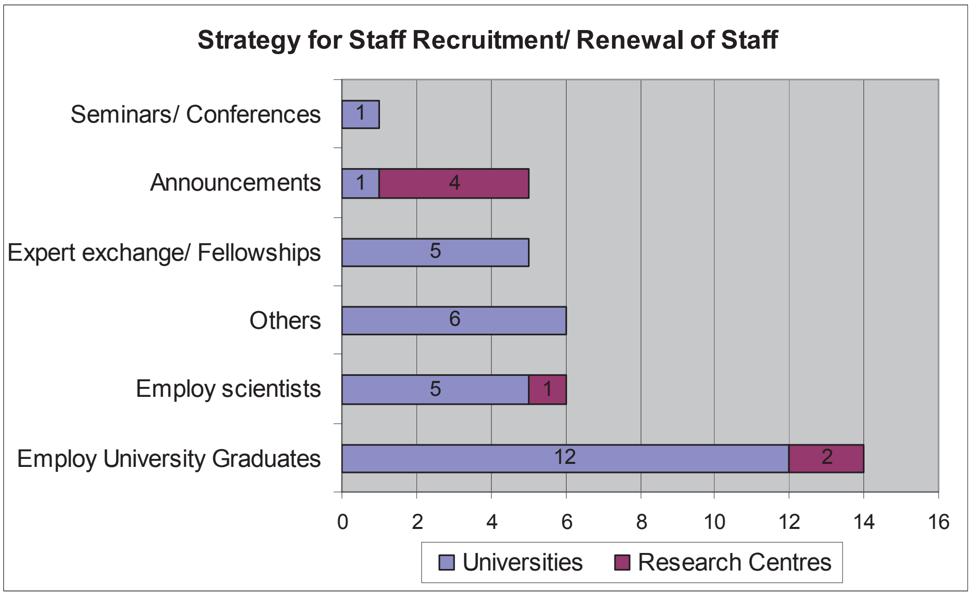


Fig. 106: Procedure of staff recruitment

The majority of institutions have implemented an incentive system for their employees (35 out of 46 institutions). The main reason for the realization was motivation; less important seemed to be the improvement of quality in teaching and education (see Fig. 107). The improvement of research results has been a reason for 50% of the research centers. Now the question arises if there are also mechanisms to control the effects of the incentive systems and how the effect of the system can be measured or if the systems need improvement in the future in order to achieve the desired results mentioned in the figure below.

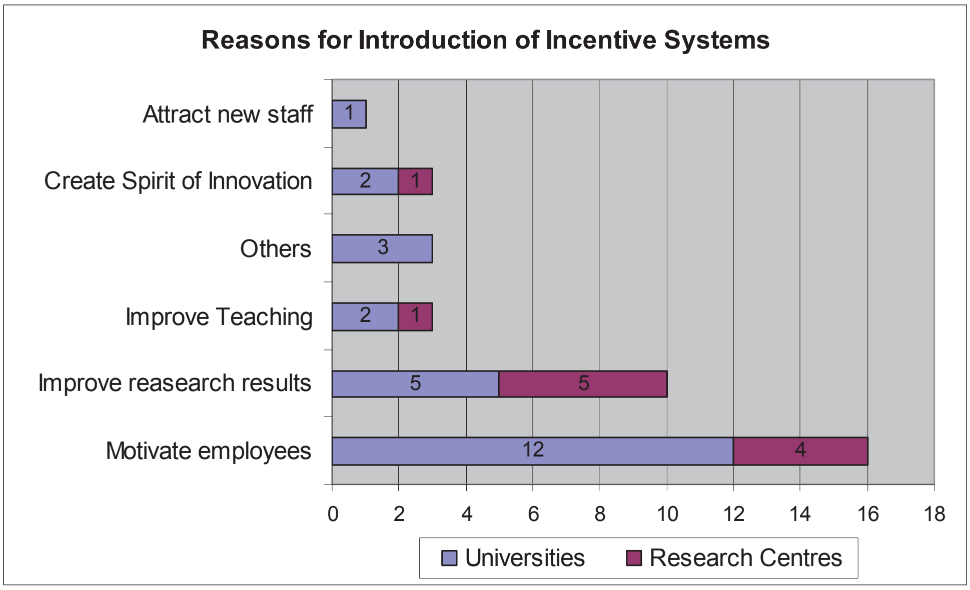


Fig. 107: Reasons for the introduction of an incentive system

5.3.9 Scientific Technical Equipment

5.3.9.1 Background

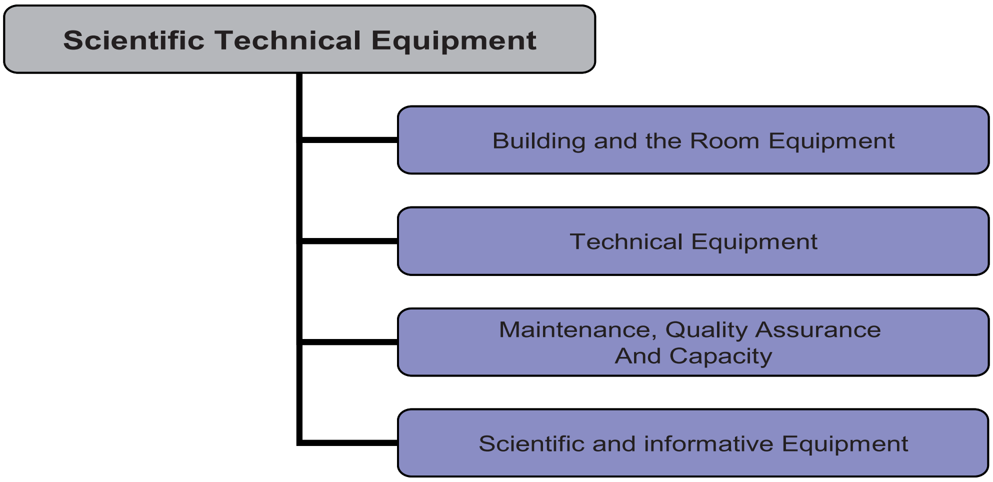


Fig. 108: Elements of the success factor scientific technical equipment

As mentioned before, the intermediate role of research institutes – between basic research and industry – besides the theoretical and scientific research is to fulfill practical and technological tasks. Therefore, research institutes must dispose of a Scientific Technical Equipment to realize various project objectives.

In addition to Scientific Technical Equipment, the building of a research institute should be able to fulfill the overall objectives. Rooms must be equipped in the way that the necessary background for R&D tasks is given.

Specific Technical Equipment must be the core of each technical oriented research institute, especially equipment for data processing or laboratories, measuring instruments and testing apparatuses, workshops and production technology.

Further to the existence of equipment, the state of art is very important. Therefore, the process of maintenance, quality assurance and capacity is playing another major role.

A research institute must dispose of well shaped scientific and informative equipments, like libraries and databases, to support an effective access to needed information. A key element regarding scientific and informative equipment is the access time to achieve the relevant information.

5.3.9.2 *Main Findings*

Most institutions are equipped sufficiently with networks and technical infrastructure within the buildings, rooms and research labs. Most of the institutions are equipped with a computer network connecting the whole institution. Only one University is handling its data processing manually and not via electronic networks.

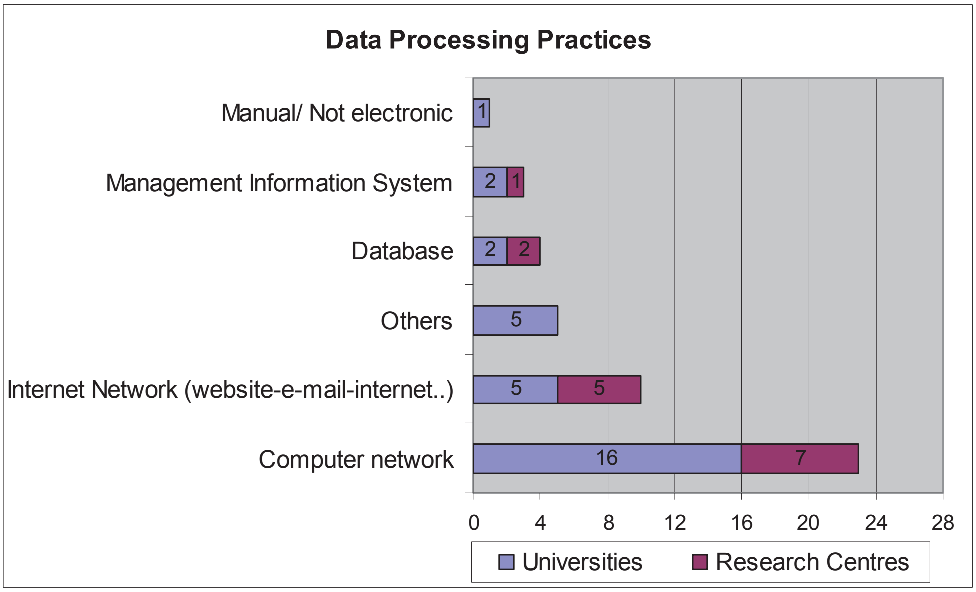


Fig. 109: Practices of data processing

Most of the institutions stated, that they perceive the technical equipment as suitable. Generally, universities seem to be a bit less dissatisfied with the technical standard within their institution. Maintenance of technical equipment is organized either by internal staff (own technicians or supporting staff) or by external agencies (maintenance contracts).

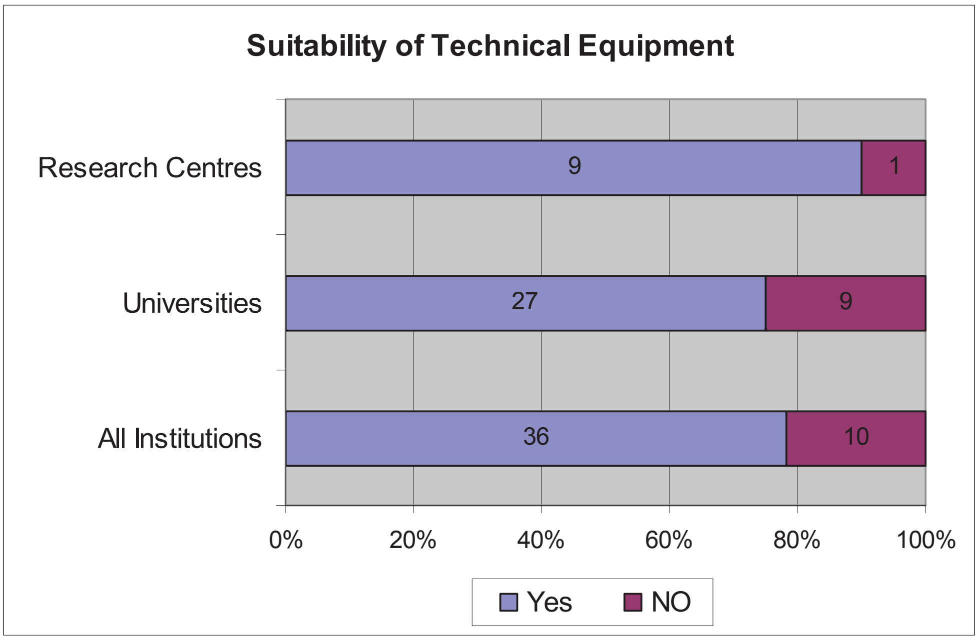


Fig. 110: Suitability of technical equipment

Concerning the attractiveness of the technical equipment in research labs and construction labs, only about 20% of the universities stated, that the technical equipment is used for academic research only. Almost 30% of universities (including faculties) and almost 50% of research centers stated that their equipment is attractive to the industry and is also used within industry projects and research.

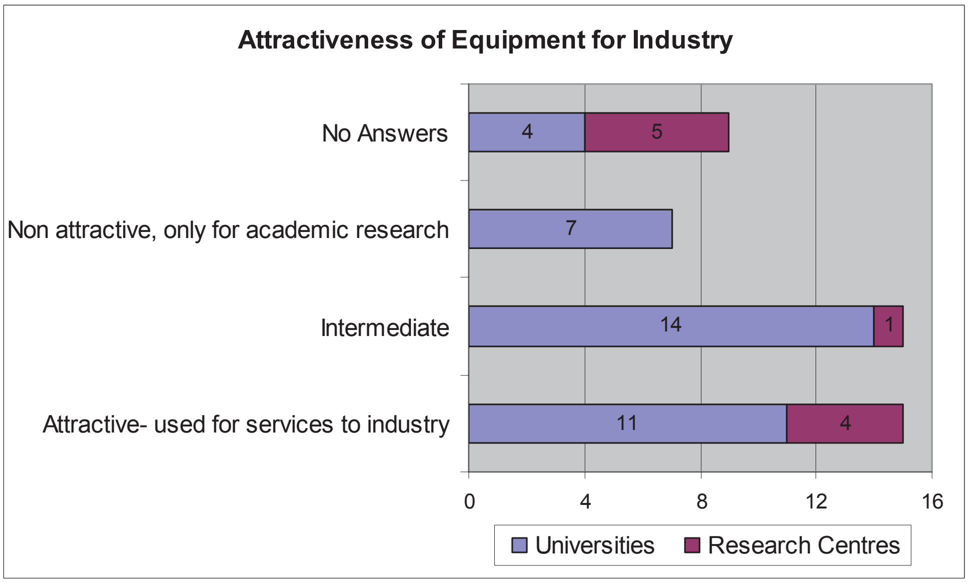


Fig. 111: Attractiveness of institutes' technical equipment for industry

In terms of the grade of attractiveness of research equipment for industrial use, institutions located in the Lower Egypt region are more often convinced of suitability of their equipment for industry than the other regions. Institutions from Cairo were not able to answer the question and picked "no answer". The equipment was assessed as intermediately useful by institutions from Upper Egypt.

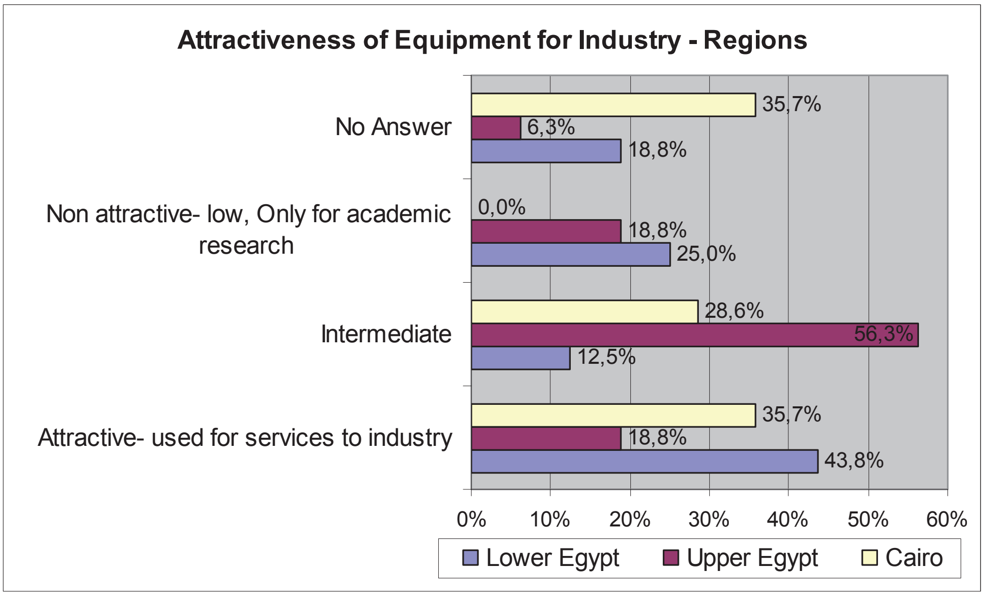


Fig. 112: Attractiveness of institutes' technical equipment for industry in regions

5.3.10 Financing

5.3.10.1 Background

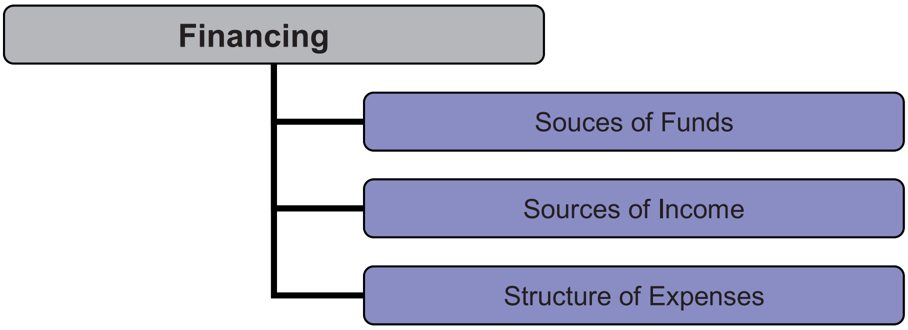


Fig. 113: Elements of the success factor financing

A financing system to provide the capital for R&D is essential to enable the function of a research institute. Consequently, the source and availability of capital, and the development of capital flows are very important for the financial security of a research institute.

The surveyed research institutes mostly dispose of different sources of funds. They often have a specific amount of basic/public funding and a contract based funding through R&D projects. Normally, the basic/public funding is decreasing over the years, because after a certain time of existence, a research institute should be able to secure it self-financing through projects in addition to a critical mass of public funding.

Additionally, the sources of income should vary among specific fields. The income should be balanced between R&D projects, consultant services, execution of studies, and education and training efforts. Furthermore, income out of licenses and patents is desirable.

Besides the income structure, the structure of expenses is relevant too. Especially the staff expenses can be critical over time, and so the amount and development of material costs must be considered.

5.3.10.2 Main Findings

This part of questions aims to identify the major sources of income of the institutions. Generally, the majority is involved in governmental projects and receives funding from the public sector (36 out of 46). They are involved in regional, national and international projects and receive funds and grants from those sides. Clients who frequently order projects or ask for cooperation make up the smallest part of the overall budget from the institutions.

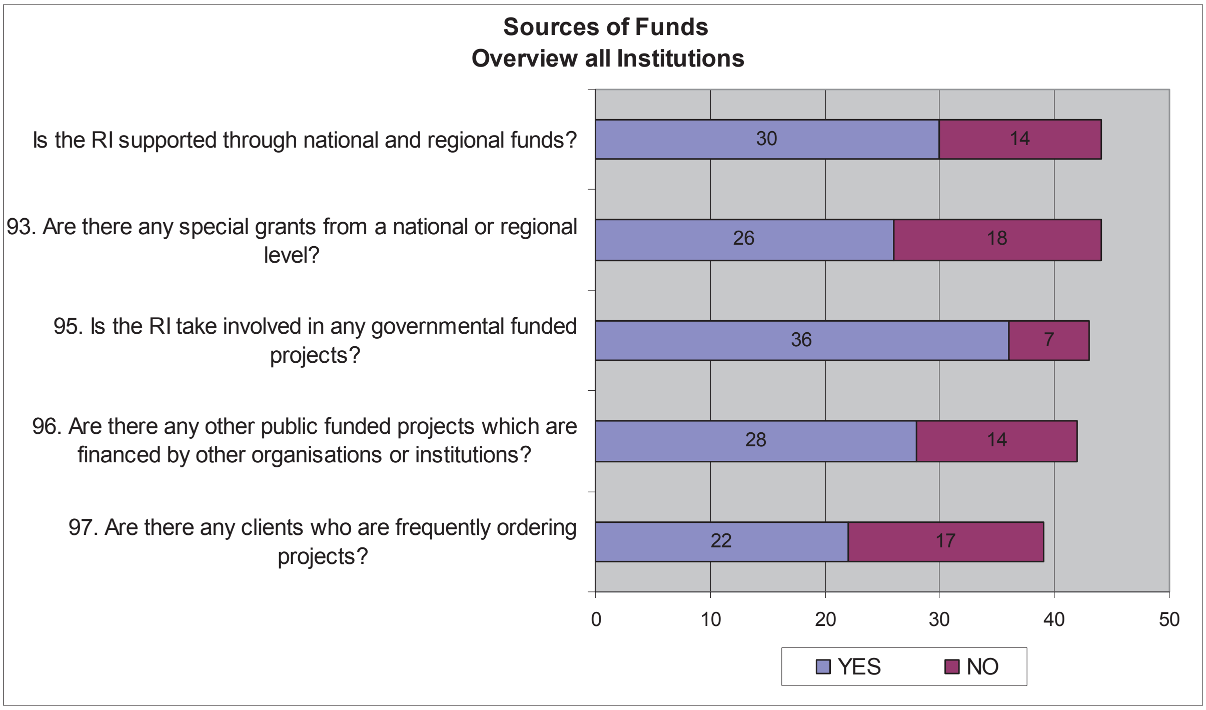


Fig. 114: Answers regarding sources of funds – overview all institutions

Regional differences can also be identified in the sources of funds of the institutions (see Fig. 115). Especially institutions from Cairo are mostly involved in governmentally (question 95) or public (question 96) funded projects. Generally, the ratio of clients frequently ordering projects is the lowest compared to other regions, indicating that research institutions from Cairo are much more depending on public funding, may it be regional, local or international. The Upper Egyptian institutions are below average concerning all questions, which might indicate a lack of funding in general in this region. This might be explained by the fact, that all research institutions involved in the survey from Upper Egypt are universities and university faculties.

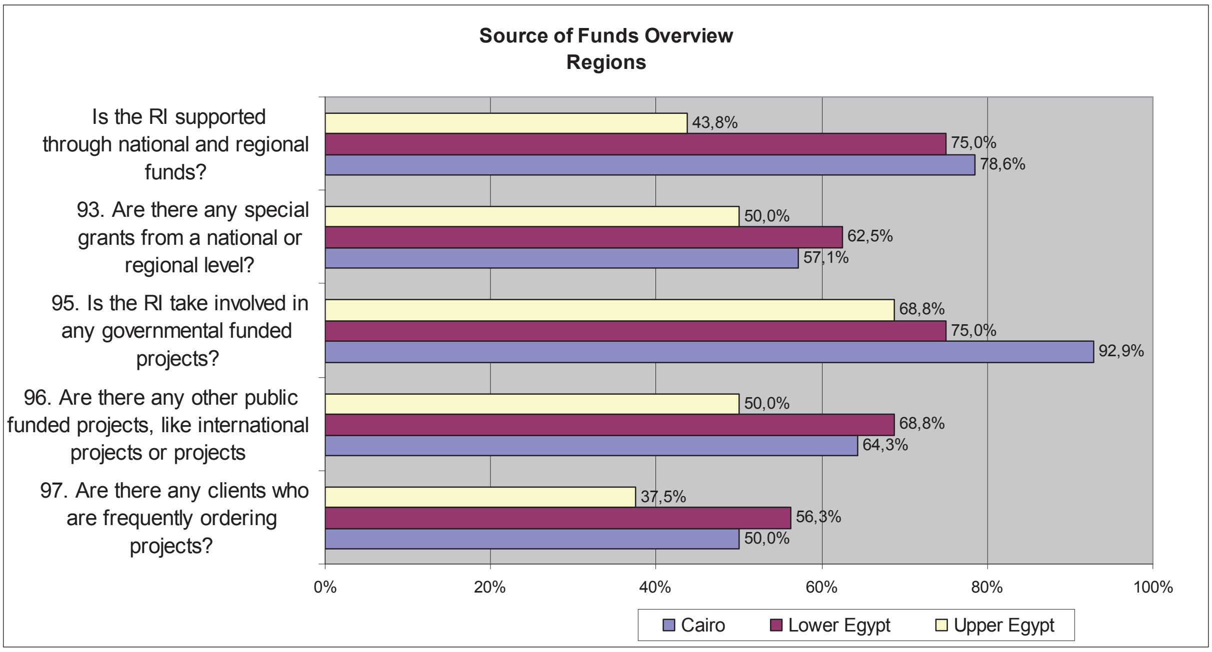


Fig. 115: Answers regarding sources of funds – overview all institutions in regions

Having a closer look at the sources of funding reveals that research centers are much more dependent and involved in funding from international sources than universities, regional funding does not seem to play a role for these institutions. For universities, national funding is more important than international funding sources (see Fig. 116).

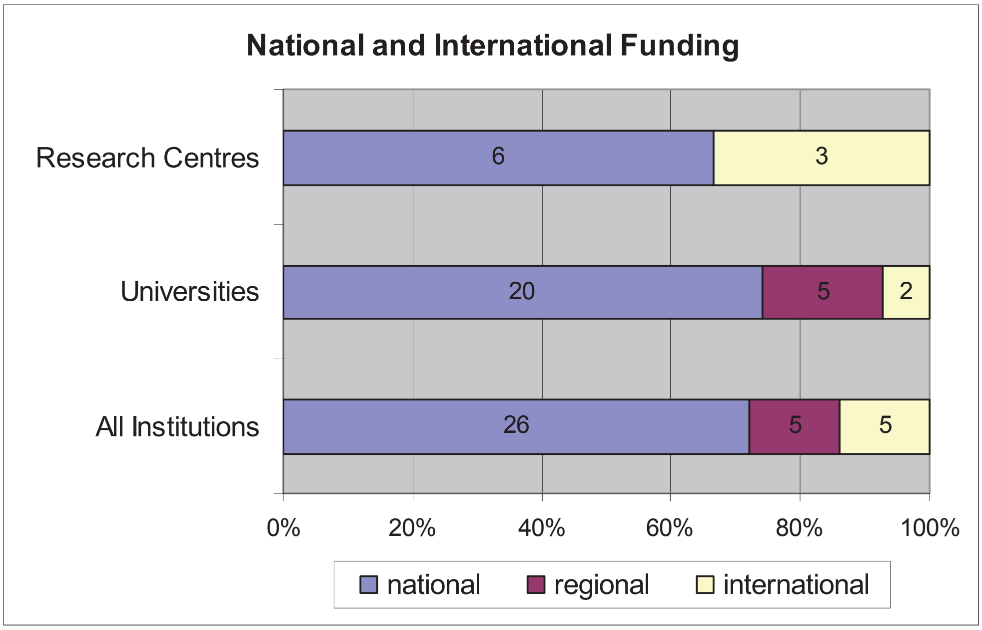


Fig. 116: By which kind of funding is the institution supported?

Taking a closer look at the regional ratios between national and international funding, institutions from Lower Egypt and Cairo are equally benefiting from national and regional funds. The low ratio of answers from Upper Egypt indicates, that many institutions from this region have not been answering the question at all, as only positive answers have been included. An exceptionally good result has been achieved by Cairo institutions in terms of international funds supporting them, which is generally very low in total average (see also Fig. 117).

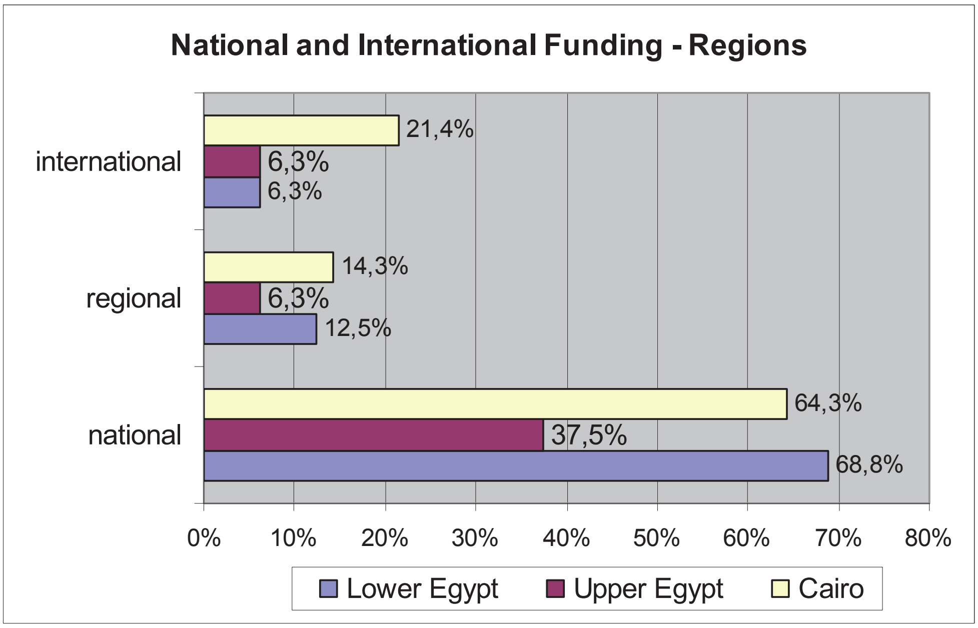


Fig. 117: By which kind of funding is the institution supported? (Regional analysis)

Coming back to figure 72: Answers regarding Sources of Funds – Overview all Institutions, 37% of all institutions answered the question about clients ordering frequently projects (fig. 113) with "no". Those institutions answering "yes" seem to be able to generate a small but stable income from these clients. Taking a closer look at this group shows clearly, that a major part of recurring clients is located in the industrial sector, closely followed by the public sector. Again, the ratio of SMEs is very small in comparison to the ratio of clients in other industries.

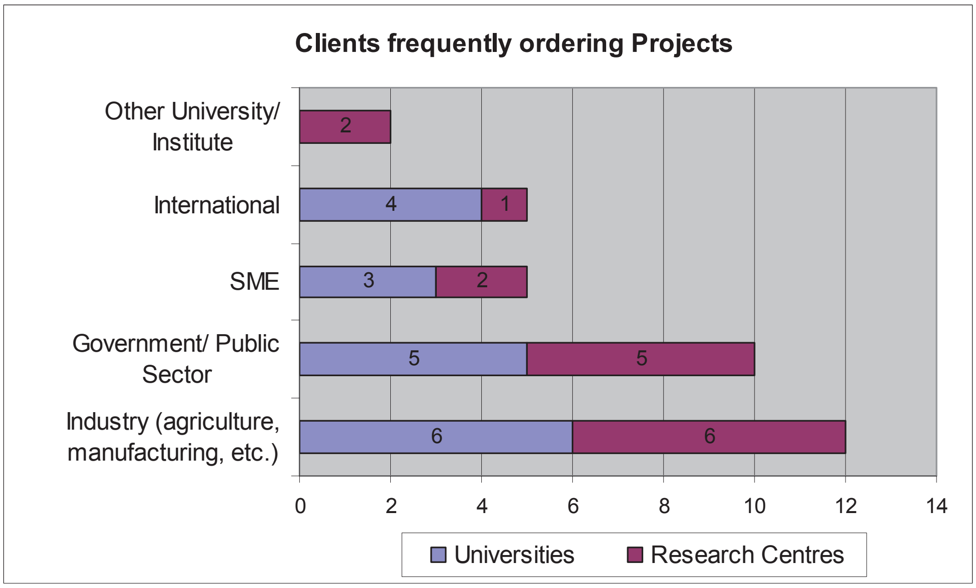


Fig. 118: Which types of clients are frequently ordering projects?

In terms of regional distribution the answers regarding ordered projects major differences can be seen in Fig. 119. Upper Egypt has no ratio of SME orders but it seems to have strong related project orders in industry. Cairo institutions are much more focused on governmental projects and cooperation, which are less important to institutions from Upper Egypt. Institutions in Lower Egypt indicate an average percentage regarding this issue but with a stronger ratio of projects ordered by industry.

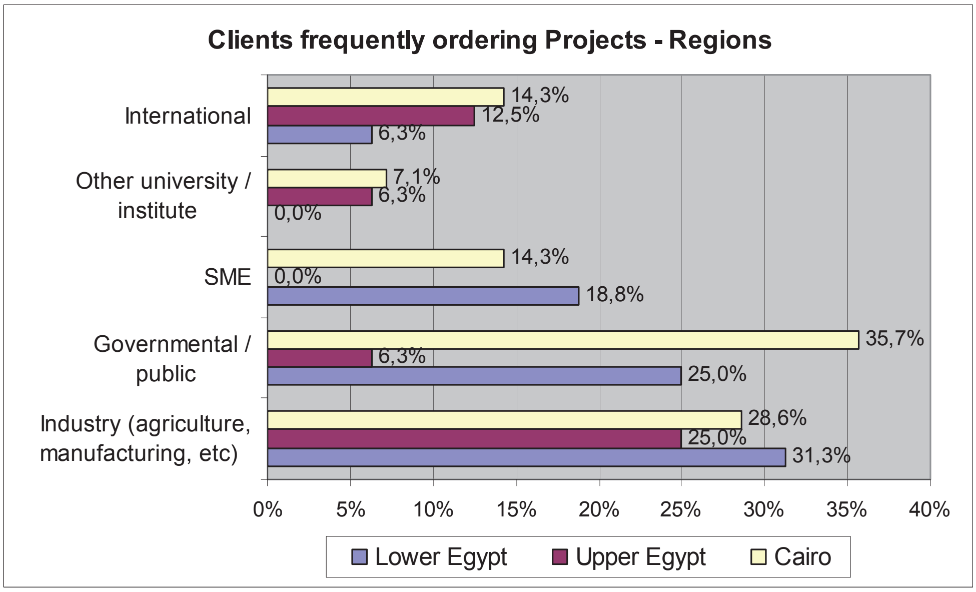


Fig. 119: Which types of clients are frequently ordering projects? (Regional analysis)

5.4 Five Performance Criteria

Performance criteria address the basic results of applied research institutes' tasks concerning the reinforcement of innovation of the economy, especially regarding SME. In addition, they measure the impact of organizational activities.

However, the criteria must be changed according to individual cases with respect to their particular importance due to enormous differences between particular institutions and an existing heterogeneity of framework conditions. A schematic approach as well as a shortened and superficial consideration has to be avoided. For instance, a simple benchmark of several institutes by means of a few indicators considering results about the relevant performance would neither be accepted by science and nor economy.

The evaluation scheme must consist of both qualitative and quantitative indicators whereas the qualitative ones should have a greater weight. Surveyed research institutes must keep in touch with their customers and carry on the dialogue with industry. In addition to the development of research, the results must be transferred into products and processes.

Nowadays it is increasingly difficult for single actors to build up expertise. This is rather achieved by networks that are established by the economy, science or politics. In addition, the integration of SMEs into those centers and clusters of competence will improve the accessibility, the ability for innovations as well as the achievement of a competitive position. As a result, the companies face a better situation in domestic and international markets.

Furthermore, the activity of networking will help the participants to increase their creativity, including the ability to adapt their organizational structures.

Increasing the innovation ability with respect to education and competence can be achieved by:

- Prioritization of content
- Flexibility of structures and processes
- Consideration of elements of performance and competition

This requires responsibility, autonomy, options for learning and experimenting, and a functioning incentive system to promote achievements in innovation.

The management of such innovation systems or networks is posing large challenges to all participants and stakeholders. The creation of relevant framework conditions as well as the availability of knowledge of markets and development trends, which has to be promoted and assured by politics, is of utmost importance.

Traditionally, SMEs are the main supporters of the economical dynamics in particular. However, SMEs are increasingly having difficulties in entering international markets in terms of an active presence. This results due to a frequent overload of SMEs, especially regarding their limited resources. Continuous reconsidering of products and procedures, and a continuous international market consideration of competitors requires high financial and human resource expenses as well as specific competences, e.g. language skills. Therefore, a special support of SMEs is necessary in order to promote the access to international markets as for example international offices of the German FhG.

In order to analyze, how research institutions do support and cooperate with industry, especially SMEs, and additional set of questions was asked in the questionnaire. These questions focus on the performance of research-industry relations in Egypt and are divided into five performance criteria:

- Strategic Business Field Planning and Industry needs
- Scientific & technological competence
- Human resources and scientific & technological equipment
- Profit situation
- Success in solution of economic problems

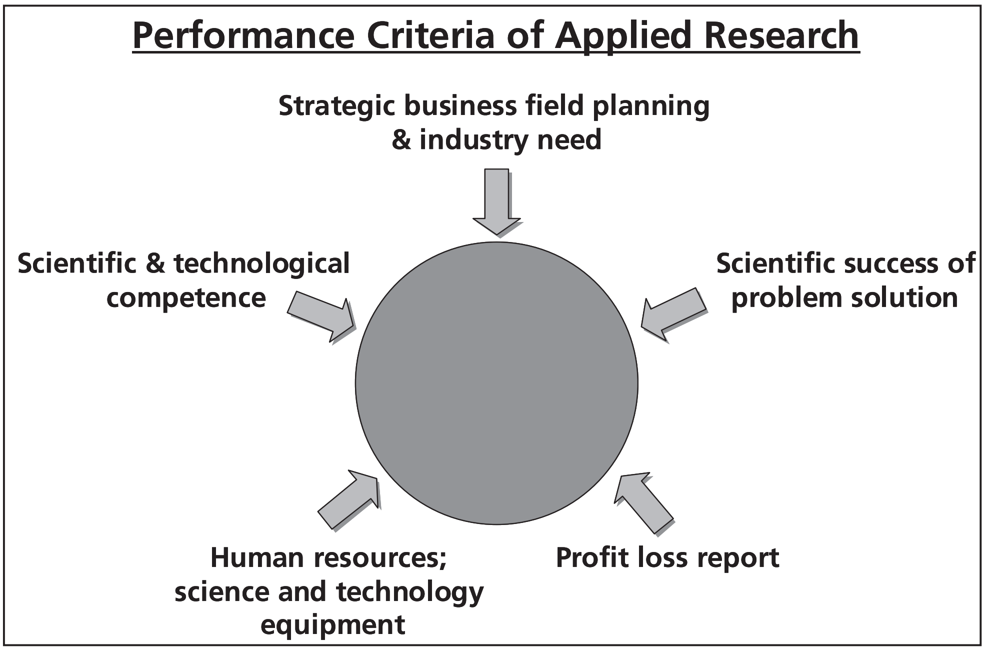


Fig. 120: Performance criteria of applied research

Each question first asked, whether the research institution performed a certain action (yes/no) and second how important/relevant these actions were for the institution (scale from high to low).

5.4.1 Coherence of Strategic Business Field Planning and Industry Needs

5.4.1.1 Main Elements

- Does the RI pay sufficient attention to current and foresee-able market developments (supply- and demand markets)?
- Does the RI pay sufficient attention to current and foreseeable technology developments in their surroundings?
- Does the RI early react to new topics (not technical) global, social, political and ecological trends?
- Does the RI take actively influence on technological objectives of the economy (sensitization for technological challenges)?
- Does the strategic business field development (research groups, performance supply) correspond to challenges of questions 1-4?
- Does the technological and industrial "networking" (e.g. strategic alliances, etc.) corresponds to challenges of questions 1-4?

5.4.1.2 Main Findings

Market and technology trends and developments are being monitored and followed by more than 80% of all institutions (both research centers and universities). Especially global trends in terms of social, political and ecological changes are being kept up with by 83% of all institutions.

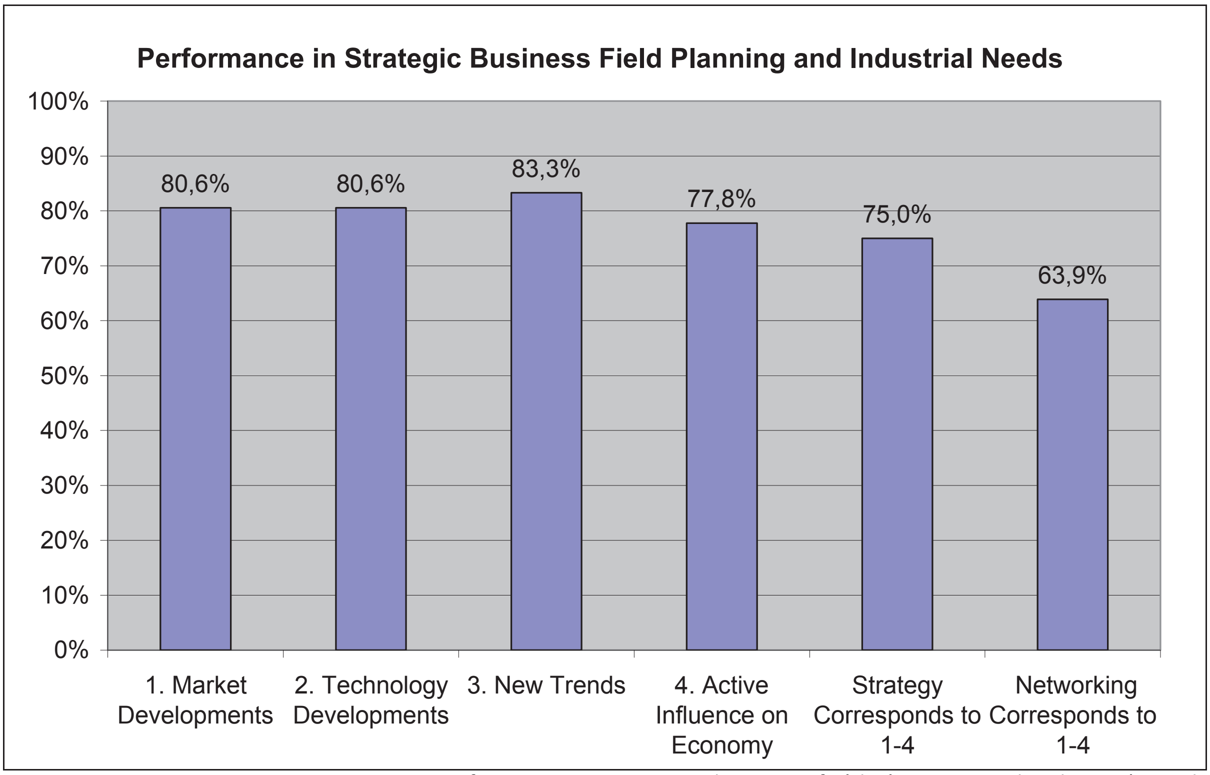


Fig. 121: Performance in strategic business field planning and industrial needs ("Yes"-answers as a percentage of total institutions)

The relevance ranking of the different questions show an almost equal distribution between Research Centers and Universities, as well as between the regions Cairo, Lower Egypt and Upper Egypt (see Fig. 122 and Fig. 123)

Only the question about the RIs attention to current and foreseeable technology developments was evaluated a little more important than the other questions concerning the first performance criteria "Strategic Business Field Planning and Industrial Needs".

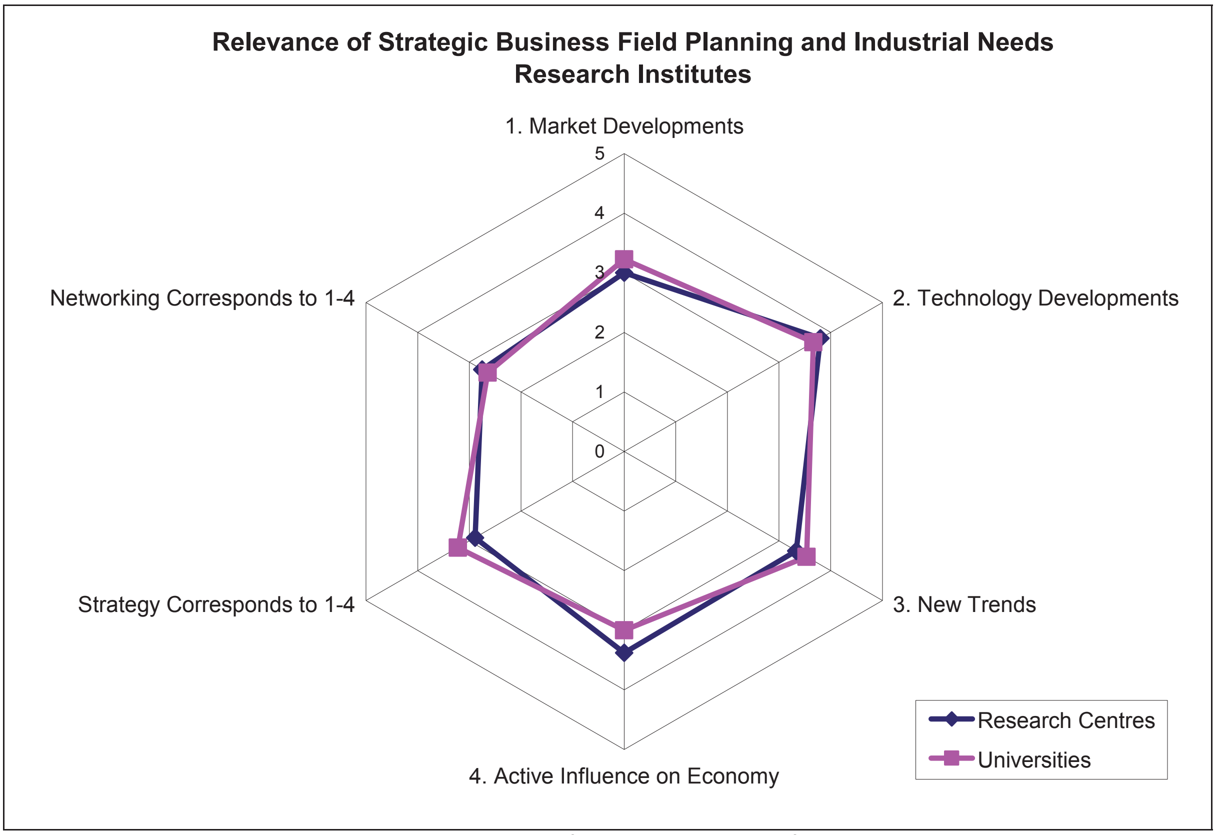


Fig. 122: Relevance of strategic business field planning and industrial needs by research institute

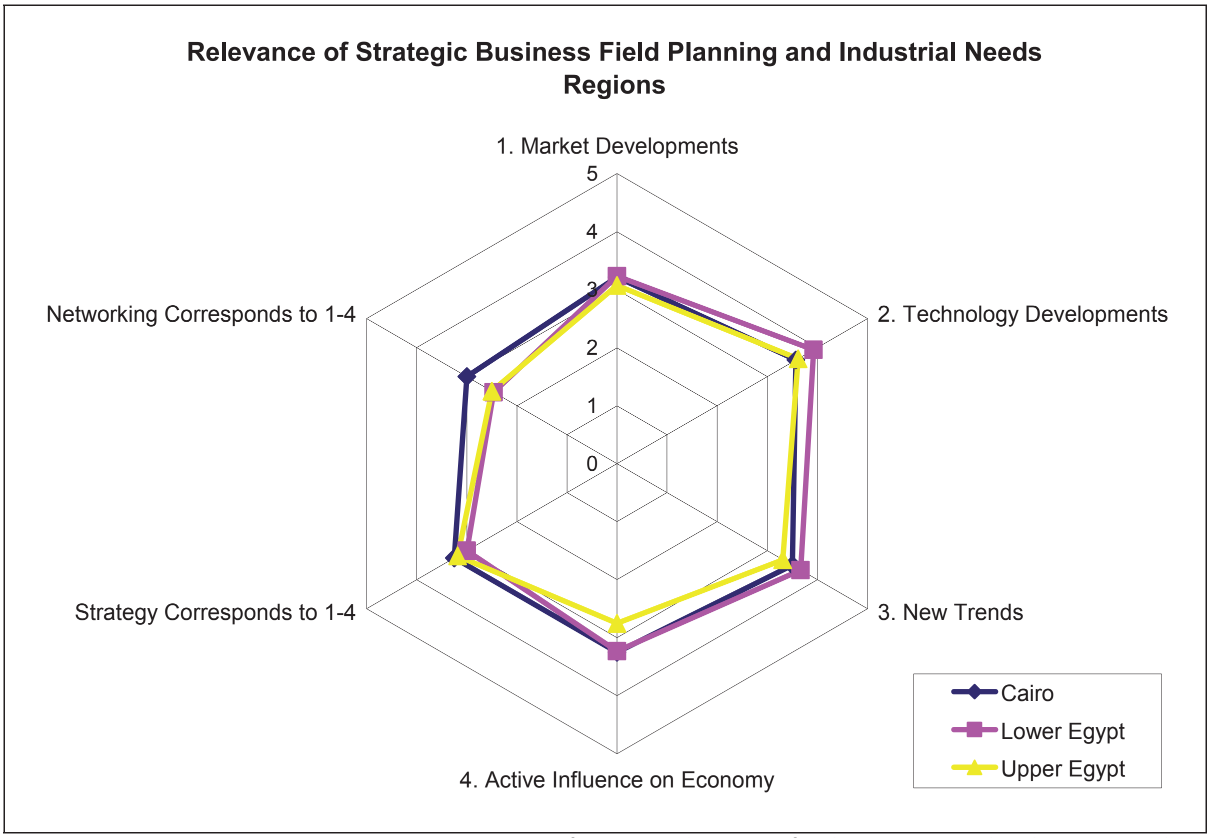


Fig. 123: Relevance of strategic business field planning and industrial needs by Regions

5.4.2 Science and Technology Competence

5.4.2.1 Main Elements

- Is the RI sufficiently present in the national and international professional public (publications, conferences, associations)?
- Did the institute produce any significant scientific findings within the last 10 years?
- Does the RI have produced any important scientific developments within the last 5 years?
- Does the RI enter new technology fields early and actively (vs. late/ reactively)?
- Does the RI cooperate sufficiently with universities and other scientific institutions?
- Is the RI initiator or coordinator of important national or international joint research program/ projects?

5.4.2.2 *Main Findings*

Similar to the answers of the first performance criteria, the majority of institutions answered the questions on their scientific and technological competence positively (around 80%). Only the questions about the entering of new technology fields and the coordination of joint research projects were answered with "yes" by less than 70% of all institutions.

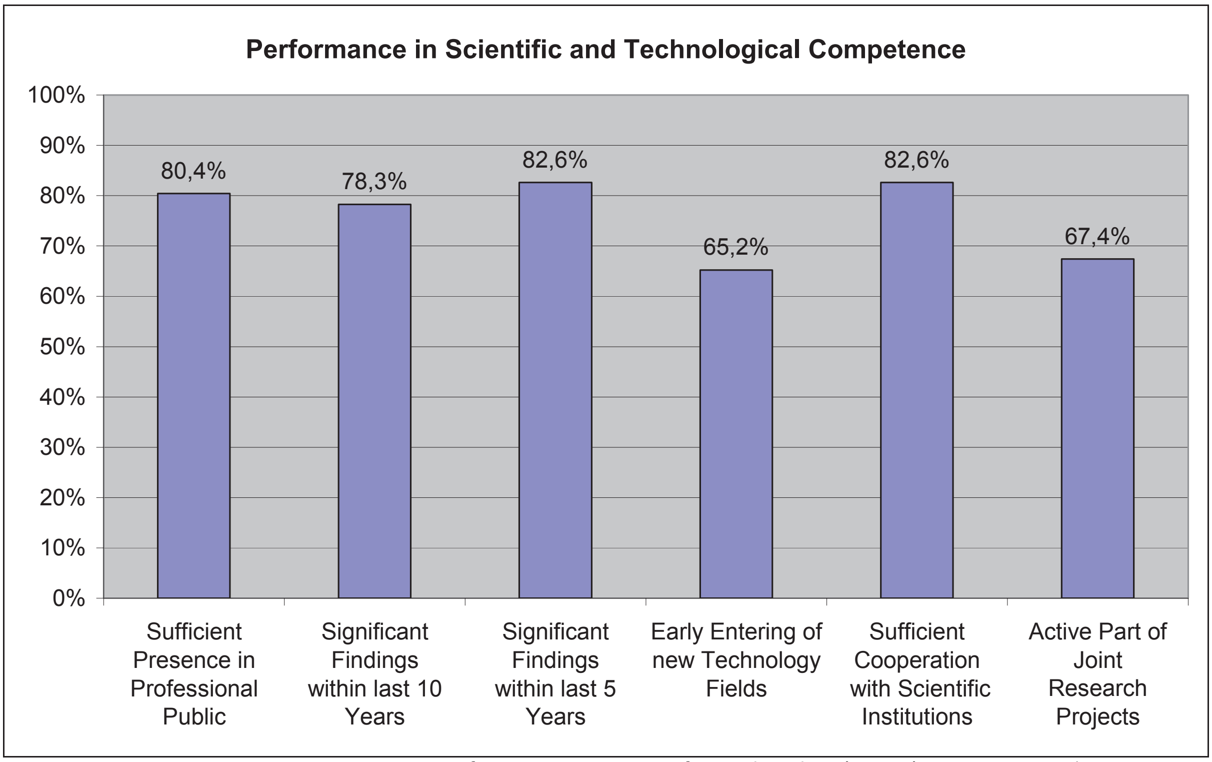


Fig. 124: Performance in scientific and technological competence ("Yes"-answers as a percentage of total institutions)

Having all detailed look at the relevance scoring of research centers and universities reveals one big difference between the two groups: whether the RI is initiator or coordinator of important national or international joint research programs/projects is less important for research centers. Universities seem to give more relevance to initiating or coordinating joint research projects.

The most important question for all institutions is sufficiency of cooperation with other scientific institutes.

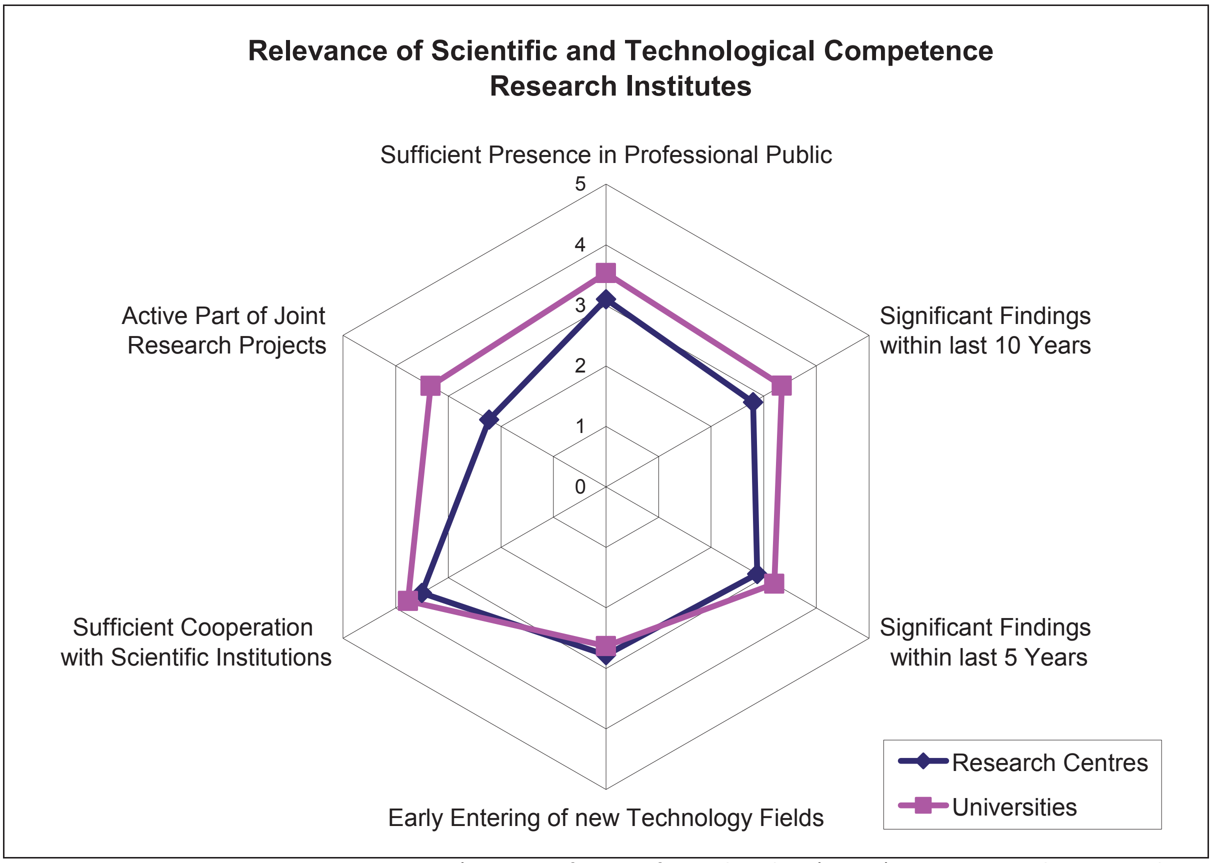


Fig. 125: Relevance of scientific and technological competence by research institutes

The analysis of performance scoring with respect to the three main regions in Egypt does not reveal major differences.

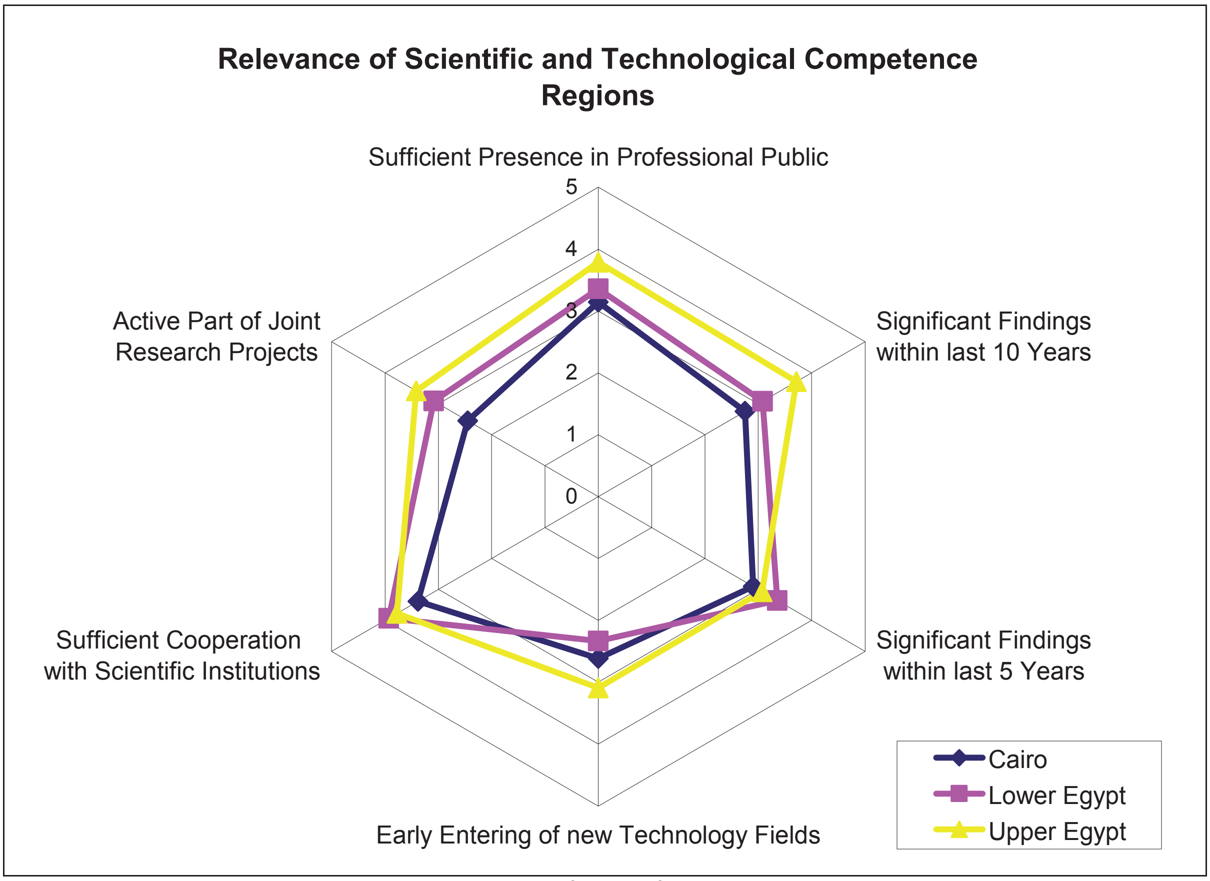


Fig. 126: Relevance of scientific and technological competence by regions

5.4.3 Success of Economic Problem Solution

5.4.3.1 Main Elements

- Which phases of the innovation process is the institute mainly active in?
  - Basic research?
  - Applied research?
  - Development?
  - Industrial realization?
- Does the RI realize sufficient system solutions, which are desired by industry?
- Does the RI fulfill the industrial orders in a satisfactory quality?
- Does the RI dispose of permanent customers (share of SME)?
- Were there any new business customers achieved within the last 5 years?
- Has the RI successfully coordinated & mediated problems between various industrial partners?

- Does the RI successfully produce innovation-support by services?
- Is there any know how transfer carried out through staff transfer in businesses?

5.4.3.2 Main Findings

The question about the main research field, the institutions are active in shows, that basic research and applied research are carried out by about 80% of all institutions. Only 63% are active in development activities related to technology and processes. Even less institutions realize solutions in industry. This result corresponds to the results from the first part of the questionnaire.

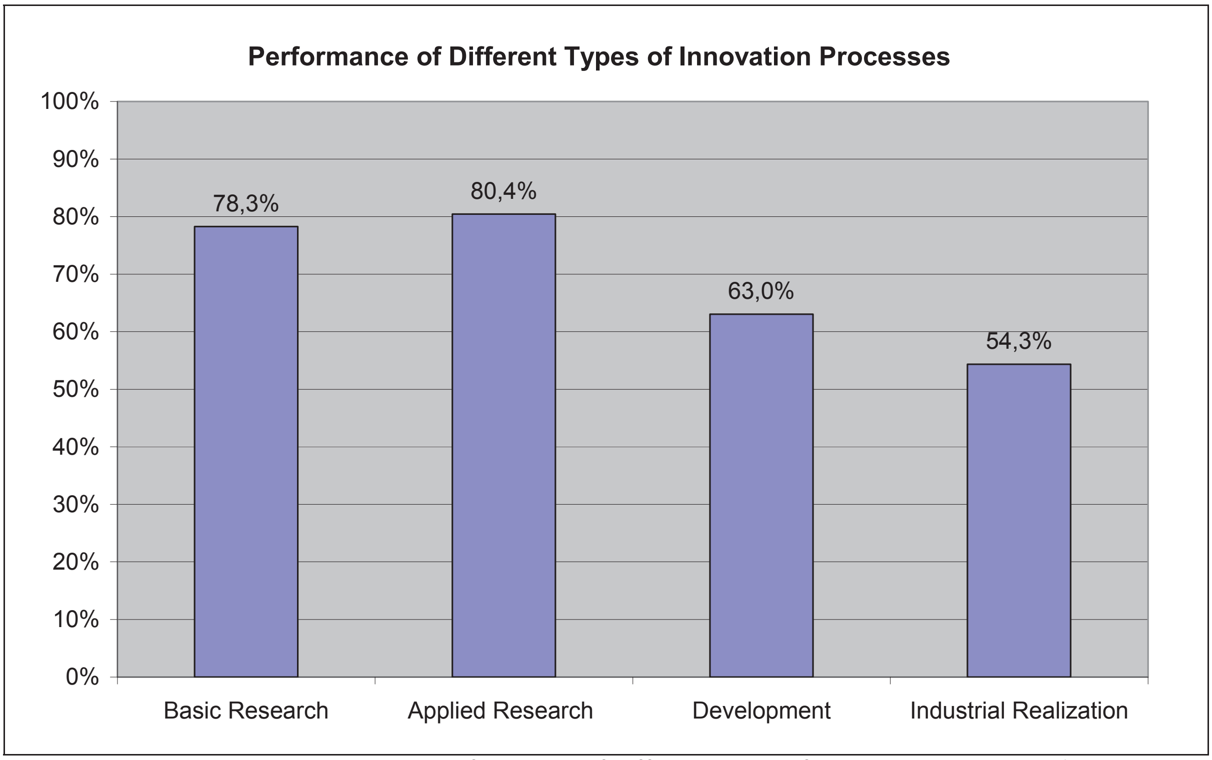


Fig. 127: Performance of different types of innovation processes ("Yes"-answers as a percentage of total institutions)

Even if there are almost no difference in the performance evaluation between universities and research centers, 'development' as a research activity has been rated less important by research centers.

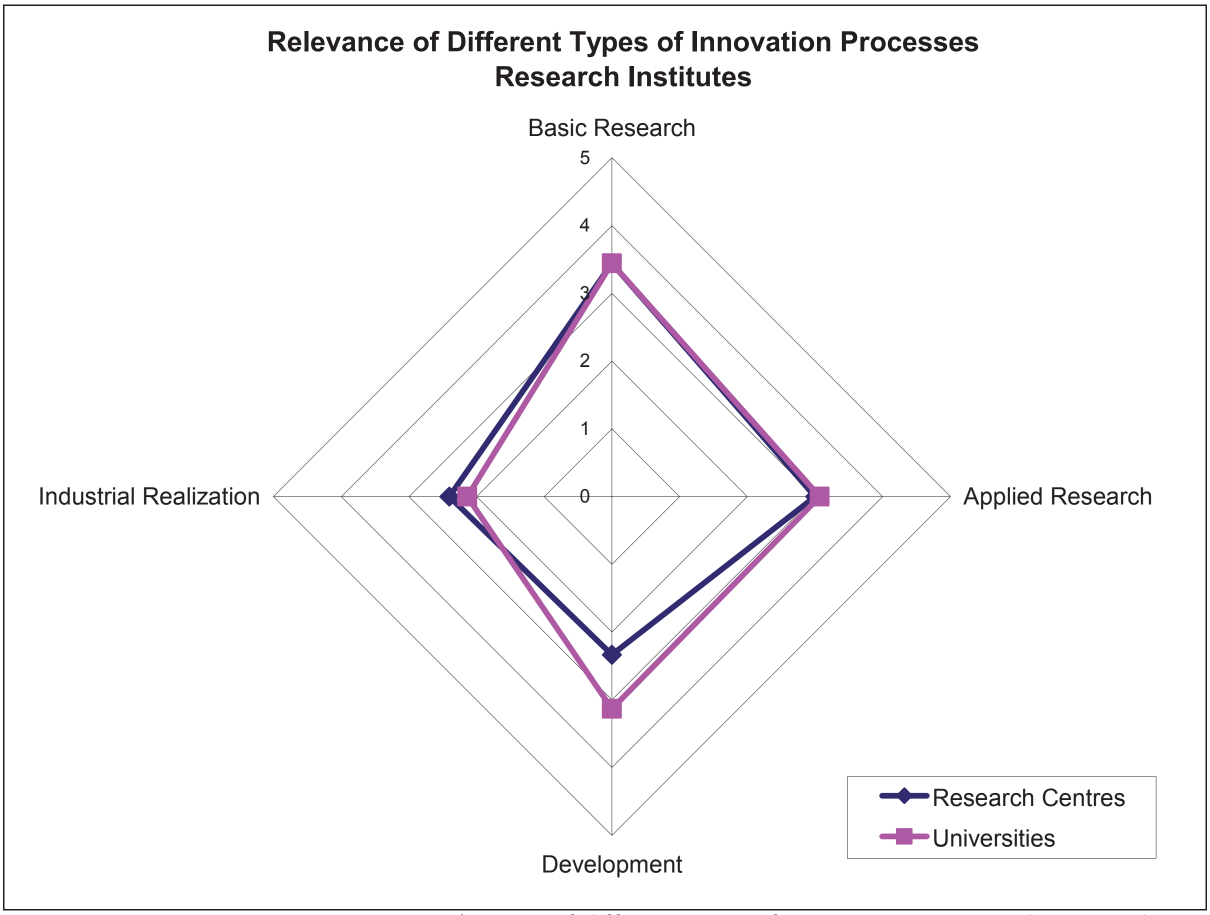


Fig. 128: Relevance of different types of innovation processes by research institutes

The relevance of 'Industrial realization' does not seem obvious to research institutions: neither research centers as well as universities are largely active in industry realization, nor is the activity considered as important.

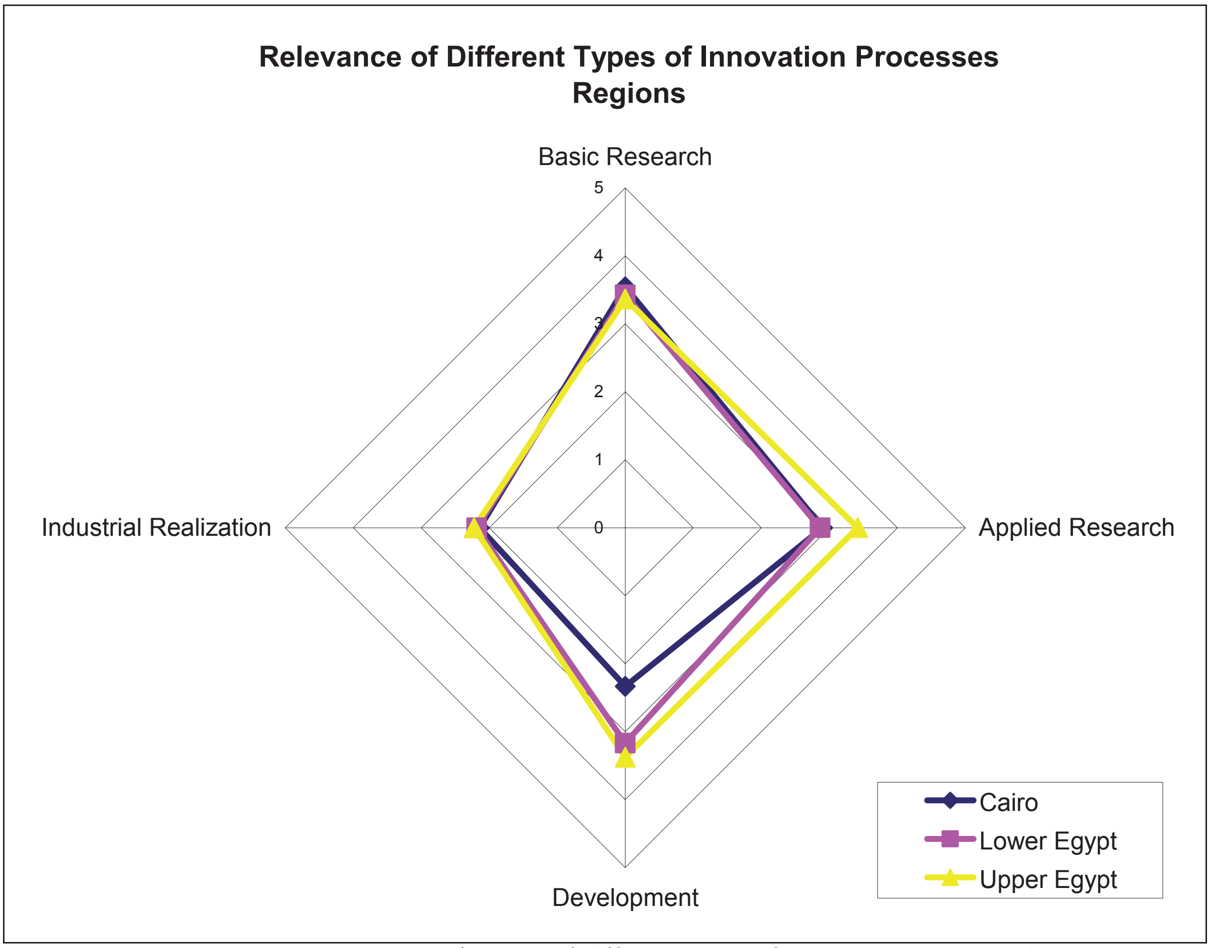


Fig. 129: Relevance of different types of innovation processes by regions

Just as in the first part of the questionnaire, the performance questions regarding the industry relationship show less positive answers than the other performance criteria. Only 39,1% of all institutions confirm to have permanent customers, especially SMEs. 54,3% state that industry orders have been fulfilled in satisfactory quality.

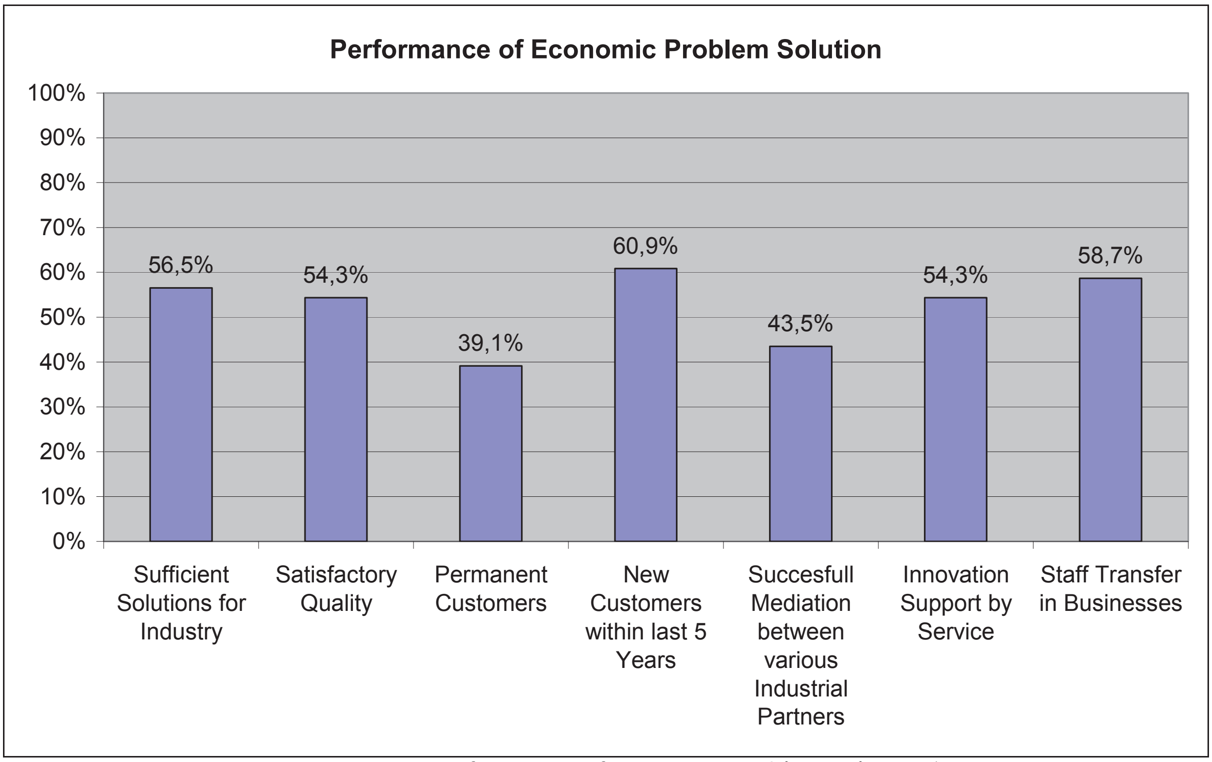


Fig. 130: Performance of economic problem solution ("Yes"-answers as a percentage of total institutions)

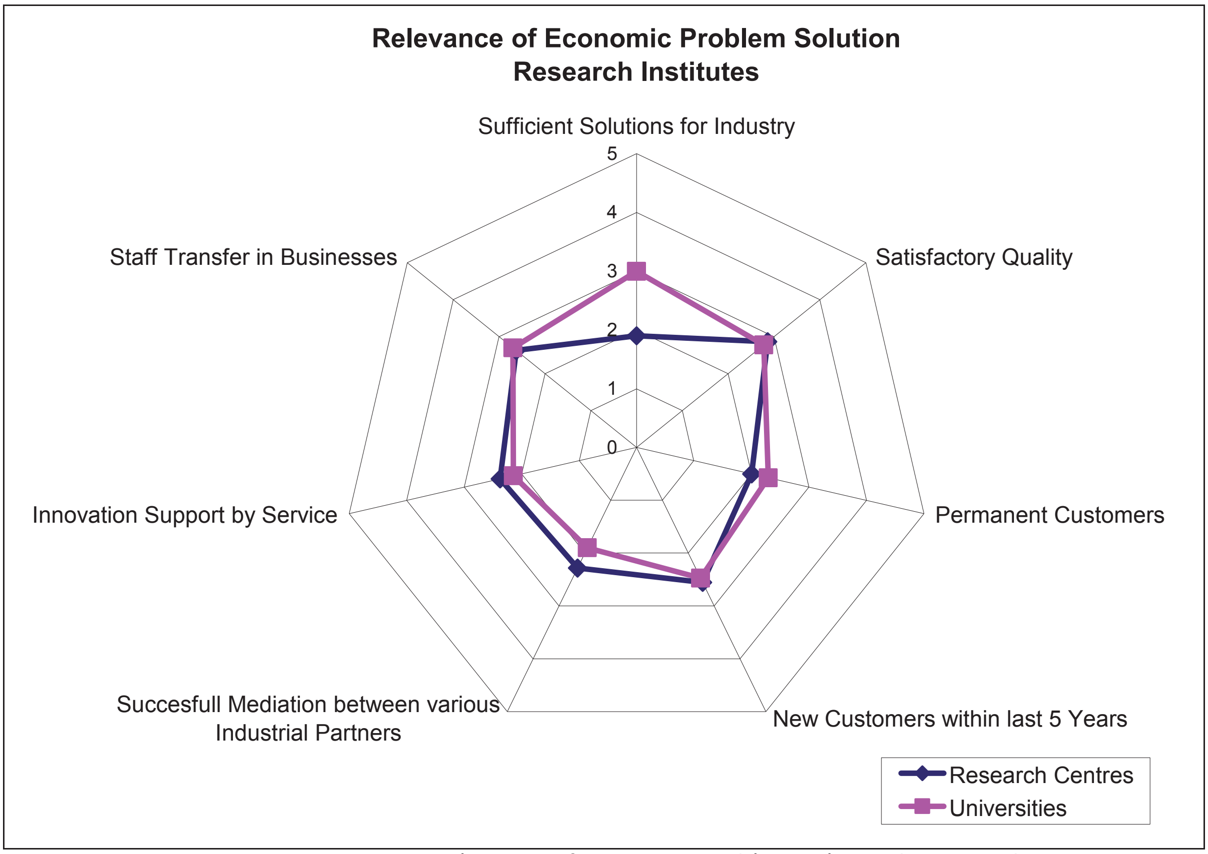


Fig. 131: Relevance of economic problem solution by research institutes

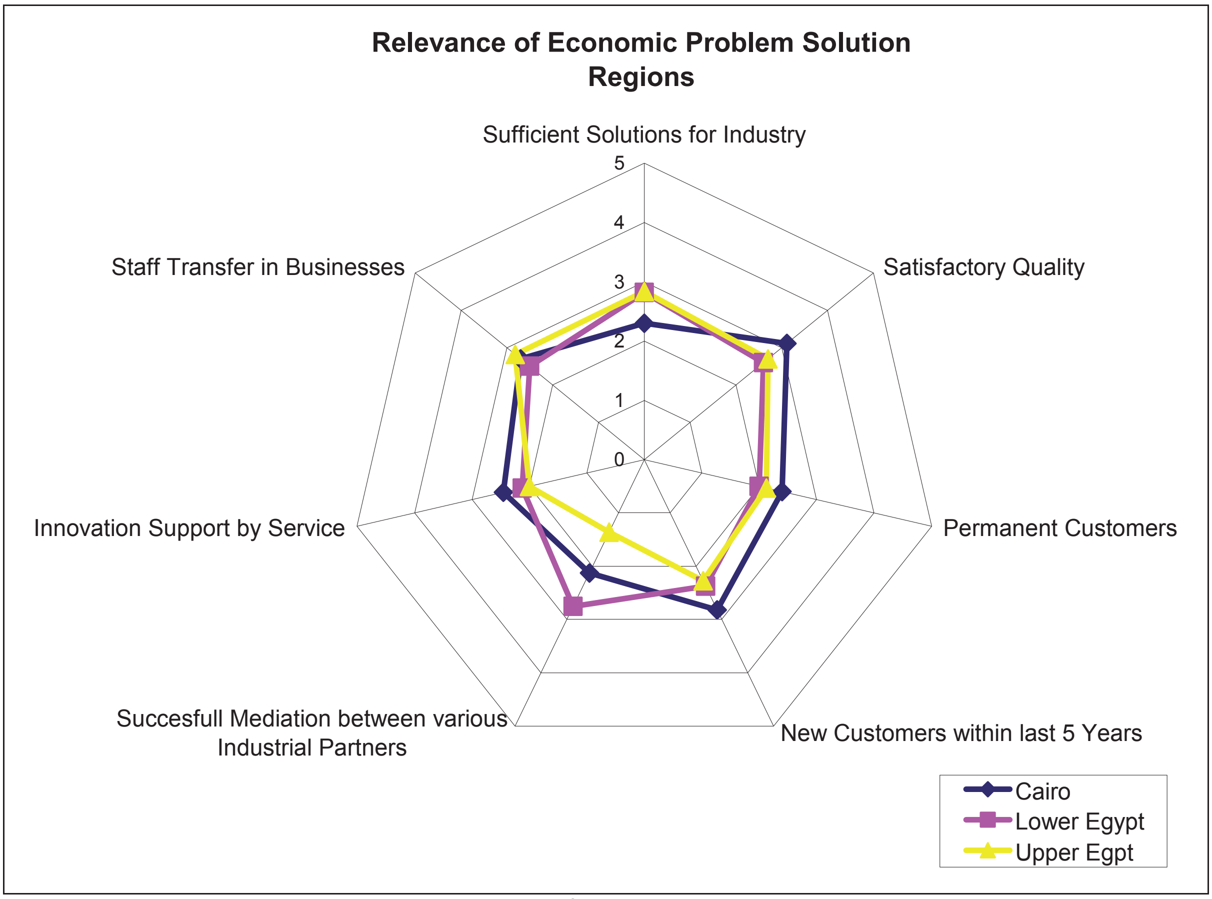


Fig. 132: Relevance of economic problem solution by regions

5.4.4 Profit Situation

5.4.4.1 Main Elements

Sources of funds of the RI:

- Basic funding (international/national/regional)
- Special grants (international/national/regional)
- Order from businesses, share of SME
- Projects from industrial associated research
- Projects from regional-or national programs
- Projects from international programs

Types of turnover:

- R&D orders
- Construction
- Consulting services/studies

- Education and training
- Licenses and products
- Maintenance and other services

5.4.4.2 *Main Findings*

Most important funding source both for research centers and universities is the basic institutional funding as well as special grants. Less relevant for a good financial situation of the institutions is income being generated by participation in international, regional or national programs, which indicates a rather weak support structure by public authorities. Orders from businesses and industry are almost equally unimportant.

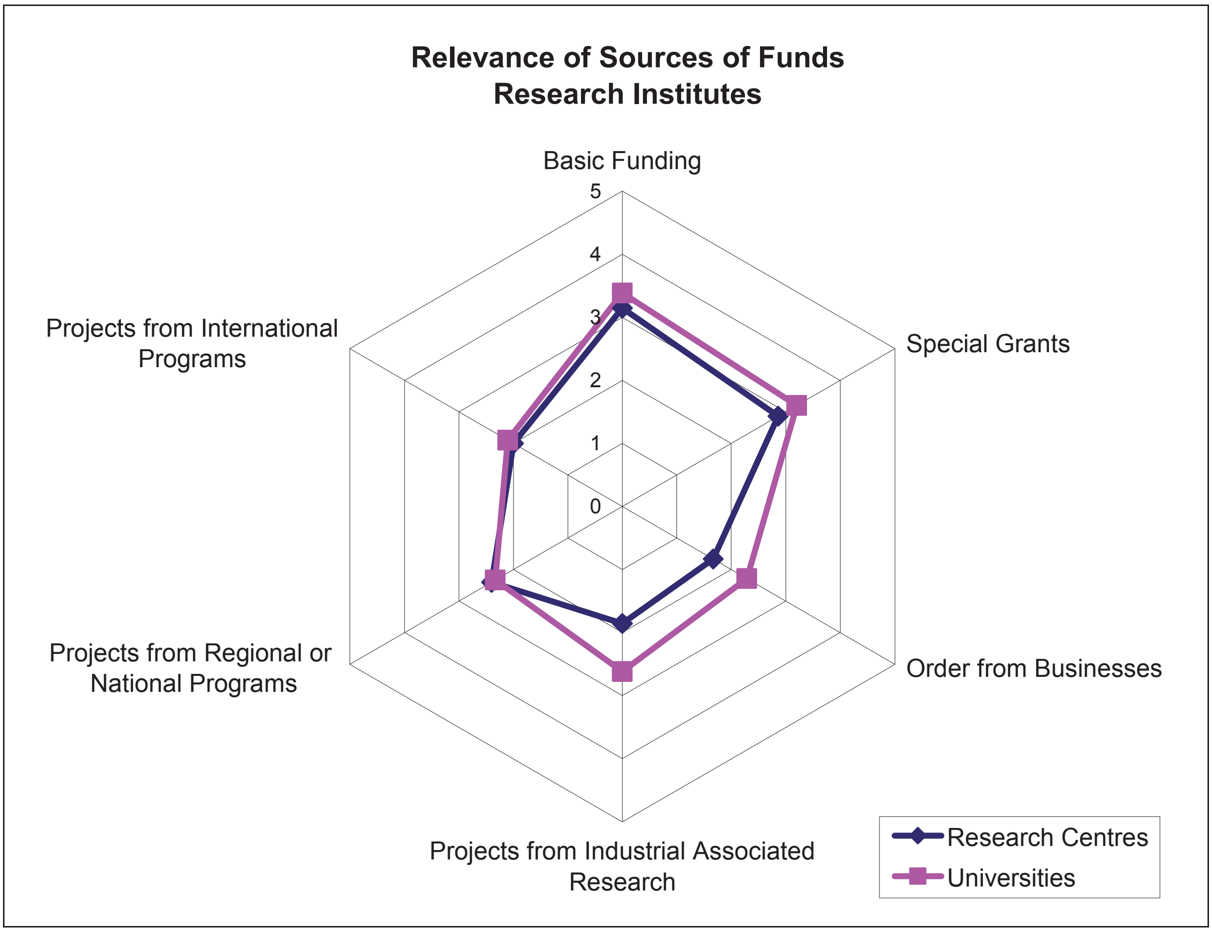


Fig. 133: Relevance of sources of funds by research institutes

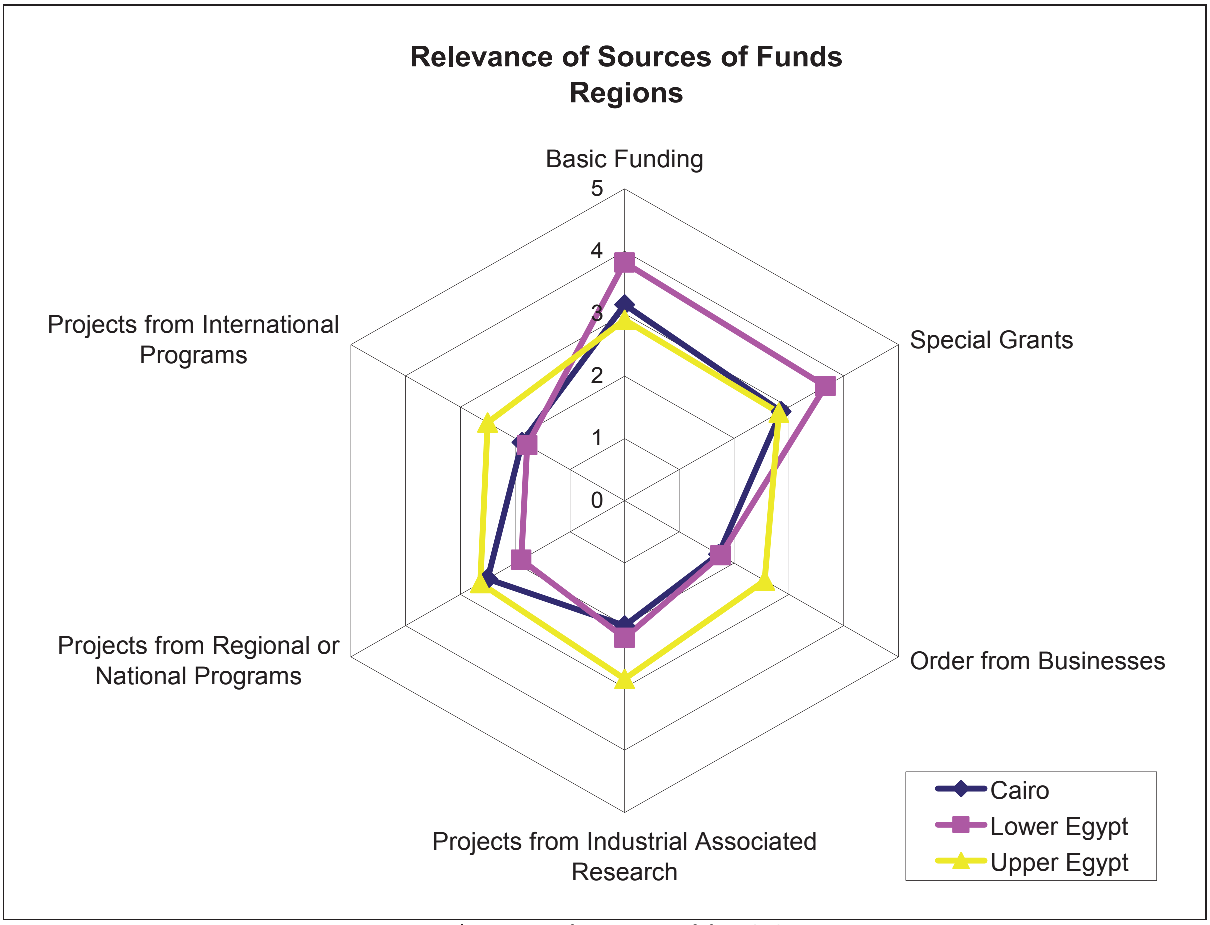


Fig. 134: Relevance of sources of funds by regions

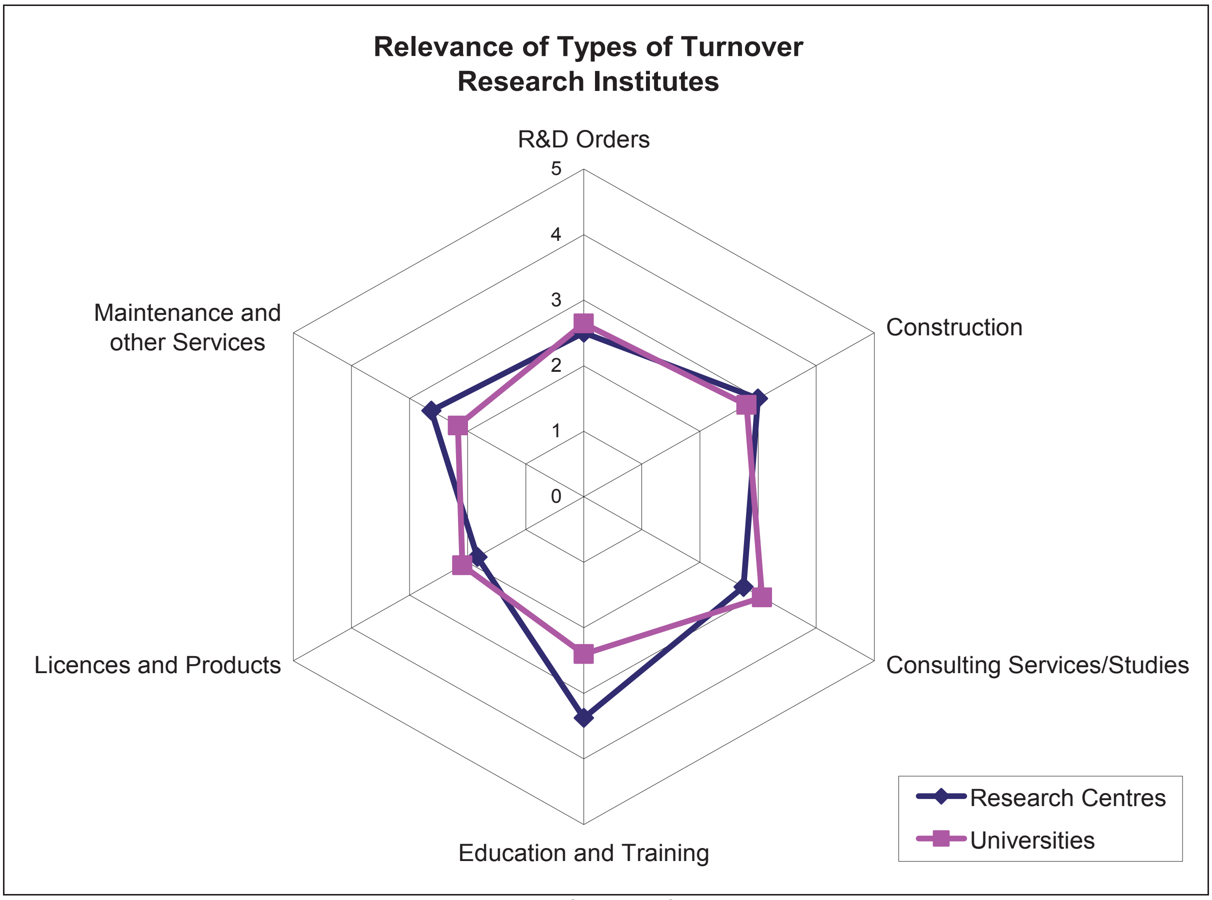


Fig. 135: Relevance of types of turnover by research institutes

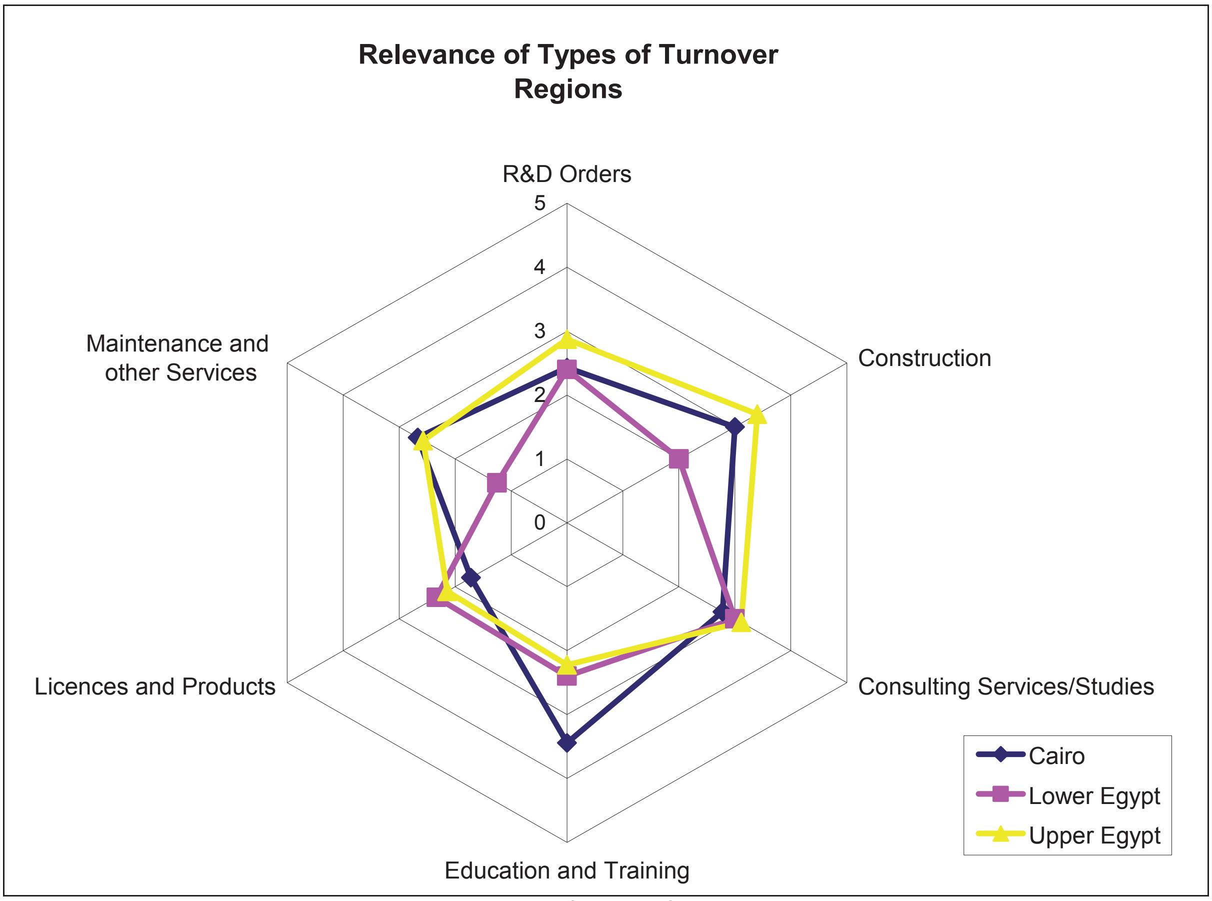


Fig. 136: Relevance of types of turnover by regions

5.4.5 Human Resources and Scientific-Technical Equipment

5.4.5.1 Main Elements

Does the institute (working group) have the critical mass regarding human resources?

- Interdisciplinary structure of professionals?
- Suitable ratio of professionals/technical and assistance staff?
- Internal flexibility of personal deployment?
- Well balanced age structure?
- Well balanced personal renewal rate?

Does the institute have the critical mass regarding scientific-technical equipment?

- Suitable technical equipment (laboratories, electronic data processing, measuring instruments and testing apparatuses, workshops and production technology)?
- Is there any material donated from industry?
- Scientific, informative equipment (database, library, access to external library inventory)?

5.4.5.2 Main Findings

Human Resources

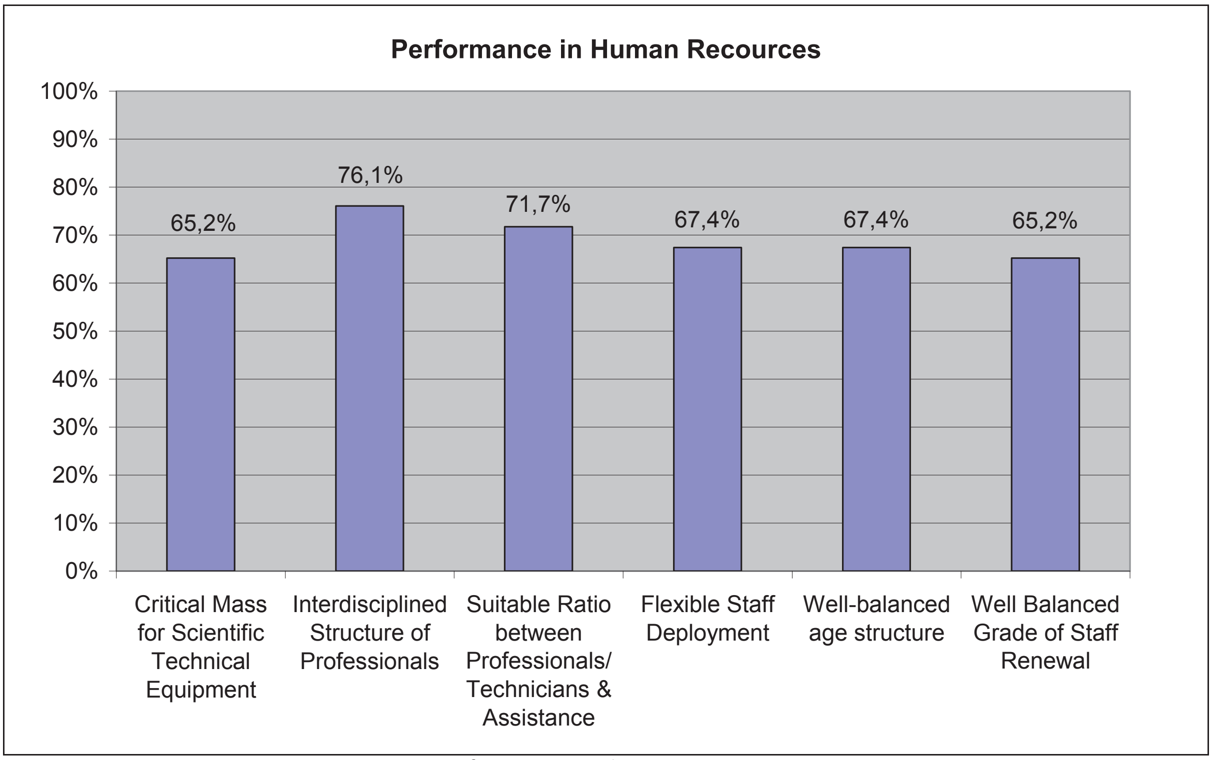


Fig. 137: Performance in human resources

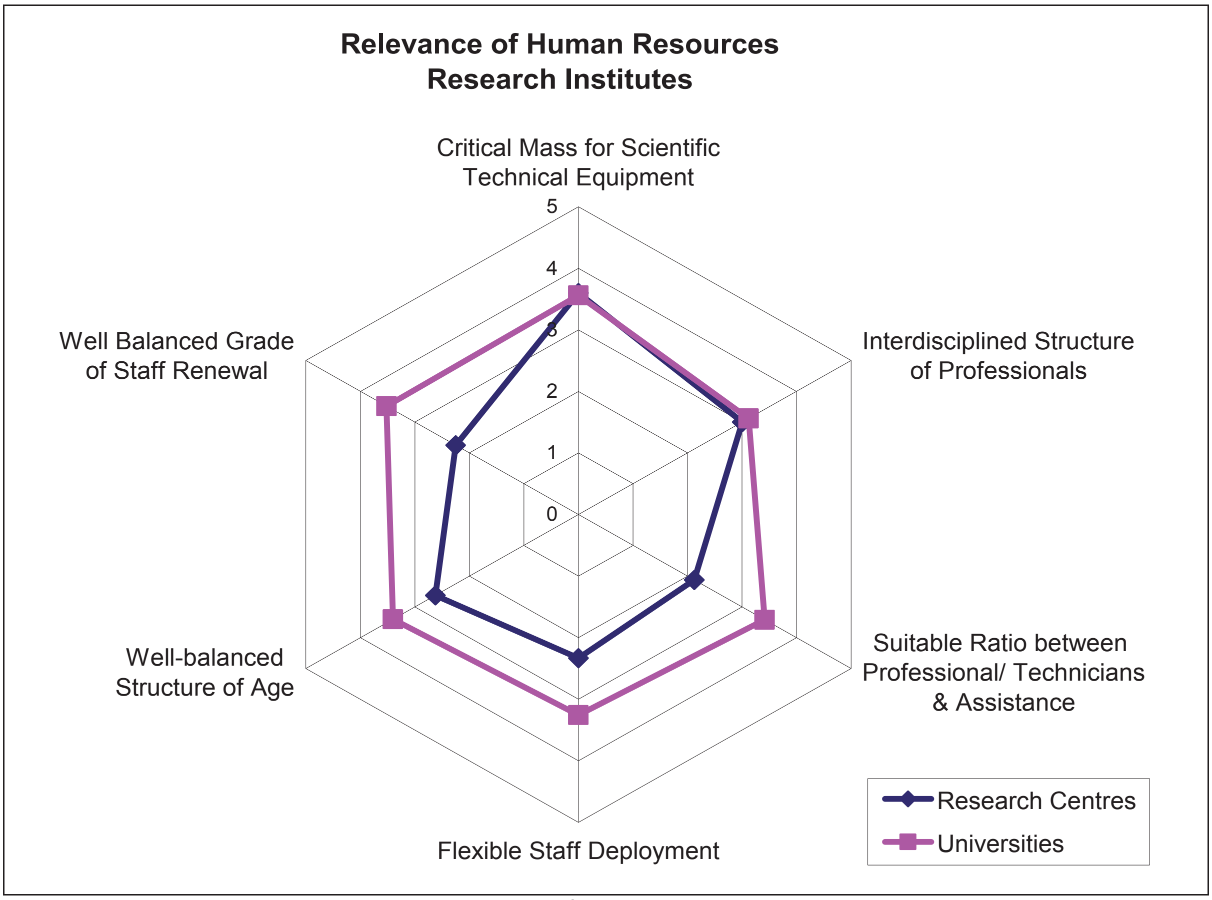


Fig. 138: Relevance of human resources by research institutes

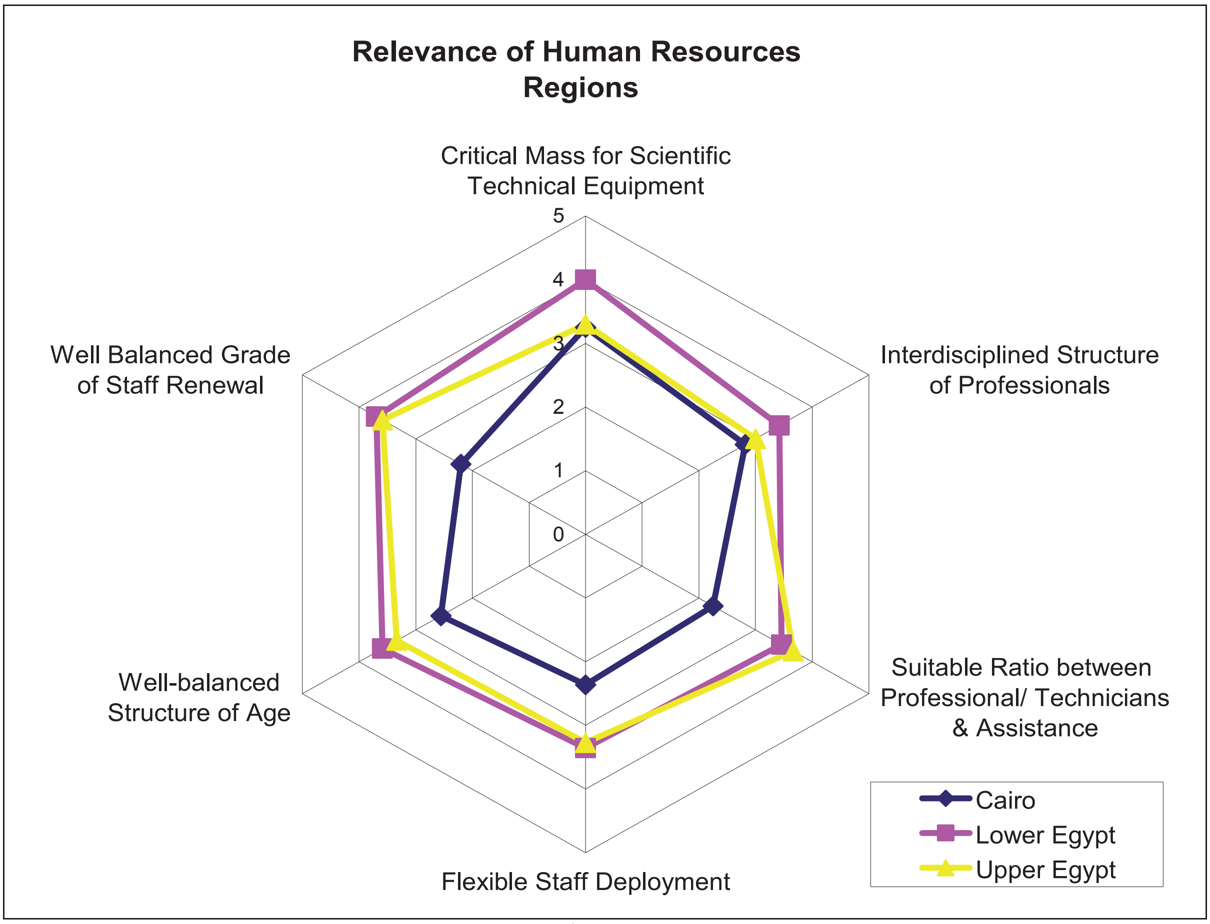


Fig. 139: Relevance of human resources by regions

Scientific Technical Equipment

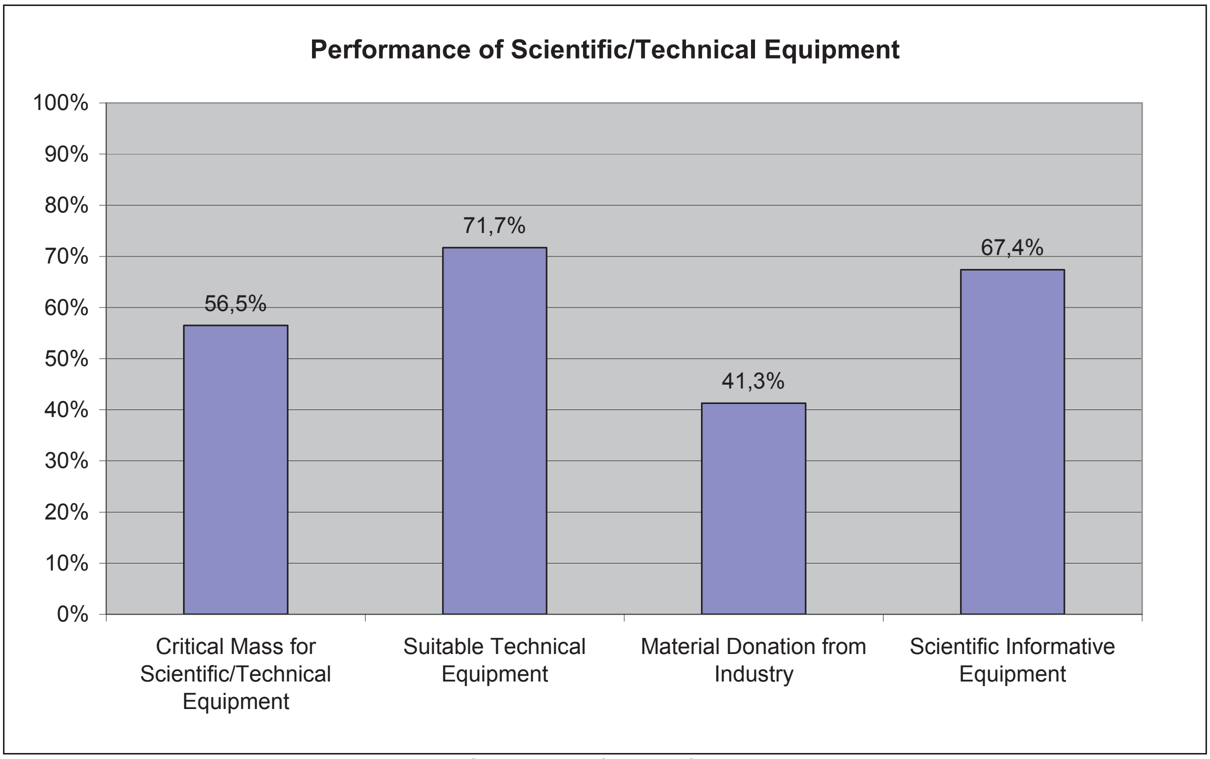


Fig. 140: Performance of scientific/technical equipment

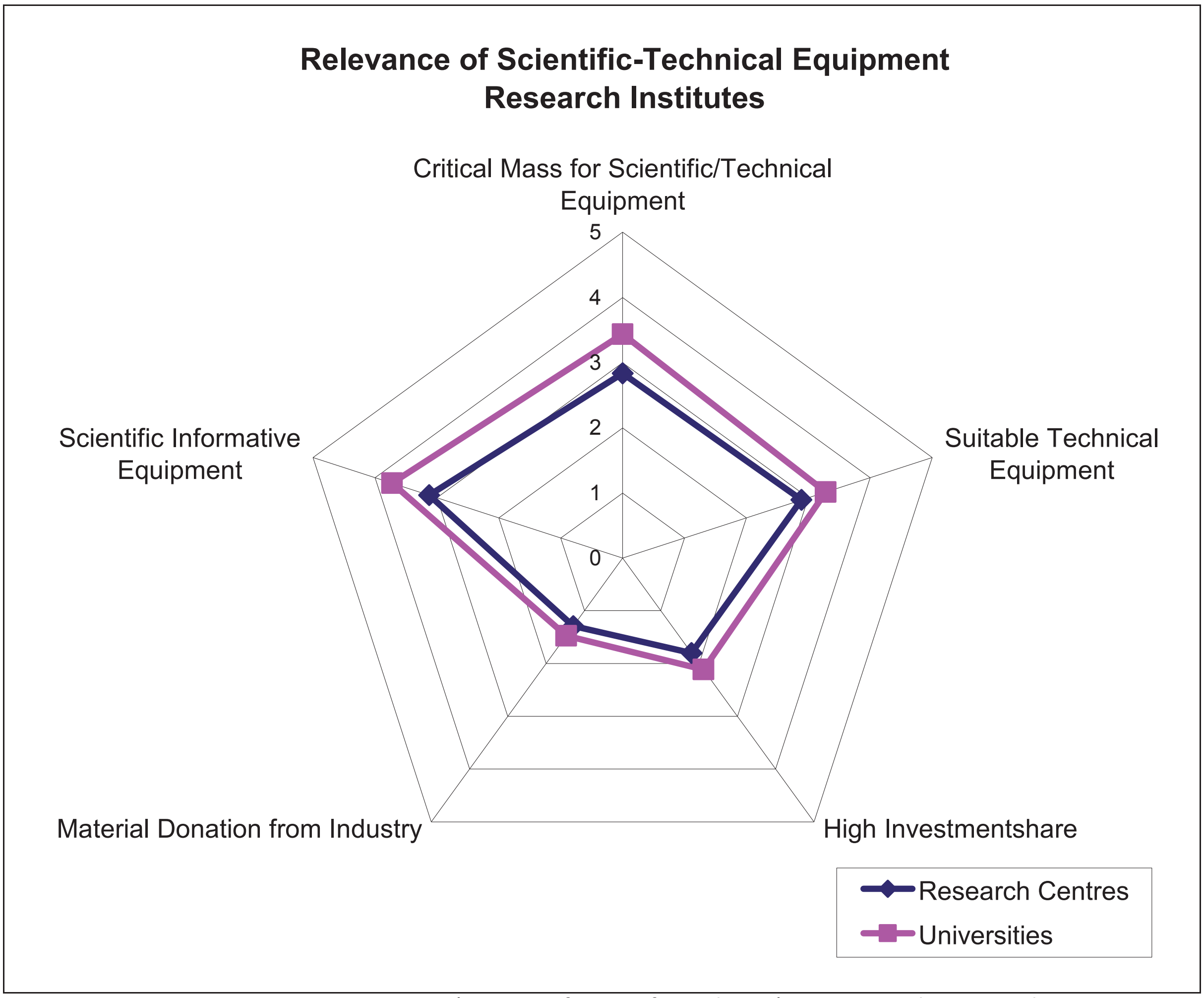


Fig. 141: Relevance of scientific/technical equipment by research institutes

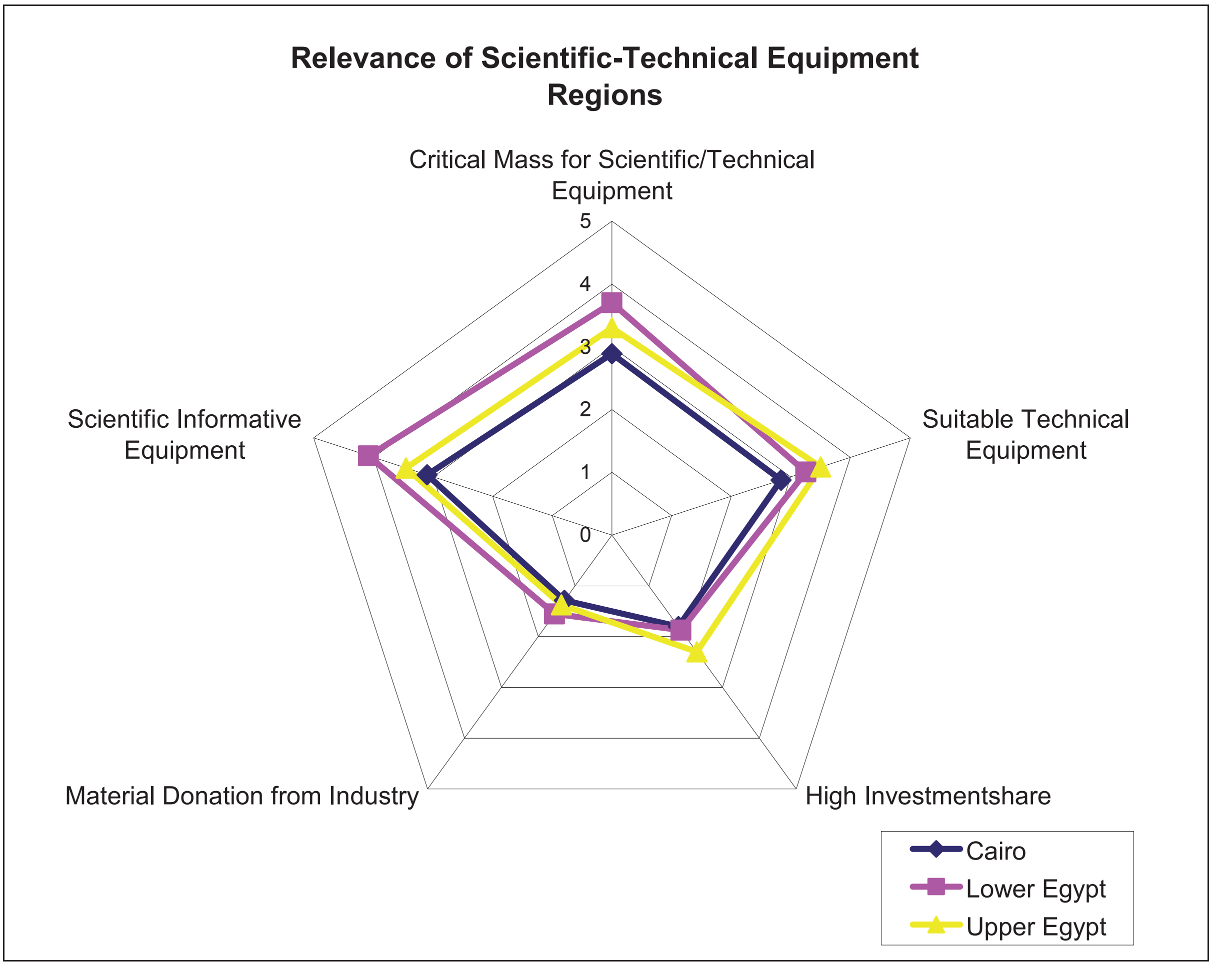


Fig. 142: Relevance of scientific/technical equipment by regions

5.5 Summary of Main Findings

As the study was performed for the first time in Egyptian research institutions, many issues raised in the questionnaire were not common to the person who filled in the questionnaire. Many questions were not completely answered or partly misunderstood – therefore the data collected is very scarce for some issues and the quality of given answers differed heavily. Due to the fact that none of the institute heads was acquainted with these issues at this stage, these problems of data quality are expected to diminish during the next round of the evaluation process.

Generally, the performance of universities and research institutions can be evaluated as being at a good level. Especially in terms of human resources and technical equipment, the existing procedures and standard seems to be fair enough as well as being at a good and stable level. All institutions are planning to grow in the future in terms of scientific personnel. This trend reacts positively to the increasing need of university education and growing numbers of students. Every year, the amount of received master and PhD degrees at universities is rising, indicating a very effective education system responding to the needs of their main clients – students and PhD candidates.

Looking at scientific performance, all institutions are well active in scientific networks and association, nationally as well as internationally. Conferences and workshops are regularly organized and visited. Projects are run nationally and internationally, setting up cooperation between different institutions in order to transfer know-how and knowledge in order to keep up to international scientific discussions. The transfer of scientific knowledge is working very well and effectively.

Still, education and training is mainly done by internal staff. The incorporation of external know-how is less common at research centers and also at universities. For example, guest lectures or training by external experts in specific research fields is only organized by a small part of institutions. Especially trainings by experts from industry are less common in universities, while 50% of research centers are actively using this strategy to develop the competencies of their staff strategically.

Furthermore, a great majority of institutions is doing a strategic planning having good contacts with its scientific environment being able to react to research trends and needs of customers. Customers are coming from different areas. The public as well as the private sector is ordering and cooperating within projects with universities and research centers. The rate of industry orders and especially the rate of SME clients are higher at research centers. It is almost a natural fact because research centers do have a higher amount of scientific projects in general as they concentrate much more solely on research activities while universities are mainly concerned with education and training activities.

Projects with industry or SMEs are being performed by a large part of institutions, cooperating for product development or basic scientific research. Nevertheless, the results from these projects could not be clearly outlined within the scope of this study. The rate of follow-up orders by these clients is low to intermediate, and prototypes and demonstrators are not the usual result from these joint projects. Only a minor number of institutions, of which the greater part is research centers, are able to apply for a license or develop a prototype from their research activities. The major output is research papers and publications. Although the process of joint product or technical development is being set up by a majority of institutions, the results are not clear and the process stops at an early stage without leading to final products which can be used by industry for their economic benefit. Prototypes and demonstrators are seen as the final step within the innovation process, before a product or methodology can be used by a company and be introduced to the market. In order to create a well-performing innovation system, research needs to contribute more effectively to the innovation performance of the Egyptian economy.

One of the major tasks for future research and improvement of the Egyptian R&D system will be the identification of those factors which are hampering the development process at an early stage, setting up processes and systems to motivate and support all steps of the innovation process – from basic research, to product innovation, to the development of prototypes and demonstrators, to the applied technical development up to the finalization the innovation within the industrial realization in the industry as a final product, methodology or process.

6. Work Package 6 – Performance of Technology Transfer and Regional Distribution of Technology Supply

The Egyptian-EU Research, Development and Innovation Program (RDI) coordinated by the Egyptian Ministry of Higher Education and Scientific Research has contracted the German research institute Fraunhofer IPK to execute an assessment to the research and development landscape of Egypt due to its expertise in several developing countries.

Work package 6 is considered important to the overall study as it can be seen as a crucial way to increase the technological capabilities of firms as well as of regions. Therefore, this WP will be investigating the intra-regional, inter-regional and cross-border technology transfer in Egypt.

The main objective of work package 6 is to identify the existing status of technology transfer in the local industrial firms/regions and factors that can be strengthening local industry.

The results of the assessment of the technology transfer in Egypt are expected to provide essential input for the design principles to shape Egypt's future national innovation system.

6.1 Introduction

6.1.1 Definition of Technology Transfer

Technology transfer is the application of technology to a new use or user. It is the process which develops technology for one purpose and either it will be employed in a different application or by another. The activity practically involves the increased utilization of existing technology.

The term "technology Transfer" is used to denote the movement of techno-economic knowledge between firms, sectors, districts and areas. It can be also the movement between two or more economies and in practice it signifies the exchange of technical knowledge between national economies. In other words, 'a secondary innovation, or the implementation of a primary innovation originally discovered or applied by another firm, which may be briefly termed as the propagation of the innovation becomes a technology transfer' (Tuerkcan, 1972).

The action of technology transfer is pursued so that companies and industry in general will get benefit from technology that had been already paid for. Put differently, existing R&D projects and developed technologies, which had already been paid for, can be further transferred to industry and private enterprises.

The primary objective of academic technology transfer is to enable the development and commercialization of academic research findings, ensuring that research ultimately reaches and benefits the public.

6.1.2 Benefits of Technology Transfer

Technology transfer involves the acquisition and assimilation of technology in order to improve the capabilities and efficiency of production processes. This includes hard and soft technologies associated with the transfer of machinery and capital equipment, production and process methods, management systems, procedures, services, knowledge and know-how. This transfer occurs usually on commercial terms between private-sector suppliers, and can be financed by foreign direct investment (FDI). However, technology transfer does not necessarily have to occur between developed and developing countries; it can equally occur among countries that are economically similar, within countries, and between countries and companies experienced in different areas of specialization or scales of production.

Firms, especially SME's in developing countries, have to adjust to changes in national policies as countries pursue broad structural reforms to support their growing participation in the global economy. In parallel, manufacturers need to be attentive and responsive to change conditions and consumer preferences in the marketplace. New rules and responsibilities established by the multilateral trading system and a widening array of bilateral and regional economic integration agreements have created new requirements for managing these changes. While it has opened new markets, it has also increased competitive pressures for SMEs exporting abroad or selling at home. Consequently, there is a vital need to improve the productivity and competitiveness of SMEs, thereby helping to overcome the challenges posed by globalization, through mechanisms that enhance technology transfer and channel investment towards SMEs (ESCWA 2005).

6.1.3 Methodology

In order to cover the different topics highlighted above and which are required in work package 6 the different tasks that have been conducted are: the investigation of regional technology transfer, the investigation of international, cross-border technology transfer and the investigation of regulatory frameworks that foster technology transfer. The different tasks are shown in table below.

	Activity	Methods
Task #1	Regional technology transfer	Desk research, expert interviews, interviews with local stakeholders
Task #2	International, cross-border technology transfer	Desk research, expert interviews

Table 3: Tasks of work in work package 6

Task #1 was conducted by visiting and interviewing food industries in several industrial cities as well as the Food Technology Center (FTC), one of the most active Egyptian technology and innovation centers, under the Ministry for Trade and Industry (MTI). The food sector has been chosen as it is a relatively well developed sector of Egyptian industry and the number of companies that are benefiting from services of the Industrial Modernization Center (IMC) amounts to 1456 all over Egypt. In addition, the Egyptian food industry has made progress over the last 4 years, mainly in growth of exports. Some relevant information has been used from work package 1 and 2 for regional technology transfer.

Task #2 was conducted by selecting a different sector, engineering industries, where relatively successful firms usually have direct contacts and approaches to international and cross border technologies. This part of the study is mainly based on a research of the relevant literature on international technology transfer and on interviews with representatives of the sector. WP4 and 5 represent some information that is relevant to this section.

The impact of framework conditions on the local/regional as well as on the international cross border technology transfer was mainly conducted by interviewing an expert in technology transfer and by desktop research of relevant official documentation, publications and literature.

6.1.4 Egyptian Industry: Historical Background

Egypt has a long history in small and medium sized industries. Private entrepreneurs had their industrial enterprises existing for several centuries. The most prominent sector was textile industry, which is almost 5000 years old.

After the revolution in 1952 some large industries have been introduced and were state owned. Egypt was much further advanced industrially than any other Arab country or indeed any country in Africa except South Africa. Under the socialist administration of Nasser, the government coordinated industrial expansion and the establishment of an industrial base which the result that bureaucracy and a dependence on political directives from the government became common to Egyptian industry.

Since the early 1990s the government has promoted privatization as a way to eventually increase industrial output.

Industry accounted 30% of GDP in 2001. Major industrial products included textiles, chemicals (including fertilizers, polymers, and petrochemicals), pharmaceuticals, food processing, petroleum, construction, cement, metals, and light consumer goods. The clothing and textiles sector is the largest industrial employer.

Cairo, Alexandria, and Helwan are Egypt's main industrial centers, producing iron and steel, textiles, refined petroleum products, plastics, building materials, electronics, paper, trucks and automobiles, and chemicals. The Helwan iron and steel plant, 29 km (18 mi) south of Cairo near Aswan is using imported coke to processes iron into sheets, bars, billets, plates, and blooms.

The petroleum industry achieves 40% of export earnings, but there are concerns that by 2005–10 Egypt will have to import oil, as oil fields mature and domestic demand increases. Egypt's proven oil reserves in 1999 were estimated at 3.5 billion barrels. In 2002, the country had 9 oil refineries, and was producing 631,616 barrels per day of crude oil, down from 748,000 barrels per day in 2000. Egypt is encouraging oil exploration, but natural gas is becoming the focus of country's oil and gas industries. In 2002, two multi-billion dollar were invested in natural gas projects designed to export gas to Europe. A large natural gas field off the Mediterranean coast of the Egyptian city Damietta was discovered in 2002, with field's reserves estimated at 530–1,060 billion cubic feet. Natural gas reserves in the country are estimated at 55 trillion cubic feet (Tcf).

Egypt's industrial sector experienced major reforms since World Bank adjustment programs went into effect during 1991, privatizing and restructuring state owned enterprises. Some of the companies are in important non-oil industries technically in the private sector, but control still remains within the government.[3]

6.2 Performance of Regional Technology Transfer

6.2.1 Specific Objectives

The following objectives are pursued for the evaluation of technology transfer (cross-border/inter-regional/intra-regional) in Egypt:

- Identification of main actors and institutions of technology transfer and regional development and their roles;

[3] http://www.nationsencyclopedia.com/Africa/Egypt-INDUSTRY.html

- Identification of main modes of technology transfer in Egypt;
- Identification of relations and networks between producers, intermediaries and users of technology;
- Determination of external impacts on technology transfer and crucial framework conditions (e.g. legal framework conditions, macro economic incentive structures).

This evaluation process will show the interactions and interconnections between the key actors of Scientific Research and Technology (SRT) in Egypt, which are mainly analyzed in other work packages.

6.2.2 Mechanisms of Local and Regional Technology Transfer

A wide variety of models of technology transfer have been used over the years. In the course of the field research conducted in the depth of Indonesia, ten locations across 21 industrial branches were investigated and ten different types of technology transfer were considered:

- In-house, i.e. inside the firm;
- Suppliers, i.e. formal or informal technological support from capital goods manufacturers and suppliers of inputs;
- Customers, i.e. mostly informal support (e.g. ad-hoc assistance to solve specific problems);
- Other firms, including competitors;
- Universities;
- Research institutes;
- Specialized technology transfer institutes;
- Consultants;
- NGOs;
- Technical Assistance, mostly from international donors.

6.2.3 Conceptual Framework

The research on regional technology transfer is based on the framework of technological capability in developing countries (Hillebrand 1994, Messner & Meyer-Stamer 1995). Specific definitions regarding innovation, technology, and innovation systems are applied.

The purpose of this section is to outline the main features and definitions of this conceptual framework. This chapter deals not only with some key categories of the discussion on technological capacity building and technology transfer it rather reflects the observation that there are quite different conceptualizations of technology-related issues. One of our key categories is innovation, but there are numerous different conceptualizations of innovation to be found in the literature. The same applies to the category of technology.

6.2.3.1 *What is Innovation?*

Innovation means a new way of doing things like producing a given good in a more efficient way – by means of a better organization of the workflow (organizational innovation) or by using a better machine (technical innovation). Innovation can also be seen as a more efficient way of defining the development priorities of a society (societal innovation). The meaning of innovation is not to mix up with invention as invention means to identify a new way of doing something, or to develop a new artifact. An invention is a one-time occurrence whereas a given innovation may occur over and over again in different firms and places.

Innovation is the key ingredient of economic and social development. Innovations are the basis of productivity increases, which lead to the generation of a surplus that can be invested, which in turn leads to further productivity increases and in the end to rising welfare. (It is, though, important to point out that this connection is not technically predetermined but has to be generated through appropriate societal arrangements, especially regarding the distribution of productivity gains.) This is the reason why the question of how to stimulate innovation receives such a great attention.

Innovation occurs in all sorts of settings and situation. The fashion industry is constantly creating new styles. Political actors sometimes come up with new solutions to societal problems, i.e. policy innovation. Research institutes develop new processes. Firms develop new products. Among the places where innovation occurs there is a limited set, which is relevant in the context of this work, namely firms and institutions are dedicated to create and disseminate knowledge in order to apply it finally for creation of innovation. A firm has multiple means of acquiring knowledge that leads to innovation like internal conversations with their employees, hiring new employees with specific knowledge or via technology transfer. But what is the meaning of technology and technology transfer?

6.2.3.2 *What is Technology?*

Innovation and technology are related issues, but they are not synonyms. The invention of a new fashion has little to do with technology: all it needs is a pencil and piece of paper, and theoretically it could also be done with the finger in the sand, i.e. without any technology at all (at least based on the common understanding of what establishes technology). At the same time, there can be technology without innovation like a factory which has once been set up (which is an innovation at this point of time) and subsequently is being run without any changes to process or product: there is technology, but no further innovation.

But these are extreme cases. In the day-to-day operation of a firm innovation and technology are closely related. Yet it is not at all simple to define technology, and a definition is not made any easier by the fact that the semantics of the term technology differs in different countries and setting, sometimes emphasizing the science of technology, sometimes the application of technical knowledge. Summing up the widely accepted definition, it is possible to delimit two variants – a narrow definition and a broad one.

In the more narrow sense technology is the know-how required to develop and apply technical methods. It appears in a bound form in machines and plants, in an unbound form in blueprints, and manuals. Technology transfer is the transmission of this know-how. The term technology transfer is frequently used as a synonym for the international transfer between industrialized countries or from industrialized countries to developing nations; yet it is not unusual that a transfer of know-how within the boundaries of one country is referred to as technology transfer.

The narrow definition refers to technical artifacts. At first glance it has the advantage of being handy. But its drawback is that its use entails the risk of loosing sight of the complementary factors. Complementary factors, without which the employment of technical artifacts makes no sense, are above all qualification, skills, and know-how (of the people who work with artifacts) and organization (i.e. the process of tying artifacts into social contexts and operational sequences).

This leads to three conclusions:

(1) Technology should not be seen in isolation from the environment in which it emerges, or from the organizational structures in which it is used. Technology does not come in a vacuum; it will be always developed in concrete social contexts and is therefore never neutral, as it will be developed on the basis of given (economic, social, political) interests. The utilization of technology is contextual: in a crime-related context technology will tend chiefly to be used for criminal ends; in a society blessed with ample resources technology can be used to feign modernity; in a competition-oriented society technology will be used to heighten efficiency and thus to increase welfare.

(2) Technology often embodies organizational factors. A closed process in the chemical industry or a production line in the metal-processing industry, for instance, consists not only of technical knowledge of individual processing sequences; it also implies organizational knowledge about possible transitions between these sequences. This is even more clear-cut in information technology: In computers, sequences that previously were performed by people on the basis of accumulated organizational knowledge have been translated into programs to control machines.

(3) Any narrow definition, accompanied by the view and approach that go along with it, can thus be tantamount to a guarantee that projects will fail – in development cooperation no less than in many international high-tech corporations, many of which have gone down in recent years flying the colors of one-sidedly technology-minded rationalization projects.

In recent years the discussion on development policy and the field of development cooperation has experienced a general acceptance of the broad definition of technology, one that does justice to those problems will be defined in the following. A common definition includes four components:

- technical hardware, i.e. a specific configuration of machines and equipment used to produce a good or to provide a service;
- know-how, i.e. scientific and technical knowledge, formal qualifications and tacit knowledge;
- organization, i.e. managerial methods used to link hardware and know-how;
- the product, i.e. the good or service as an outcome of the production process.
- The advantage of the broad definition is that it can help to avoid barren discussions and that it prevents, for instance, any equating of technical artifacts and technology. It reflects gathered experience, for example, in development cooperation. In view of this definition it is obvious that technology cannot be transferred in a package form. At the same time it is, against this background, easier to comprehend that technology is involved whenever production goes on – even when seemingly primitive technical artifacts are utilized in the process, for "no country is without technology, not even the most primitive" (Enos 1991).

Technological and economic development are linked inseparably – sustained economic growth results in particular from increasing the efficiency of inputs, i.e. from the introduction of new, better machines, through organization improvements, successful learning processes, and enhanced qualifications – in short: through technological progress. This insight has all along left its mark on the discussion and the practice of development policy; the latter has regarded technology transfer, beside the transfer of capital, as a crucial approach to overcome underdevelopment. This goal has been achieved in very few countries; all in all, the welfare gap between industrialized and developing countries has widened. There is no doubt today that more than technology and capital are required for dynamic development. Political and economic framework conditions, socio-cultural factors, and an eye for specific ecological conditions are what decide on the success or failure of development strategies.

That does not necessarily mean that technology is a secondary element. Quite on the contrary, technology is more than ever a central factor of economic development. Technology is the link between the inputs capital and labor and the output, the product. Technology can be the lubricant, which makes production efficient; but it can also be the sand that clogs up the process, causing that in the end, the outcome will be less than the input.

6.2.3.3 *What is an Innovation System?*

An innovation is based on knowledge, i.e. one of the elements of technology. This knowledge can be acquired in two different ways: in a solitary way and by interaction. The first way of getting knowledge is through experimentation without communication. The second way involves personal or non-personal communication. Non-personal communication includes reading books or manuals, watching TV programs or CD-ROMs, browsing the worldwide web, or listening to broadcasting. Personal communication includes attendance of school education and other training activities, cooperation with colleagues in a firm, and discussions with outside technicians or consultants. As a rule, acquiring knowledge by interaction is more efficient.

A large part of knowledge requirements by a firm is available internally like the knowledge of the engineers, managers, technicians, and other employees. Their knowledge is partially acquired externally, based on formal training, and partially acquired in a cumulative process based on learning-by-doing. This internal knowledge, which is available at any given time, is the main resource of a firm when it comes to innovation. Apart from that, there are sources of knowledge outside the firm. Most important are other manufacturing firms – customers, suppliers of inputs and equipment, and other firms (including competitors in the same branch). Also important are service firms, which offer consultancy, software, or access to databases. Other external sources include business and professional associations, technology institutions, research centers, universities, government agencies, and others.

From a different perspective, it is obvious that a firm relies on external knowledge in two ways, an indirect and a direct one. The indirect way includes school education, vocational training, and higher education of its employees as well as ongoing training. This creates the knowledge base of a firm; it is not aimed at resolving an immediate problem but rather at providing the knowledge that helps in finding a solution. The direct way includes exchange of information and experiences with other firms, or contracting consultants, or cooperating with a contract research institute.

It is by no means obvious that direct acquisition of external knowledge is a paramount feature of a firm's innovation effort. One reason why a firm may rely mostly on its internal knowledge is the "not-invented-here-syndrome", i.e. a firm's conviction that its knowledge is at the leading-edge, that it knows best how to do things and that therefore the effort to acquire knowledge elsewhere is a waste of time and money. Another reason is that knowledge-acquisition often takes place on a two channel-basis (give and take) and that a firm rather prefers not to disclose its knowledge, in particular not to other firms, as it fears that this might undermine its competitive advantage.

Nevertheless, it is largely undisputed that successful firms rely to a large, and increasing, extent on external sources of knowledge. As the interactive mode of knowledge generation is becoming increasingly important, the phenomenon of innovation systems has received increasing attention among innovation researchers. It is one thing to note that there is an interactive mode of knowledge generation. It is quite a different thing to understand how exactly this works.

There are two different perspectives on the innovation system phenomenon. The first perspective is the National System of Innovation Approach (Nelson Lundvall, 1992). Researchers tried to find out why and how innovation takes place in different countries, and they found remarkable differences – between advanced industrialized countries, and even more so once they included advanced developing countries. This approach is to some extent concerned with the specific way different actors cooperate within a given system. But its main focus is on differences between countries. These differences can be traced back to historical development trajectories and the set of institutions in each country. Factors like the basic organization of the economy (in German called 'Wirtschaftsordnung'), the structure of the finance system, the emergence of the science and university system, and the general set of incentives that firms and other innovation actors face are paramount in explaining differences. In this perspective, it is those factors, which determine whether firms have to innovate, and to what extent they can manage to do so. The analysis of R&D institutes, technology transfer organizations and other manifestations of technology-related activities in a narrow sense is not the main perspective of this approach.

The second perspective addresses phenomena like regional innovation systems and sector-specific innovation patterns (Cooke 1992; Cooke 1996; Heidenreich/Cooke 1997). This perspective is much less about the macroeconomic and regulatory framework and much more about the innovation system in a very narrow and specific way. It is about a system and its environment, i.e. a set of actors who cooperate to innovate. A macroeconomic framework, which forces and encourages firms to innovate, and to look for interaction with other firms and institutions, is taken for granted. Researchers try to find out how exactly technology- and innovation-related interaction works: Who cooperates with whom, why are things so different between regions, even if they have similar industrial structures, or between branches, even if they face the same macroeconomic and regulatory framework conditions.

In trying to synthesize these approaches, we have formulated the four-pillar model of innovation (see figure 133). Trying to outline the key elements of an innovation system, it draws on both perspectives:

The first pillar is the firm. This is where a large part of innovation takes place, and firms are the targets of efforts to stimulate innovation. Internal organizational factors and inward Technology Transfer depend mainly on whether the firm is one of the following types:

- Innovators: first to adopt a new idea

- Initiators: adopt idea soon after the innovators
- Fabians: adopt idea only after its utility was widely acknowledged in the industry
- Drones: last to adopt new ideas

Some factors have been identified that foster Technology Transfer inside the firms

- High quality of incoming communication
- Readiness to look outside the firm
- A willingness to share knowledge
- A willingness to take on new knowledge, to license and to enter joint ventures
- A deliberate survey of potential ideas
- An awareness of costs and profits of R&D
- Good quality intermediate management (Nirma)

The second pillar is established through the macroeconomic, regulatory, political and other framework conditions. They define the set of incentives firms are facing. More specifically, they establish whether or not firms have to innovate. Firms' innovative efforts are usually the result of a necessity – firms have to innovate to master the challenges of competition and to stay in the market. In turn, this means that firms, which are under little competitive pressure, will often not feel inclined to put much effort into innovation, something that is perfectly rational as innovation always involves cost and risk.

The third pillar is the technology institutions. In a developed economy, there is usually an enormously diversified set of such institutions. Some of them conduct basic research, an activity that is hardly relevant for firms (except for very young industrial branches, which draw directly on scientific breakthroughs, like genetic engineering). Some do more applied research and development, i.e. come up with new products and new ways of manufacturing them. Some are specialized in transferring such know-how to firms (transfer agencies), or focus on waking-up firms, which are unaware of innovations they will need to survive (extension agencies). Then there are technology incubators, i.e. institutions, which host new, technology-intensive firms. Other institutions include, for instance, those, which specialized in technology assessment and forecasting, or in social science research on technology. Also, institutions like business associations can play an important role here, not so much in terms of R&D but in terms of stimulating interaction. Finally, there are institutions in measurement, standards, testing, and quality assurance (MSTQ); in fact, they are the very basic institutions, which should even be present in environments where other institutions have not yet a role to play. – Technology institutions are the world of the second perspective. They interact with each other, and with firms, and they do that in various ways. There cannot be a blueprint for interaction, because it depends – on framework conditions, on firm size, on industrial branch, on the phase in an industry’s lifecycle, and so forth. The only thing that is for sure is that something is wrong with a technology institution, which does not interact. There can, however, hardly be a prescription with whom a given institution is supposed to interact. Determining this requires a careful analysis of the institutional setting, i.e. the incentive framework, further technology institutions, and firms. The outcome of such an analysis can be that a given institution has just no role to play, at least not under given conditions. This will often be the case in developing countries where firms are not prepared, neither in terms of qualification nor in terms of attitude, to cooperate with technology institutions.

Finally, there is the fourth pillar, which consists of education and training institutions. There is certainly some overlapping with the third pillar, as some research institutions will do some training, and some training institutions (especially universities) may be involved in R&D. However, it is crucial to understand that even in the case of universities their core mission is training. There is currently a lot of controversy about the ability of universities to do research and development, and to transfer its results to firms. The model of the research university was created in 19th century, when universities where quite elitist places, and it is unclear whether it is the adequate role model for the mass university of the late 20th century. In any case, it is important to acknowledge that even in advanced countries the importance of universities for economically research and development (as different from basic research) is often overestimated. In developing countries, the potential of universities to contribute to firms’ upgrading efforts is usually very limited.

The four-pillar-model helps to avoid a too narrow perspective. For instance, it is common to find innovation deficits at the firm level, particularly in developing countries. Typical causes are deficient management know-how and technical education. A typical development cooperation response is then to create certain meso level activities, like technology extension, management training, and technical training. More often than not, the analysis of macro-level factors is at best superficial. Yet macro-level factors are often the main causes for firms' behavior; what may appear dysfunctional to the external observer may be highly rational in the perspective of the firm owner. Therefore, it is crucial to develop a systemic view, including macro-level factors, to understand the incentives and restrictions, which shape the behavior of businesspeople, and to understand whether the conditions for interaction between firms and meso-institutions are in any way favorable. In practical terms, it is often helpful to employ methods like action research to identify potential for change and possible points of entry for external support, and to stimulate learning processes among key actors.

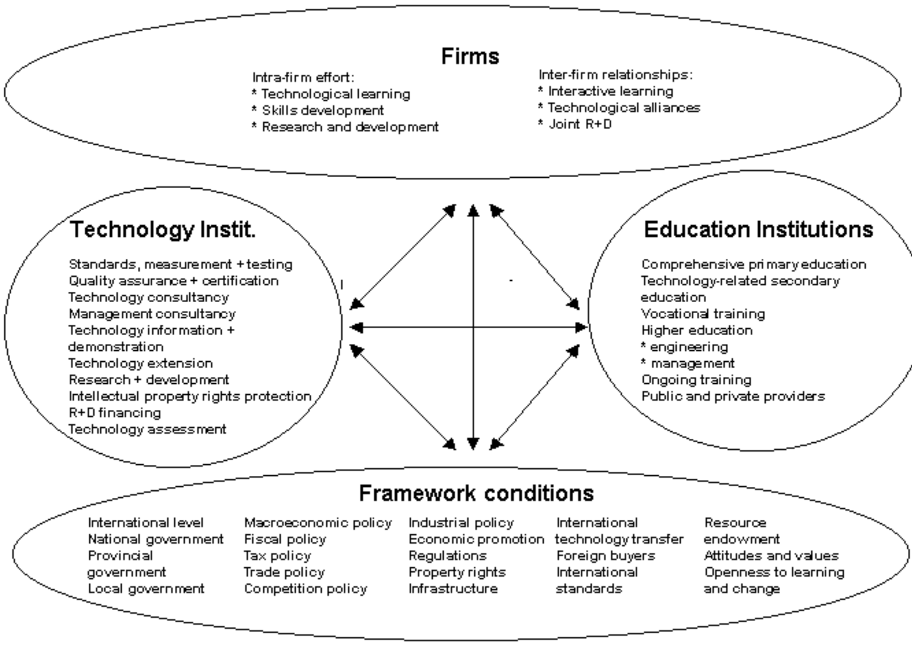


Fig. 143: The Innovation System: four pillars of technological capability (Source: PERISKOP)

Hypotheses

Based on an evaluation of the literature and a number of preparatory interviews with key actors, we formulated a hypothesis at the beginning of the research. It has to be pointed out that all the following hypotheses are in the first place the perceptions and opinions of the authors of the respective literature and of the interview partners.

Innovation Capability at the Firm Level

There seems to be a wide gap between a small group of large firms with a reasonable level of technological capability on the one hand and a large group of small and medium sized firms with little as well as and an huge number of micro firms with no technological capability, on the other hand.

There is some evidence that dynamic private sector companies are to a high extent concentrated in few industrial cities (10th of Ramdan, 6th of October, Sadat, Alexandria).

The business sector complains about suffering from severe financial distress.

It appears to exist a wide gap of distrust between the private sector and the public sector, whether research or industrial. Firms perceive the public sector as a burden, which hardly takes efforts to support them.

Framework Conditions

It is criticized that the Government does not pursue a defined technology strategy, either implicitly or explicitly. There seems to be, however, a slowly growing conviction that the old, high-tech-oriented strategy was not fully adequate. The Government is said to lack an overall integrated development strategy. The financial pressure on the Government appears as one of the reasons why wages of public officials are and remain low. This, in turn, is named as one of the causes for the high level of corruption.

Apparently, there is an enormous diversity in the skill level of government officials. Loans are hardly available for firms due to the distress of the financial system after the financial crisis, but also due of the problems in enforcing contracts, which leave banks vulnerable to defaulting debtors.

A certain impression is given that there are serious difficulties in enforcing property rights, since the legal system is apparently not well developed and courts are said to be rarely independent.

Technology-related Institutions

The system of S&T institutions, being almost 100% of state-owned, appears to be top-heavy, i.e. it has the shape of an inverted pyramid, and this in two senses. First, it is top-heavy in terms of regional distribution. Institutions are concentrated in and around Cairo, and to a much lesser extent in Alexandria in the north and other cities in Upper Egypt. There seems to be no effective research and technology extension structure beyond this. Second, it is top-heavy in terms of administrative overhead. A working hypothesis is that there are more administrators than professionals, who actually do R&D work.

Funds available for S&T are very limited. R&D expenditures amount to just 0,25 % of GDP. Existing institutions obviously tend to pursue a supply-driven approach, offering services to firms, which did never ask for. In research institutions, a concept of pure research for its own sake seems to be frequent. Research institutes attached to ministries other than the Ministry for Higher Education and Scientific Research are not necessarily conducting research, and are apparently not interrelated with policy-making or any other practical application. S&T agencies are said to suffer from a high level of inefficiency as regards management and administrative skills.

Education System

The quality of higher education institutions is suffering from deterioration in almost all public universities.

The vocational training system seems to be weak and disorganized. Even though some firms are willing to pay for training, their willingness to do so appears to be limited due to information asymmetry, i.e. the problems in evaluating the quality of training providers due to the obvious absence of any kind of certification system.

6.2.4 Mechanisms of Technology Transfer Applied in Egypt

Neither the Egyptian S&T community or universities and research institutes nor the industry is yet in the position to develop new major technologies or production according to its specific needs by itself. Some exceptions exist, but in most cases technologies and innovative products have to be imported from abroad. This was indicated by the results from the innovation survey conducted by the MHESR. Results from Cornelia:

Nevertheless, universities have been criticized for being more active in developing technologies than moving them into private sector applications. This is potentially problematic since success in university/industry technology transfer could be a critical factor in sustaining the global competitiveness of firms.

On the other hand some mechanisms are applicable in Egypt, which cannot be categorized as technology transfer processes, but are definitely of great value to the industrial firms. These are as follows:

NGOs are acting as an intermediary body for technology transfer. A prominent agency exists, the Federation of Egyptian Industries (FEI) and affiliated industrial chambers. The Association of Industries was first established in 1922 by visionary entrepreneurs from the Egyptian business community, as a non-governmental organization. The persistence and track record of success that had followed shaped the nowadays known as Federation of Egyptian Industries. In 1958 an industry organizing law created an organizational link between the Federation and the Ministry of Industry. FEI is still counted as an NGO but has a tinge of being a public institution related to the MTI.

The vision of FEI is to develop realistic, value-rich programs designed to uplift the performance of the Industrial Sector and proactively tackle their problems in order to create a globally competitive industrial society. And its mission is to drive industrial economic growth, both domestic and export, using an independent, proactive, self-sustainable & integrated approach to global competitiveness, while balancing the needs of our stakeholders.

FEI Strategy: Using the proper thought process, governed by a solid business model through creating a workable scientific structure and utilizing proven methodologies, the FEI will provide the necessary tools and financial resources in order to do the right thing the right way, therefore leaving a legacy that can be measured, qualified, rewarded and recognized.

FEI Business Agenda:

- To directly represent members' interests before governmental and legislative bodies, as well as other local& international associations.
- To participate in developing policies & legislations that result in encouraging investment and developing suitable environments conducive to rapid growth of national economy.
- To advocate structural reform that leads to transparency in governmental legislative & enforcement practices.
- To contribute to the development of Egyptian industry by adopting new technology & international quality standards.
- To provide information to its members via its databases, publications, seminars, etc. in order to serve their requirements.

Specialized Technology Transfer Institutes/Centers

Lately there exists an increasing attention towards innovation within the S&T society as well as the Ministry of Trade and Industry (MTI). The MTI saw itself in the position of responsibility to establish and continuously develop 12 technology transfer and innovation centers (ETTICs http://www.tic.gov.eg/center_en.htm) which operate sectorally, sub-sectorally or horizontally. The primary target sectors are ready-made garments, leatherwear and textiles, plastics, engineering, traditional industries, food, furniture and marble and granite. As far as technology transfer issues are concerned, the current Egyptian Industrial Development Strategy states the main objective of the establishment of ETTICs to be "fulfilling the technological needs of the Egyptian industry in particular of the exporters to become constantly competitive. They are meant for transfer and diffusion of new technologies and innovations by the efficient management of top-notch technologies, brought about from global technology markets".

The Deutsche Gesellschaft fuer technische Zusammenarbeit (GTZ) Gmbh cooperates with a national partner the MTI in the Private Sector development Program (PSDP), through the realization of specific projects and consulting activities intended for these centers. The study "The Egyptian Innovation System: An Exploratory Study with Specific Focus on Egyptian Technology Transfer and Innovation Centers" was conducted by the German Institute for Innovation and Technology VDI/VDE to identify the framework conditions set by the Ministry of Trade and Industry (MTI) to enhance the innovation in and technology transfer to the private sector, considering the possible role of the Egyptian Technology Transfer and Innovation Centers (ETTIC) in the strategic options of MTI and in the innovation landscape; to identify institutions and programs that are dealing with the promotion of innovation in the private sector; to identify the private sector's ability/demand/interest in innovation and technology transfer; and to assess the cooperation between the private sector and the R&D sector.

The study revealed that the ETTICs lack marketing and communication to the Egyptian industry. Yet they are located in an interface position that requires excellent communication and marketing skills. Therefore, if the managers are well educated in management concepts, ETTIC experts will be in a position to fulfill the required tasks as well as assess the managerial strengths and weaknesses of their clients and will be perceived as esteemed experts or consultants.

In addition, ETTICs constitute valuable tools for designing and implementing innovation support policies and programs. Yet, till today, not all of them fully exploit their impact potential. On the contrary, for various reasons, many of them do not act effectively as needed.

As ETTICs are a specific part of MTI, this could be hampering the flexibility of their operational work. They are part of the execution of general administrative procedure and cannot make operational decisions as well as payment authorizations only in regard to client orientation.

One good example of these centers is the Food technology Center. Though it is not yet fully operating in full conformance with the strategic objectives set by the MTI, but it could attract over 100 of industrial enterprises providing them with training, consultancy, testing services. In a further developmental process the FTC is aware of its role in technology transfer and innovation therefore strategic partnerships will be established from which its clients will benefit.

The distribution of ETTICs adds to the potential of these centers to be of crucial importance in the processes of innovation and technology transfer for SMEs. In principle the centers can have branches in regional districts and the distribution of industrial enterprises would be a guiding factor for the establishment of centre branches or new centers.

- In-house, i.e. inside the firm: many of the interviewed firms rely on the knowledge inside the firm in developing the products and/or processes. This has been noticed in the food industry sector in particular. The entrepreneurs usually tend to rely on the in-firm know-how rather than hiring a consultant from outside. The causes might be related to the lack of trust from previous bad experiences.
- Consultants: As far as local expertise is required for industrial enterprises it is usually executed on the basis of part-time job, no researcher is a full timer in industry. Very few industries hire specialized qualified staff for a full time job. This phenomenon is mostly seen in the ICT sector, where firms can afford the high salaries of the experts.

- Suppliers, i.e. formal or informal technological support from capital goods manufacturers and suppliers of inputs: the technical assistance, mostly from international donors: this is the normal mechanism of technology transfer among Egyptian firms. The suppliers are usually the main source of knowledge that accompanies the purchase of technological equipment or machines.
- Other firms, including competitors; results from the questionnaire show that most of the information and to a lesser extent knowledge is transferred through informal meetings with consultants, suppliers, or even competitors on conferences, meetings and exhibitions. A study by Stephan Schrader's article on "Informal technology transfer between firms: Cooperation through information trading" showed that employees frequently give technical information or an advice to colleagues of other firms, including direct competitors. This paper addresses whether such information-transfer is in the economic interest of the firms involved.
- Customers, i.e. mostly informal support (e.g. ad-hoc assistance to solve specific problems);
- Science parks model: Mubarak City for Scientific Research & Technology Applications (MuSCAT) is the newest addition of research institutes in Egypt that was directed to the development and renovation of industry. It is the only announced science park in Egypt.

In 1993 the decision to develop a science park in the Alexandria region was taken in order to acquire and improve scientific technologies in different areas of human life. The Muscat occupies 250 acres in the industrial area located at New Borg El Arab City, west of Alexandria. This region also inhabits about 40% of the Egyptian industry. The science park comprises 12 research centers, which will be developed at different intervals. The first stage of Muscat was inaugurated on the 13th of August 2000 and included Genetic Engineering and Biotechnology Research Institute (GEBRI), Informatics Research Institute (IRI) and Institute of Advanced Technologies and New Materials (IATNM). In addition, a Technology Capabilities Development Centre is fully functioning in the Dekhlia Branch. Till present no more centers have been added.

From the objectives of MuSCAT it is clear that they are identical to those of several other research centers and institutes affiliated to Ministry of State for Scientific Research. The most important of those are the National Research Centre, the Metallurgical Research and Development Institute and the Electronic Research Institute by analyzing the data from the R&D study. It has to be mentioned that the nomenclature is not a decisive factor for the functionality of the research institutes.

6.2.5 Main Findings

There is hardly any local/regional innovation system anywhere in Egypt. This is not to say that there is no technological capability building and innovation; in fact, there is quite a lot of this within firms and also in institutions. But technological capability building is rarely based on intense interaction between different actors/organizations at the local level.

There is little interaction between firms and training as well as research institutions. Firms rely on other sources of technology.

There is an inward-orientation of training- and research-institutions. Their incentive structure so far militates against networking with firms. Training institutions define their courses and curricula mostly without taking demand by private firms into account.

Research institutions define their research priorities based on the availability of government funding, or at least the hope that there might be some government funding available.

There is an enormous distrust of firms' vis-à-vis government institutions. Firms rather prefer to be as little as possible in contact with government institutions, including training and research institutions. This is due to low or at least unpredictable competence on the one hand and the high incidence of corruption and graft on the other hand.

For firms, suppliers and customers are the main sources of technology. This applies particularly to SMEs.

An interesting finding, however, is that NGOs play an important role in technology transfer. The Federation of Egyptian Industries and its industrial chambers, there are hardly any institutions in Egypt, which focus their activities mainly on the transfer of technologies. Therefore, they are located as intermediaries between research institutions and firms.

Decentralization may create potential to strengthen local/regional innovation systems. However, so far the decentralization process rather resulted in uncertainty of the regional actors.

There is little contribution of the ETTICs to technological capacity building. Their programs are little known. Their relevance for innovation in firms is close to zero, while they have a limited relevance for research institutions.

6.2.6 Typical patterns of Local/Regional Innovation Systems

Institutional structure

In each region there is more than one state university and a number of private higher education institutions as well as technical schools. Some universities have specialized research centers and those are distributed in relation to the universities location.

It should be underlined that the independent research centers and institutes are only located in Greater Cairo.

Beyond this, there are various government bodies, which have an impact on technology issues in particular, IDA, GAFI, ITIDA, NTRA…etc.

At a second glance, however, doubts arise whether the presence of all those regional actors already establishes local innovation systems. A system is defined by connections and feedback links. This, however, is the weak point that needs to be overcome. The institutional structure is fragmented, and interactions between companies and supporting institutions are rather weak.

Relationship between government and private sector

The research confirmed something, which has already been documented that the relationship between government and the private sector is improving by time. This can be shown in the number of programs and regulations that are issued in order to foster and promote private sector. Since the present cabinet is taking charge a dramatic change in policy toward private sector is executed.

Even though Egypt is not on top regarding the corruption index (ranked 115), still there is some interaction with government, be it for legally mandated licenses or support activities. The high probability that government officials will expect side payments or benefits can not be denied, and so this is the main reason why private companies tend to limit their interaction with government to the minimum.

Towards the end of the scale, two other findings are notable. First, foreign research institutes and universities play no role at all. They may be relevant for Indonesian institutions, but not for companies. Second, specialized technology transfer institutions play hardly a role. As far as institutions are concerned, most relevant are local/regional universities and national research institutes.

International customers are more important for the SMEs, something that reflects their stronger involvement in international value chains. Moreover, foreign technical assistance (development cooperation) is an important source of technology for resource-based industries. Not surprisingly, international consultants appear to have some importance for capital-intensive industries.

Firms

The main observation is the relatively low overall level of technological sophistication, except for a small number of visited firms. In order to phrase this finding in a more positive way, one might state that there is an enormous potential for technological upgrading. Given the fact that many of the industries investigated here are already involved in export operations, being encouraged by the government through several channels, despite their low level of technological capacity, this opens interesting perspectives regarding increased export competitiveness and thus increasing exports.

Technology-related institutions

Regarding research institutes, it is important to differentiate between research institutes outside universities, which are linked to scientific research sector of the MHESR, and specialized research institutes inside universities.

Currently, research institutes outside universities tend to be caught in a vicious circle: salaries are low, equipment is inadequate, and incentive systems are oriented towards keeping government bodies happy. Research institutes tend to attract second-rate university graduates; currently, after graduating from university, a private sector employee may earn five to ten times the wage of his class colleagues who went to work for research institutes. The social prestige of research institute employees is not high any more, especially at the firm level. Researchers at the institutes focus at acquiring project research funding from government bodies with a very specific target: promotion; accordingly, institutes pursue little effort to work with companies, either in terms of joint research and development projects or in terms of transferring research results. The prestige of the institutes with the private sector is low, if they are known at all. Therefore, there is little chance for the institutes to go for contract research in order to improve their financial situation, increase salaries, and upgrade their equipment.

A number of research institutes inside universities do not display more favorable conditions in terms of internal capability through they are prestigious and tend to be able to attract first-rate researchers. Beyond that, however, they are involved in the same pattern as research institutes outside universities.

Taking these findings together, it becomes obvious that the low degree of interaction between research institutes and companies has systemic reasons rather than being accidental. Apparently the given fact in terms of interaction often refers to testing activities, as research institutes dispose of lab facilities, which are not available to most firms. The application of research and development is relatively small in some research centers and institutes. This reflects an overall incentive structure where employees at research institutes face little stimulus to go for co-operation with companies due to the fact that it does not improve their career perspectives which are based on academic achievements and it does not influence positively their income.

There are few institutions in Egypt to be found which focus on their activities mainly on the transfer of technologies and which act as intermediaries between technology producers and technology recipients. An interesting common practice is that a project has a start and a budget, but not necessarily an end or results.

Training institutions

The common perception among companies is that training institutions, be they in vocational training or at the higher education level, suffer from three problems:

- their curricula are outdated;
- what the students learn is not what the firms need;
- the students suffer from attitudinal deficiencies.

The reason behind is a combination of market and government failure. The larger part of training in Indonesia, in particular in terms of higher education, is organized as a market, i.e. training institutions offer courses and students pay to attend them. There is a proliferation of training providers, which offer courses in a wide variety of levels of sophistication (even training institutes for secretaries present themselves as "universities") and a wild variety of quality. Moreover, there is a second level of markets, i.e. bribery and graft, as it is not difficult to purchase diploma without ever having attended any course. Accordingly, diplomas, which are supposed to solve the problem of information asymmetry, do not fulfill this purpose. Except for a limited number of highly renowned institutions, it is difficult for a potential employer to assess whether a job candidate passed exams in order to get the diploma and if so what did he study or if the diploma was purchased.

FRAMEWORK CONDITIONS

The following section is an enumeration of existing regulatory frameworks and gives information about implementation programs which if implemented will support the technology transfer. Several ministries are issuing regulations and legislations and offering programs to enhance technology transfer and diffusion in Egyptian industry, to SMEs in particular. The most important examples for regulatory frameworks are as follows:

The workmanship has always been carefully supervised by the government of Egypt (GOE) throughout Egyptian history. The Government of Egypt (GOE) is undertaking a series of versatile amendments towards reforming and improving business and investment climate in Egypt. The government strategy is strongly committed to rationalize investment procedures, to dismantle bureaucratic obstacles, and to liberalize business. In order to achieve its goal, the GOE undertook a series of reforms regarding its policies as well as its institutional frameworks to pave the way for an improved investment climate and a more developed business environment in Egypt.

To attract more Foreign Direct Investment FDI is indispensable to develop appropriated and integrated national as well as regional institutions and structures. Furthermore, FDI attraction unquestionably requires a supportive business environment and a community of qualified and professional people with the skills and knowledge to attract FDI flows within the highly competitive international context.

New set of government policies, investment laws, and guarantees have been introduced with the purpose to fortify and revitalize the investment environment in Egypt. On one hand, Egypt's proximity to international markets and the rapidly growing demand for certain industries, locally as well as worldwide, play a vital role in encouraging exports and improving productivity. On the other hand, new investment laws and government regulations have recently eased international trade barriers and therefore foreign investment flows into Egypt. Due to the increasing competitiveness Egyptian businesses are forced to meet international standards in order to compete in the global markets. As a result of international trade agreements, Egypt enjoys a wide range of market access to North America, China, Europe, North Africa and the Middle East, with its central location bridging the three continents, Europe, Asia, and Africa.

As part of the coherent and comprehensive framework set off by the new ministry of Investment, a number of exceptional incentives are being granted to companies in particular for their purchases of stakes in public sector enterprises, and their endeavor for administrative restructuring and financial modernization.

A closer look at existing framework conditions reveals that almost all SMEs were set up with the objective to foster FDI rather than technology transfer at the local or regional level.

Examples of successful framework conditions are:

Industrial Modernization Center (IMC)

IMC started as an EU Program to modernize Egyptian industry.

IMC has an impact on, for example, the food industry sector, as this sector is considered to be one of the oldest industrial sectors in the Egyptian economy. It is also characterized by having large private ownership, 95% of formal establishments in the sector are privately owned. Earlier in 2005, food exports reached in total 3,888 million EGP while in 2007 the amount raised to 6,970 million EGP and by the end of 2008, exports of food processing industry increased to 8,061 million EGP.

IMC services to the food industry companies are:

- Assist food companies in compliance with international food and safety standards such as ISO 22000
- Implement a number of lean manufacturing projects with tier 1 companies
- Apply R&D program to solve wastes problems in poultry, meat processing and fruit vegetables sub-sectors

- A comprehensives trade fairs plan and business match making
- Know how transfer through in company experts
- Sector Projects:
  - To assist in establishing national Food Authority
  - To assist in issuing unified food law
  - Dairy and cheese project to upgrade 20 small factories in cooperation with the Food Chamber.

Science and Technology Development Fund (STDF)

In 2006, the Egyptian State Ministry for Scientific Research has embarked on an ambitious exercise to overhaul Science and Technology (S&T) activities in Egypt. In the course of the year 2007, the outputs of that exercise were a complete restructuring of the S&T governance and management model in Egypt, in addition to the establishment of the Higher Council for Science and Technology (HCST), and the Science and Technological Development Fund (STDF).

Funding (as autonomous as possible), the sources are government funding, donations and gifts, grants and loans, and investment of resources.

Several programs exist which foster the collaboration between researchers at universities and research institutes with industrial partners in identified fields of national priorities. All programs target to improve the research capacities at universities and research centres as well as building bridges with SMEs.

Recently a new center, Enterprise Egypt or Bedayah, has been launched to promote entrepreneurship and to support SMEs. The center will have the support of the SDF, the AG FUND and UNIDO. The presence of these centers in university campuses across Egypt is a good indicator for the promotion of TT from research to industry.

6.2.7 Conclusion

In 1980s all over the world, the potential opportunities that technology transfer could bring were recognized. This was based on a simple economic theory. Technology, which has already been produced, hence paid for by someone else, could be used and exploited by other companies to generate revenue and thereby to achieve economic growth.

With this theory in mind governments finally begun to encourage companies to get involved in technology transfer. They set up a whole variety of programs trying to utilize technology that had been developed for the defense or space industries. They encouraged companies to work together to see if they could share for the common good.

Information is central to the operation of firms and that it is the stimulus for knowledge, skills and expertise. In the industrial context it is argued whether the form of projects or the activities transforms knowledge into action. Only when information is used by individuals or organizations it will become knowledge, albeit tacit knowledge.

- Transfer of technology from developed to developing countries can improve the national economies.
- Frameworks that specifically target the promotion of technology transfer are to a great extent existing, even though not directly targeting technology transfer. The GOE is realizing the importance of and being developed. These include government- sponsored models, or institution-sponsored models, and to a lesser extent self-sponsored models, planned program development, and single or multinational/multi-institutional collaboration.
- Although technology transfer and training of individuals are highly important, sustainable programs may provide the most lasting effects. Successful partnerships require fiscal commitments, cooperation and strategic planning.
- A suggestion could be to issue a law for technology transfer, though not a usual law to find in developed countries, but it was a facilitator factor as in the case of Vietnam. Yet such a law necessitates the identification and prioritization of a list of technologies that has to be prepared in order to make the issued law effective in promoting a new wave of technology transfer in Egypt.
- Several approaches have been used in Egypt with varying success. These are licensing, consultancy, training and to a lesser extent forming joint ventures. The problem of technology transfer has been extensively addressed from many different perspectives. Very few of the research studies, however, have examined it as a process, trying to understand more about how different kinds of technologies are transferred across organizational boundaries. This research examines the transfer of technologies over a three-year period in an international joint venture comprising three operating divisions of large multinational chemical companies located in Germany, the United States, and Japan. A total sample of 208 technologies was identified as having been transferred between the venture's partners. Descriptions of the types of technologies, the methods used to transfer them, their degrees of success, and the organizational, national, and cultural differences in which the international transfers took place are investigated (Katz et al, 1996).
- Given the importance of an awareness of external information and the role of technological scanning and networking, awareness is seen as the necessary first stage in the inward transfer process.
- In order for an organization to search and scan effectively for technology that will match its organizational capabilities, it needs to have a thorough understanding of its internal organizational strengths.

- Technology Transfer Offices activity should be characterized by constant returns to scale and those environmental and institutional factors explain some of the variation in performance. Productivity may also depend on organizational practices, as there are no quantitative measures available on such practices, so we rely on inductive, qualitative methods to identify them. Based on 55 interviews of 98 entrepreneurs, scientists, and administrators at five research universities in the US, concluded that the most critical organizational factors are faculty reward systems, TTO staffing/compensation practices, and cultural barriers between universities and firms, although the US universities have a long history of multiple successes with industry. Accordingly these factors should be taken into consideration and related to the Egyptian environment in order to assure the success of this initiative.

6.3 Performance of International, Cross-border Technology Transfer

This study on international, cross-border technology transfer in Egypt is an important part in the technology transfer issues.

Like other developing countries, Egypt is a net importer of advanced technologies evolved in the developed countries. These advanced technologies are crucial to drive and sustain rapid economic growth necessary to raise the standard of living of the Egyptian people, as the companies will provide more job opportunities in a difficult time even for qualified employees.

In view of the economic importance of these imported technologies, it is important to identify the major sources and channels through which these technologies are transferred to Egypt as well as the barriers and restrictions hampering the smooth and efficient transfer of these technologies into Egypt.

The objectives of this study on international, cross-border technology transfer in Egypt are:

- To identify and describe the main actors in this technology transfer;
- To identify and assess the importance of the major forms and channels through which appropriate advanced technologies are transferred to Egypt;
- To assess the extent to which cross-border technology flows either flow to large- or to small- and medium-scale enterprises;
- To assess the extent to which cross-border technology flows involves various sectors, such as the ICT, food and engineering industries.

6.3.1 Basic Definitions

To get a better understanding of what the concept of international (cross-border) involves, it would be useful to define the concept of '*technology*' first, before defining the concept of '*technology transfer*'.

On a general level, the concept of '*technology*' refers to all scientific and engineering knowledge, which has been adopted and adapted for commercial use. More recently, this concept has been broadened to refer to the application of science to the solution of specific problems or as knowledge about physical relationships applied systematically to useful purposes. Technology has also been defined as involving the knowledge and/or methods that are necessary to carry on or improve the existing production and distribution of goods and services. From this viewpoint, technology would also include entrepreneurial expertise and professional know-how (Santikarn, 1981; 3-4). Yet another definition views technology as the knowledge and machinery needed to run an enterprise. Under this definition technology would include both *software* (blueprints and operating manuals) and *hardware* (machinery and other capital equipment) (Chee, 1981; 2).

Under the latter definition, the *transfer of technology* thus involves the transfer of skills and technical know-how as well as the transfer of machinery and other capital equipment (*embodied technology*). As this transfer usually involves the transfer of modern technologies from advanced countries to the importing, developing countries, this concept involves the *international* or *cross-border* transfer of technology. When technology is acquired by international (cross-border) transfer, the process of translation of *technological knowledge* or know-how (the information about physical processes which underlies and is given operational expression in technology), into practice is usually undertaken by expatriates rather than the nationals of the recipient countries (Dahlman & Westphal, 1981; 13). While for the international technology transfer it is crucial to gain access to modern technologies from advanced countries, the challenge developing countries are facing, is how its own nationals can eventually master these transferred technologies in order to use these technologies in an effective and efficient way. To achieve this local technological mastery or capability, technological effort is required.

The required *technological capability* or *mastery* in developing countries can be defined as the ability to make effective use of (borrowed) technology. The *technological effort* required to achieve this technological capability can then be defined as the conscious exertion to use technological information and to accumulate technological knowledge to choose, assimilate, adapt, or create technology. This effort is needed to evaluate and choose technology; to acquire and operate processes and produce products; to manage changes in products, processes, procedures and organizational arrangements; and to create new technology (Bell, Ross-Larson and Westphal, 1984; 107-08.).

Hence, several steps, in the sense of technological effort, need to be taken before the transfer of technology (including the equipment, instructions and blueprints) leads to local effective technological capability or mastery (absorption, deployment and subsequent upgrading) (Lall, 1993b; 100). The initial transfer of technology will not automatically lead to its efficient operation if the necessary skills and technical and managerial know-how are not generated by the recipient country, as there are many 'implicit' elements in technology that need a long period of learning. Although this learning may be partly the automatic result of production experience, in most activities it also requires technological effort in the form of purposeful investments by a firm in training its employees (managers, technicians, plant workers), searching for new technical and other relevant knowledge, experimentation, and developing the organizational expertise to create, communicate and diffuse knowledge internally. In the more advanced activities the absorption of new technologies also requires investment in research and development (Lall, 1993b; 100).

6.3.2 Hypotheses

1. As a developing country is still at a relatively low level of scientific and technological development, Egypt's technology development strategy in first instance should not be focused on 're-inventing the wheel' meaning not trying to invent new technology, but primarily to import the most favorable foreign technologies which are relevant to its development needs and can be adapted to its local conditions whenever necessary.

2. As a net technology importer, sustained international, cross-border technology transfer is crucial to sustaining Egypt's development as well as its ability to fully master these transferred technologies.

3. It is Egypt's national interest to pursue a liberal, 'open-door' regime to foreign technology imports, both through formal modes of transfer (FDI, technical licensing agreements, capital goods imports, 'turn-key' projects, technical and management consultancy contracts as well as through informal modes (e.g. participation in world trade, reverse engineering).

4. Any attempt to control or intervene directly in this process of international technology transfer would slow down the vital foreign technology inflows essential to sustaining Egypt's national development.

5. However, it is important for statistical purposes that international technology transfer is monitored and recorded by requiring domestic licensees to report their technology imports as reflected by the royalty payments and other payments. Such knowledge would help the government in devising policies to strengthen the bargaining power of domestic firms, not by direct and counter-productive intervention but by, for instance, providing training courses to managers and employees of domestic firms about TNC strategies, negotiation strategies with TNCs, and overseas marketing channels.

6.3.3 Channels of International, Cross-border Technology Transfer

Like in other developing countries, there are numerous channels of international, cross-border technology transfer open to Egypt. These include (World Bank 1996; 4; Dahlman, Ross-Larson & Westphal, 1987; 768; Hill & Jones, 1983; 61-62):

1. Formal modes of technology transfer, involving formal arms-length transactions, such as:
   - Foreign direct investment (FDI);
   - Technology (technical) licensing agreements;
   - Imports of capital goods;
   - Foreign education and training;
   - Turnkey projects;
   - Purchases of technical assistance.
2. Informal modes of technology transfers, such as:
   - Copying or 'reverse engineering';
   - Participating in world trade.

6.3.4 Main Findings

Like in other developing countries the bulk of international technology transfer to Egypt takes place in the private sector meaning from private firms of the advanced countries to private Egyptian firms. In general, technology transfer through the public sector is less important than what takes place through the private sector.

In Egypt, licensing is the most common form or model for technology transfer. The Egyptian firms feel always safer when they receive a license from an international reputable company rather than working on a technology with research institutions locally. Though there exists the risk of not prolonging the license from behalf of the licensor, which may put the Egyptian licensee at risk of losing its market share and competence.

A typical example was encountered where a compressor company was on the top of compressor production in the region and when the license was not continued the company started to search for alternative solutions to relocate itself in the market. One of these solutions was performing a joint development with a local university partner which failed due to over estimation of the project time frame and the budget as well, though a third party was paying for most of the budget (almost 80%). Again a collaborative project with an international research partner failed as the time frame did not suit the company and the negotiations were aborted. The last resort was seeking assistance from another compressor company, which already had the technology. In that way, the technology was transferred from the international to the local company. This cycle will be repeated as long as the local Egyptian industry is not willing to invest in own developments and staff capabilities.

Technology transfer through joint ventures is practiced at a minimum level and mainly in the ICT sector, where multinationals either merge with local companies of the same production sector.

Another channel for international technology transfer takes place in the public sector through official development assistance (ODA) programs which usually also contain a technology transfer component, specifically in the form of technical assistance or manpower training programs provided by individual donor countries or by multilateral aid agencies (Hill & Johns, Conglomerate performance over the economic cycle, 1983, P. 62), including the World Bank and the United Nations Industrial Development Organization (UNIDO). UNIDO's "Investment and Technology Promotion Program" is a good example. It comprises institutional capacity-building and an advisory service to promote investment and technology flows and facilitate business alliances.

The institutional capacity-building services aim to establish and/or strengthen (a) national Investment Promotion Agencies (IPAs), (b) technology centers and technology support institutions to assist enterprises with the assessment and transfer and absorption of new and appropriate technologies, and (c) Subcontracting and Partnership Exchanges (SPXs) to support SMEs in their development of business relationships and build up their technical and management capabilities.

Advisory services are provided to investment and technology institutions as well as to industrial associations in developing countries and economies in transition to assist them in formulating and appraising business proposals, searching for international partners and locating sources of funds.

A recently common form, best demonstrated in ICT sector is the foreign direct investment (FDI). A thesis conducted by Dr. Ahmed El Sayad on technology transfer and foreign investment. The case in Egypt showed that there appeared no specific coherent and systematic framework to understanding the dynamics of the process of technology transfer that clearly emerge from literature; and neither does the assessment of the implications of national policy and interlinked issues on the content of technology transferred from foreign market modes of entry, the key objectives of his thesis were "to develop a dynamic conceptual framework that allows for systematic representation and exploration of the process of technology transfer associated with the different modes of foreign entry into a host developing country (Egypt). To empirically explore the dynamic process of technology transfer associated with foreign market modes of entry into Egypt, and to assess and critique Egypt's current policy environment impacting on modes of foreign entry into Egypt and their associated technology transfer."

The thesis quantitatively explored the technology transfer process occurring in foreign companies operating in Egypt, under various contractual and investment modes of entry. Findings revealed that the highest level of technology transfer occurred at the start-up phase of all modes. This transfer involved all components of technology. In cases of FDI and JVs, technology transfer sustained through continuous and regular foreign interactions, and increases with the introduction of new 'events' such as new product lines being added. In the license modes, a slow down of technology transfer is found after the start-up phases. In regards to linkage issues impacting on both foreign entry and TT, the findings confirmed the importance of learning, compatibility partners, contractual perspectives (and others).

The thesis also highlighted the overwhelming impacts of Egyptian government measures that hamper aspects of technology transfer.

A better understanding of dynamics of the technology transfer process associated with FI, along with an integrated and more flexible policy framework are essential requirements for attracting quality FI and catalyzing associated transfer of technology.

Finally, conducting research on technology transfer associated with modes of FI is very challenging in Egypt and needs several methodological and technical contributions.

Through the support of MCIT, multinational companies operating in the Egyptian market are encouraged to invest in research and innovation activities through grants provided by the Information Technology Industry development Agency (ITIDA). Additionally, MCIT focuses on augmenting the innovation capabilities of businesses in Egypt, as well as scientific establishments working in ICT, to foster internationalization projects. ITIDA is developing organized efforts to enhance the participation of Egypt in international partnerships revolving around research and innovation.

MCIT has opted for a win-win strategy in its relations with leading companies doing business in Egypt. Leading international and local companies are given incentives that will support them building a long term presence in Egypt by creating some favorable factor conditions or by providing them with medium to long term contracts for development of ICT infrastructure. Factor conditions include the support of MCIT in training of new graduates to develop their expertise with a certain technology to some desirable level or providing infrastructure at globally competitive rates. The contracts are primarily for supply of hardware and services to upgrade the infrastructure and services in Egypt according to the requirements set in the Telecommunications Master Plan, as well as the National ICT Plan. In return, the companies commit to technology transfer into the Egyptian market through hiring and training local human resources as well as undertaking investments in value added that result in exportable services and equipment to serve neighboring markets.

A number of frame agreements have been signed with multinational and local companies since this framework was established in 2002 as well as some services firms. The list of companies includes QuickTel, an Egyptian company who signed a cooperation agreement with MCIT in 2004. In addition, other big multinational companies like Alcatel, Siemens, Nortel, Lucent and Motorola have committed to expand their presence in Egypt through a number of activities that aim towards the transfer of technology and exporting to neighboring countries. Such examples include establishing or expanding training centers to qualify a new generation of engineers and computer scientists trained on design and installation of state of the art wireless and IP networks, development of value added services, in addition to maintenance and upgrade of traditional technologies of wire line networks. Such investments would result in creating almost five hundred new high quality engineering jobs in the implementation of activities related to MCIT and Telecom Egypt agreements, in addition to all the necessary support jobs.

This was possible as ICT is a new emerging sector and related to a new ministry, which adapted laws and regulations in order to allow FDI in ICT industry. Accordingly, the hampering aspects of the traditional governmental body are described in the policy of the MCIT. This again is best demonstrated in the existence of the Information technology Industry Development Agency (ITIDA), which is receiving allotments from the ICT industry, where the industry is paying 1% of its revenues to ITIDA against receiving services. More important is the flexibility of ITIDA and the ministry to initiate programs to encourage entrepreneurship and recently R&D activities with local and international research facilities.

An example for a successful international and cross country technology transfer in Egypt is Siemens in Egypt: Siemens Egypt now has a well established branding within Egypt synonymous with technology, innovation and quality. A large portion of the technology used for any call made through Telecom Egypt is supplied by Siemens, and ICT represents the strongest of all Siemens businesses in Egypt. The company has had a long history in Egypt since 1859, when Werner Siemens came to Suez to link Europe and India with telegraph cables running through the Red Sea and two years later Siemens Egypt was established. However Siemens most influential contribution to the Egyptian ICT infrastructure began only 15 years ago, concurrently with the states policy to make telecom services available nationwide. Siemens strategy depended primarily on positioning itself as a local partner to all its clients. It reacts and interacts with the community it is operating within by developing a strong local identity and partnering with local companies. Growth in telecommunications has been huge. Ten years ago Egypt had only 80,000 fixed lines and it has now reached ten million. Such an extraordinary growth rate was made possible in a relatively short time by partnering initiatives and by the measures the government has been taking to spread the telecommunication services.

Most Egyptian citizens today, whether in the middle of Cairo or in remote villages can now have access to voice and data communications. Siemens deployed 10 Gbps transmission systems into Telecom Egypt's network, which made Egypt the first user of this type of system in the MENA region and established Telecom Egypt as a leading operator. In 1990, Egyptian German Telecommunications Industries (EGTI) began the production of EWSD digital exchanges and was established as a joint venture with Siemens Egypt, Telecom Egypt and the National Bank of Egypt. Now EGTI has recently started expanding on a regional scale. The Cairo based network care centre serves the Middle East and African regions. Siemens and EGTI have installed more than 3.5 million fixed telephone lines for Telecom Egypt, bringing telecommunication access all over Egypt. Siemens and EGTI are an exemplary example of the Public Private Partnership policy the government adopts to enhance Egyptian ICT.

Yet the question remains: do these investments have an impact on local industry? Or are these mainly targeting employment rates to better position a ministry politically? And at the end serve in the first place the multinational company. Is it in the plan to encourage spill-over's and thereby promote local entrepreneurship?

6.3.5 Regulations and Framework Conditions for International and Cross-border technology Transfer

In addition to regulatory procedures and frame agreements undertaken by the ministry of Communication and Information Technology, other ministries are also involved in facilitating the process of technology transfer, even though indirectly. These are the MTI, Ministry of Investment and the MHESR. All have frame agreements with peer ministries or organizations in developed countries. The most important organizations issuing regulations and frameworks are described as follows:

General Authority for Investment and free Zones (GAFI)

In July 2004 a new Ministry of Investment came into office to oversee investment policy, coordinate among various ministries with investment-related areas of responsibility, and provide dispute settlements services for investors. The new ministry supervises the Capital Market Authority, the Egyptian Insurance Supervisory Authority, the Mortgage Finance Authority, the privatization program, and the General Authority for Investment and Free Zones. The General Authority for Investment and Free Zones (GAFI) is the principal governmental authority concerned with regulating and facilitating investment, and stands ready to assist investors worldwide. GAFI is currently broadening its scope from the traditional regulatory framework into a more effective and proactive investment promotion agency. In coordination with the World Bank's Multilateral Investment Guarantee Agency (MIGA), GAFI has been able to undergo serious changes in facilitating and promoting investments into Egypt through its Research and Market Intelligence, Promotion and Facilitation, and investor aftercare bodies. Triggered by the new government's key objectives, GAFI represents Egypt's sole "One Stop Shop" for investment, which aims at easing the way for investors worldwide to take advantage of the opportunities in Egypt's promising emerging market. GAFI makes emphasis on various investment opportunities that lie ahead in distinct business sectors throughout the Egyptian economy. With this purpose, GAFI holds its responsibility through developing communicational campaigns and assisting its image accentuating the improved investment climate in Egypt worldwide.

The lack of specialized technology commercialization offices at Egyptian universities leads to a situation in which industries and universities do not have a basic understanding of how to share and profit from their technical expertise. Several attempts are being undertaken by the MHESR to enhance the exixence of an innovation and technology transfer culture in collaboration with European partners. These are:

The TEMPUS Program has a project "Enterprise-University Partnership" which is aiming at establishing Technology Transfer Offices (TTOs) in four Egyptian universities, namely, Cairo University, Assiut University, Helwan University and the American University in Cairo. The four universities will benefit from partnering with Freie University (Berlin), Linkoping University (Sweden), Politecnico di Torino (Italy) and Vienna University of Technology (Austria). Additional support is provided by the Egyptian Patent Office and the European Patent Office. Industrial partnership is represented by the Sixth of October Investors' Association. This project attempts to resolve the situation that Egyptian universities have no effective mechanisms for technology transfer between university and industry.

Research Development and Innovation (RDI) program

The Government of Egypt placed Research and Innovation at the heart of its development strategy out of conviction of the pivotal role of Science and Technology as a vehicle towards a knowledge-based economy. In this context, the Ministry of Higher Education and Scientific Research has undertaken multiple initiatives to invigorate this sector. Among these initiatives the Research, Development and Innovation (RDI) program was launched with a grant of €11 million by the Ministry of Higher Education and Scientific Research and the European Commission in October *2007*.

The RDI program overall objective is to contribute to enhancing Egypt's economic growth and international competitiveness through improving its research, development and innovation performance. The program has two specific objectives:

1. Strengthening the link between Research and Development (R&D) sector and the industry while enhancing the innovation and technology transfer culture.

2. Facilitate Egyptian participation in the European Research Area.

The three main components of the RDI program are:

- EU-Egyptian Innovation Fund (EEIF)
- Research, Development and Innovation Network (RDIN)
- Policies for Monitoring and Evaluating R&D projects, program and institutions (M&E)

Through the first component (EU-Egypt Innovation Fund), the RDI program creates awareness of the importance of innovation and significantly enhances cooperation between the academia and the industry. This was clearly demonstrated by receiving more than 700 proposals, of which 51 were granted, in two calls for collaborative projects between enterprises and research institutes/universities from Egypt, EU and MPC states. In addition to joint research projects with European partners, the Fund encourages to create a culture of industry-research collaboration in attempt to bridge the gap between both. In that context, it is worth mentioning that 10 innovation support projects received grants to establish technology transfer units and industry related offices in universities and research institutes, as well as raise awareness to promote innovation among public and research communities.

The second component (Research, Development and Innovation Network) enhances Egyptian participation in EU funded programs. This is demonstrated by the number of submitted proposals during the first two years of FP7, which is equivalent to the number of proposals submitted during the four years of FP6. Also the overall success rate in acquiring FP7 projects demonstrated a significant rise to 12% in 2008, up from 8% in 2007.

The monitoring and Evaluation Component implemented in close collaboration with the Ministry was successful in conducting and analyzing extensive surveys on R&D performance, innovation practices of Egyptian enterprises and industry needs. This will enable the implementation of the second phase on three to four Universities and Research Institutions.

In that way the RDI program is considered as an important actor in promoting international and cross border technology transfer. Technology transfer can occur in one of the following three channels: local research, European research and European industry.

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Annex 1: Additional Figures

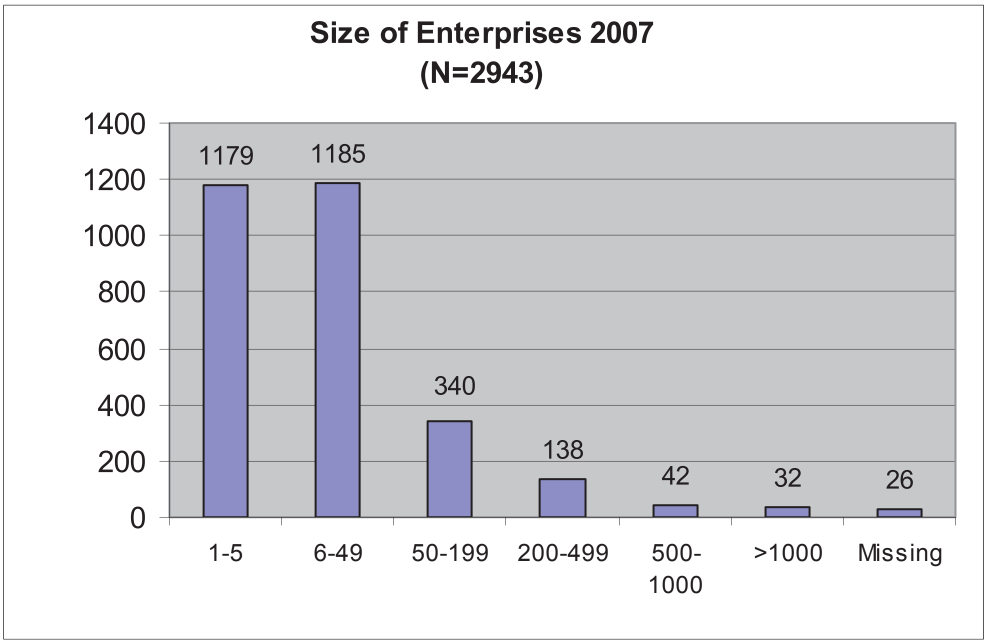

Fig. A - 1: 2007 size of enterprises involved in the innovation survey in total numbers

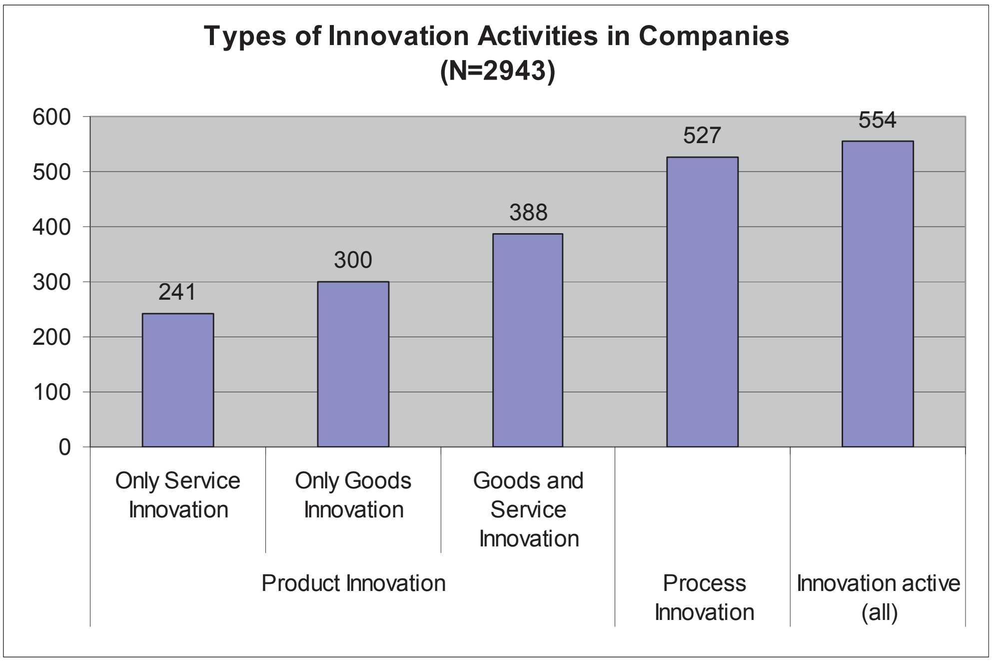

Fig. A - 2: Innovation active companies – split by types of innovation in total numbers (all companies)

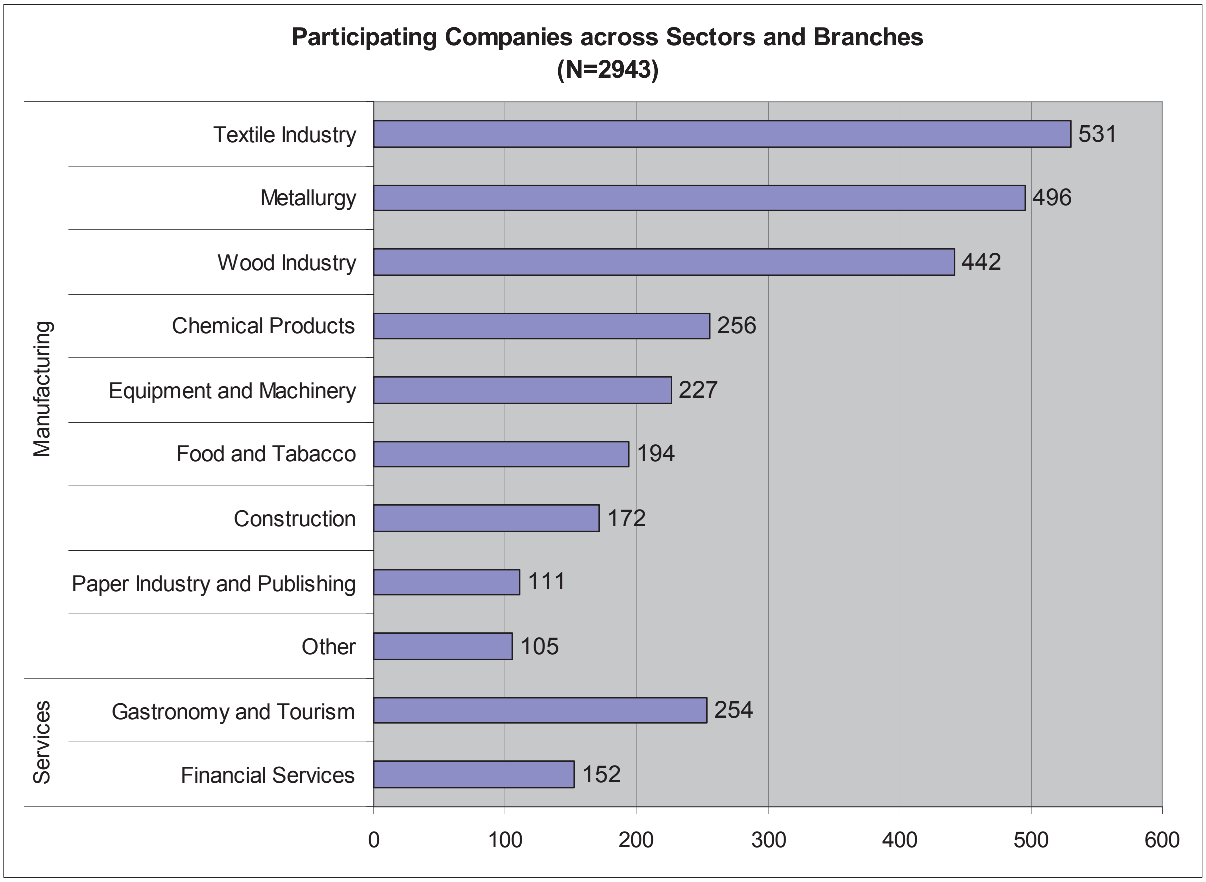

Fig. A - 3: Number of companies participating in the innovation survey displayed by sector and branch in total numbers

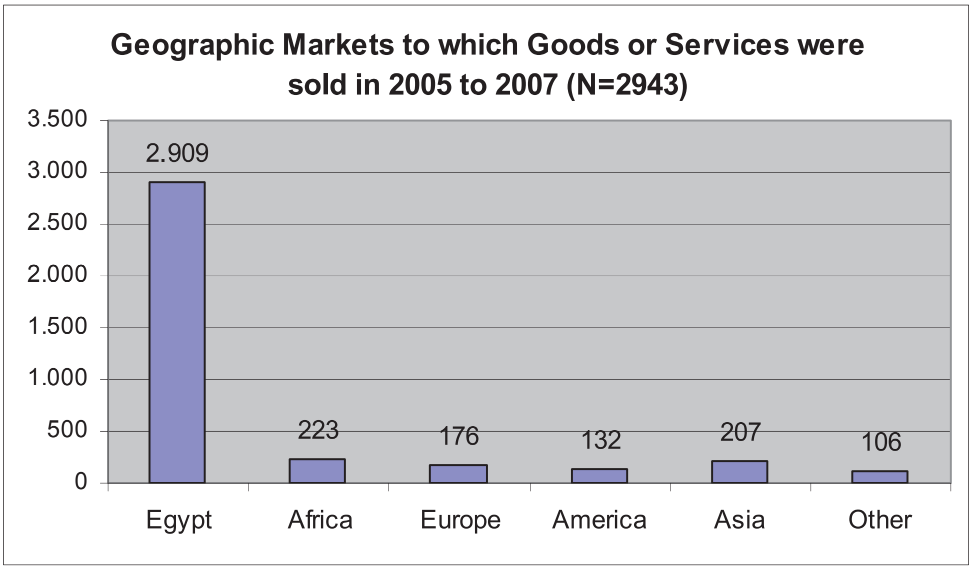

Fig. A - 4: Geographic Markets to which goods or services were sold in total numbers (all companies)

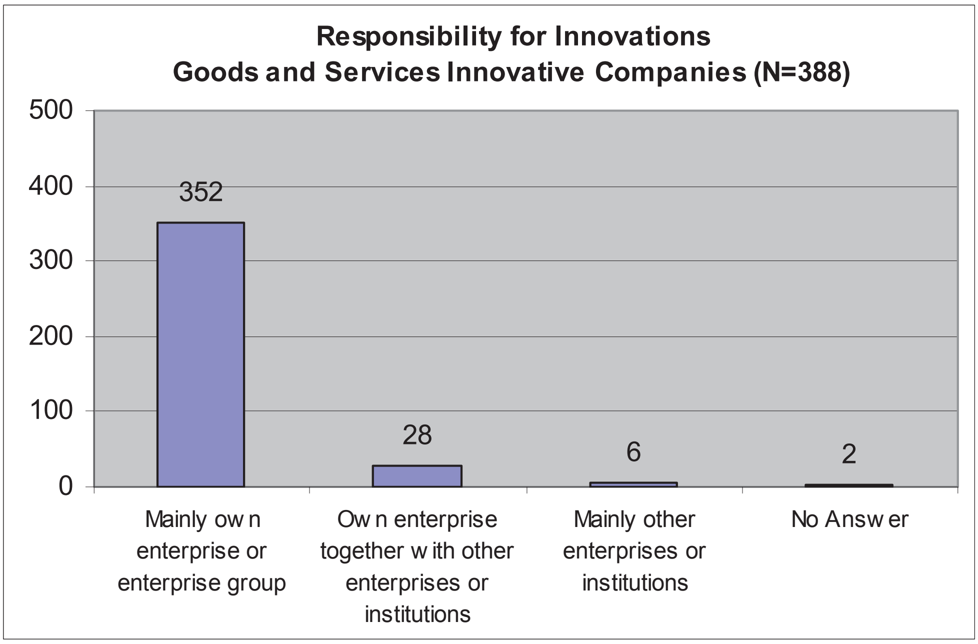

Fig. A - 5: Responsibility for Innovations in total numbers (innovation active – goods and services only)

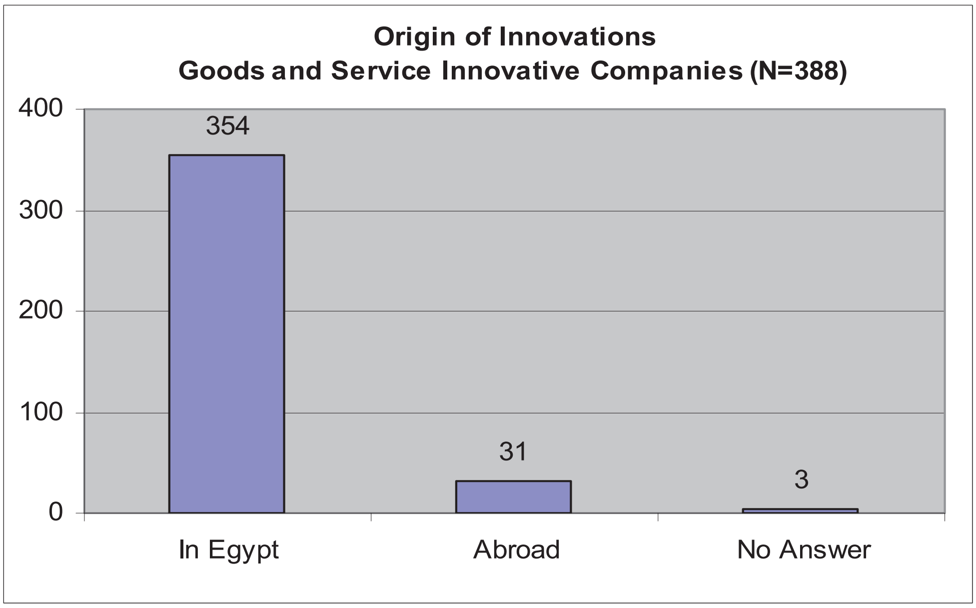

Fig. A - 6: Origin of Innovations in total numbers (innovation active – goods and services only)

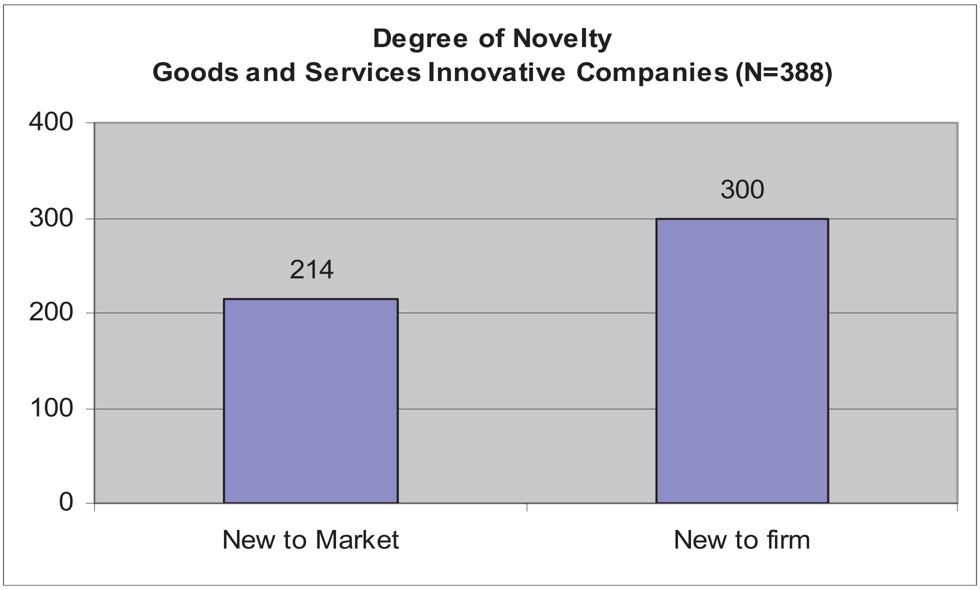

Fig. A - 7: Degree of Novelty in total numbers (innovation active – goods and services only)

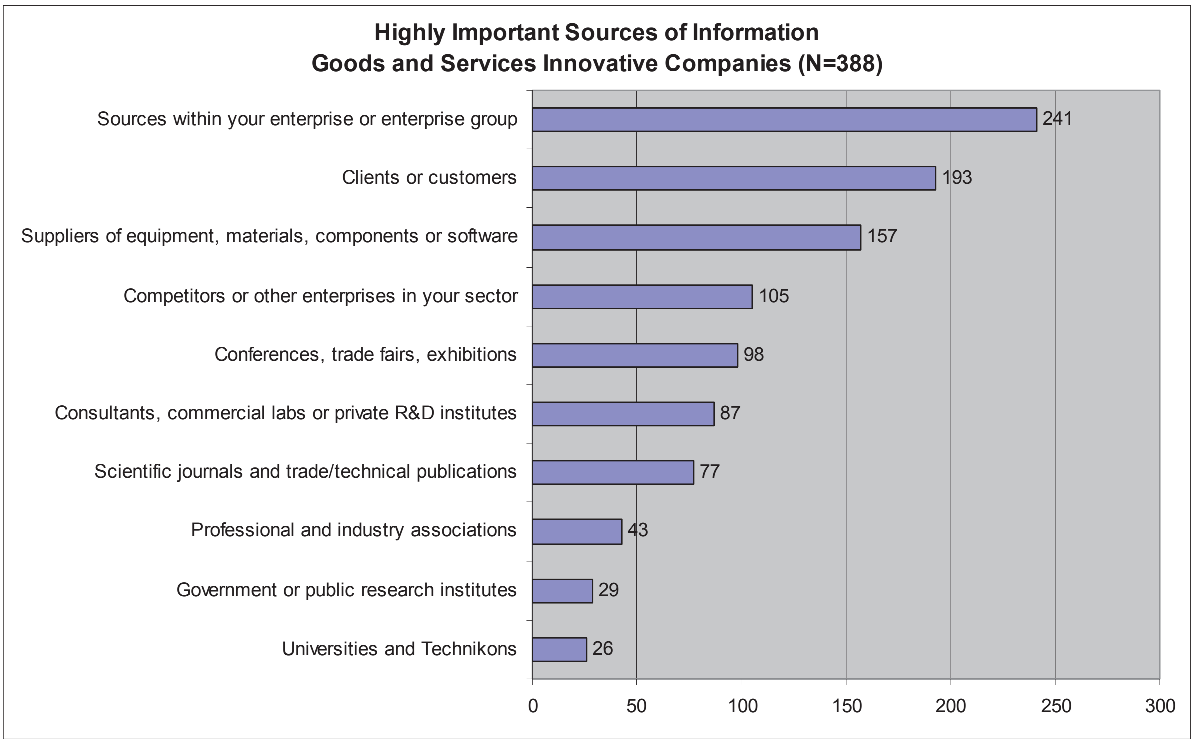

Fig. A - 8: Highly important sources of information for innovation activities in total numbers (innovation active – goods and services only)

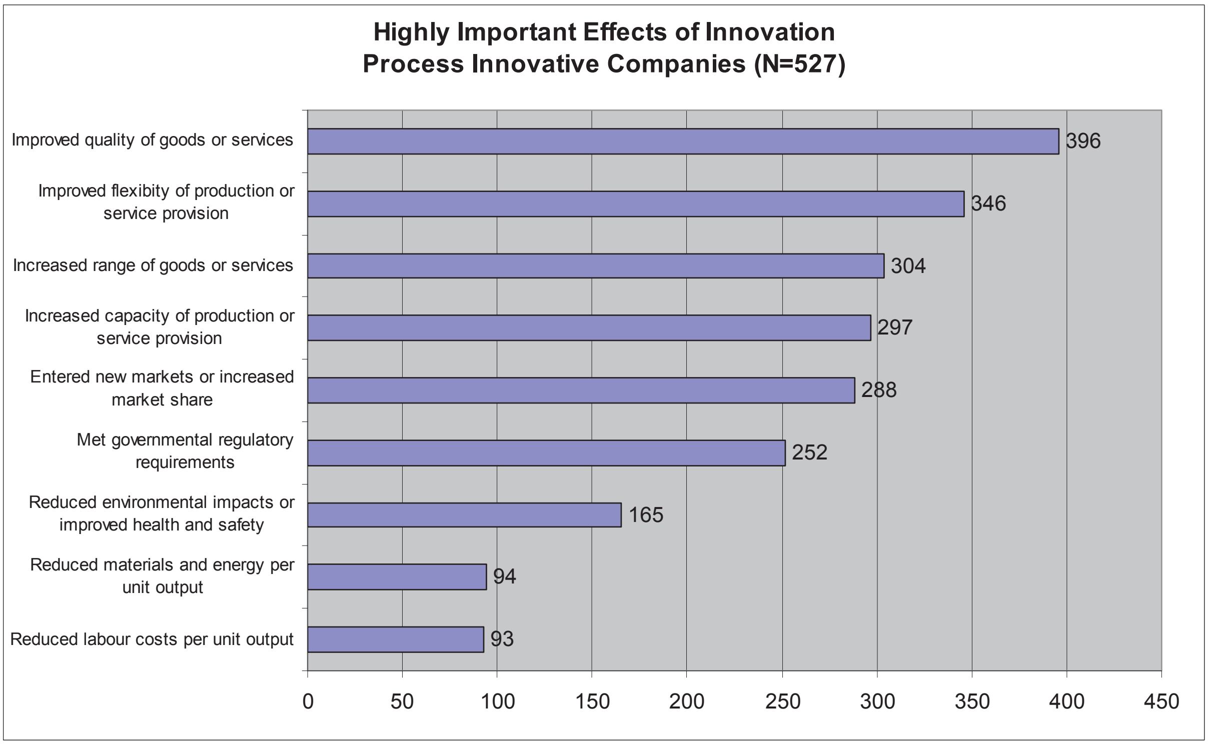

Fig. A - 9: Highly important effects of innovation in total numbers (innovation active – goods and services only)

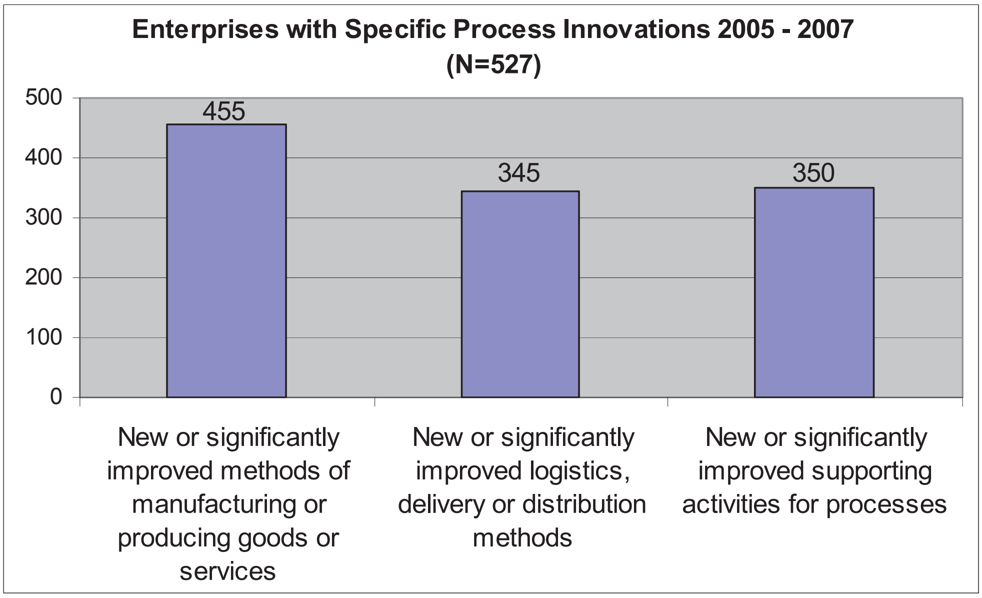

Fig. A - 10: Specific process innovations 2005-2007 in absolute numbers (Innovation active only – process innovations)

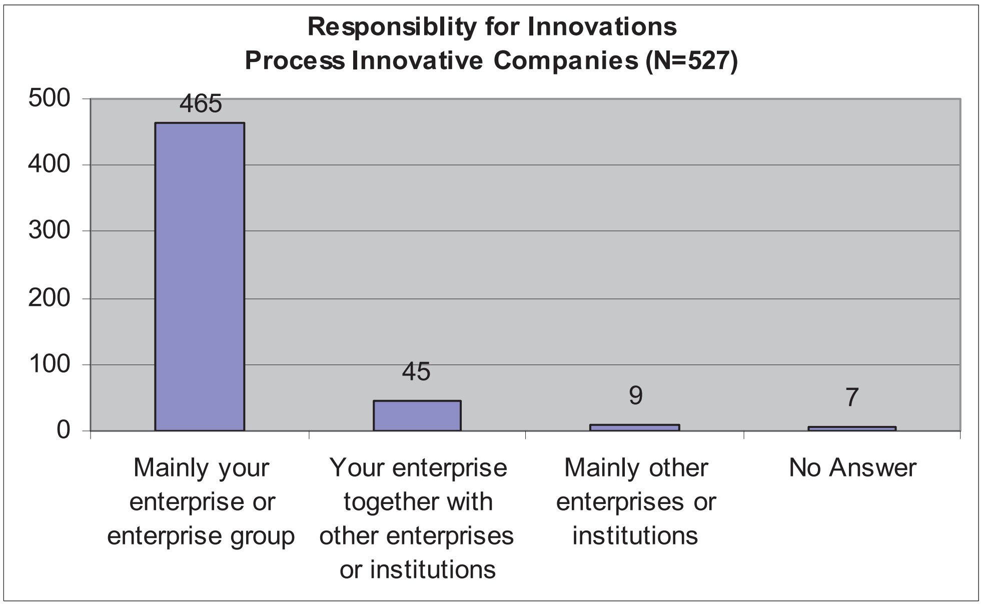

Fig. A - 11: Responsibility for innovations 2005-2007 in absolute numbers (innovation active only – process innovations)

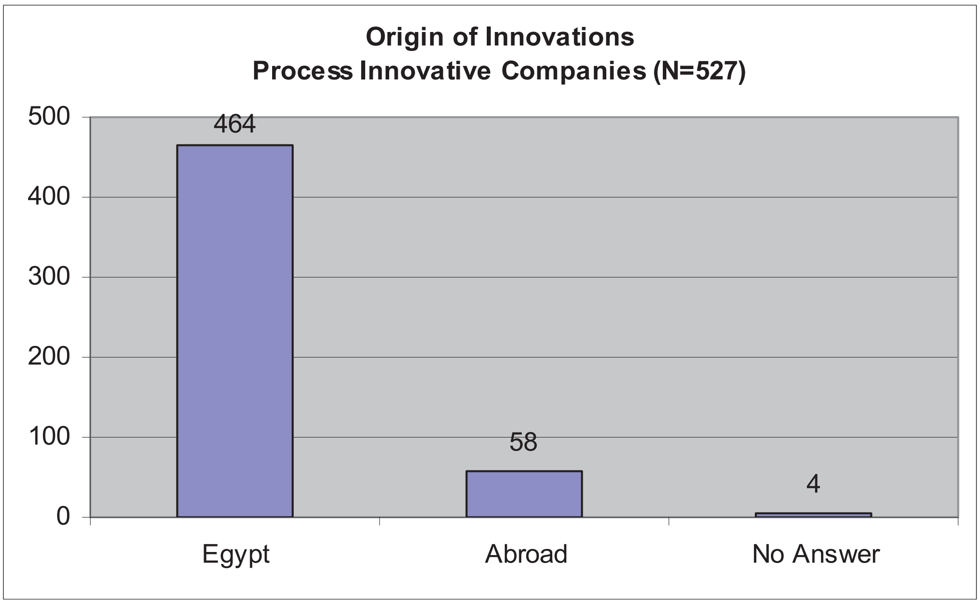

Fig. A - 12: Origin of innovations 2005-2007 in total numbers (innovation active companies only – process innovations)

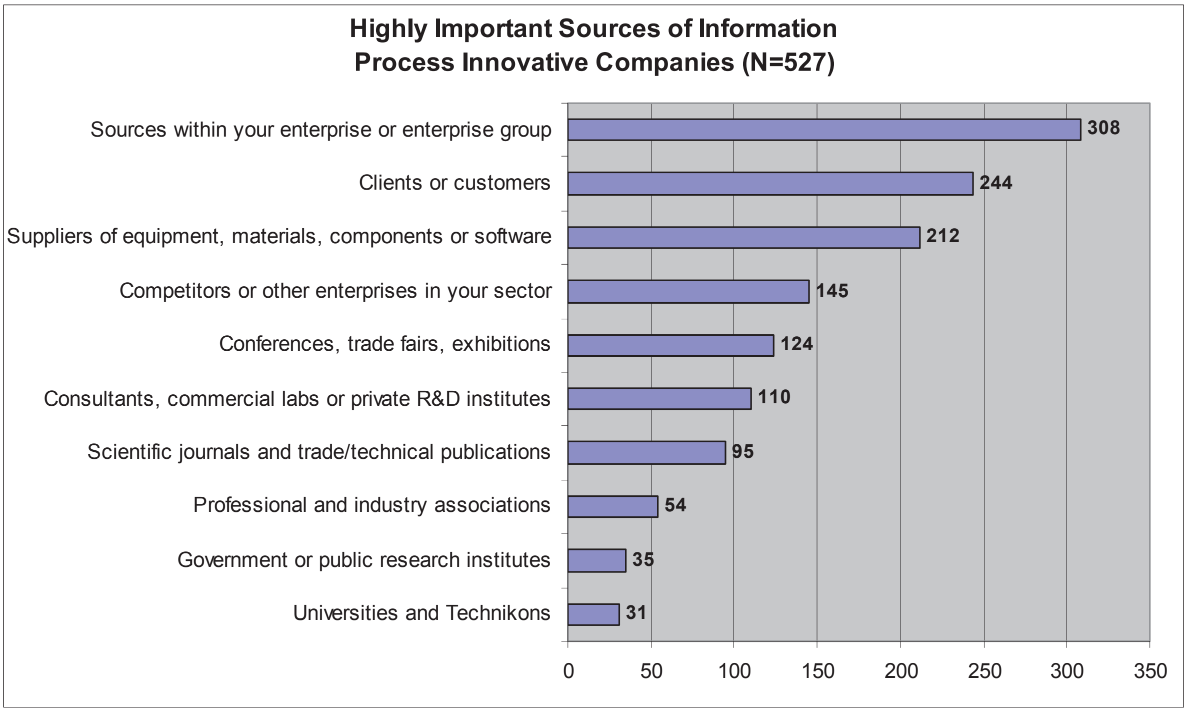

Fig. A - 13: Highly important sources of information in total numbers (innovation active companies only – process innovations)

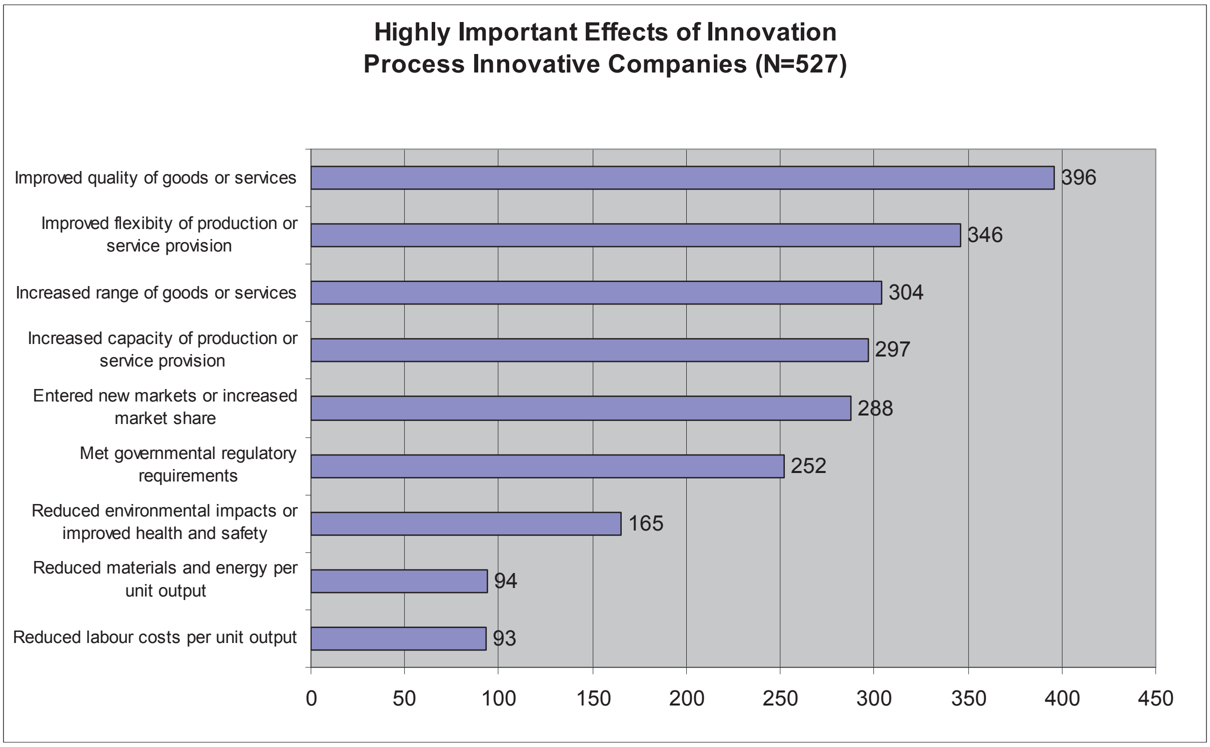

Fig. A - 14: Highly important effects of innovation in total numbers (innovation active companies only – process innovations)

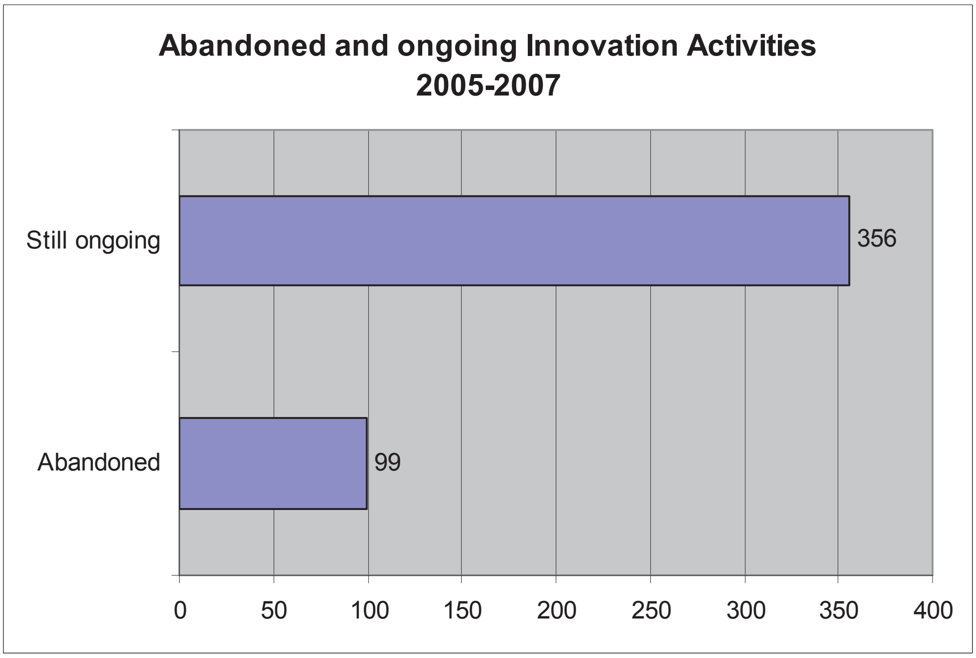

Fig. A - 15: Abandoned and ongoing innovation activities 2005 – 2007 in total numbers (all companies)

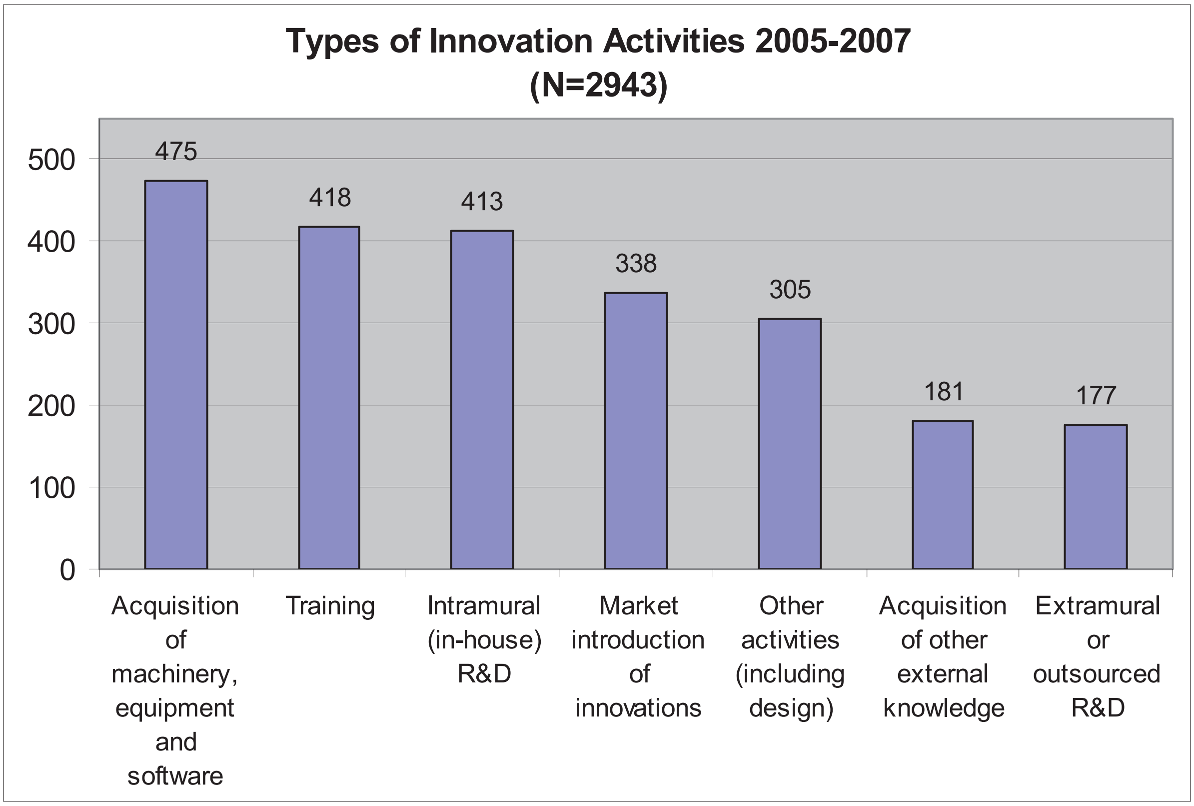

Fig. A - 16: Types of innovation activities 2005-2007 in total numbers (all companies)

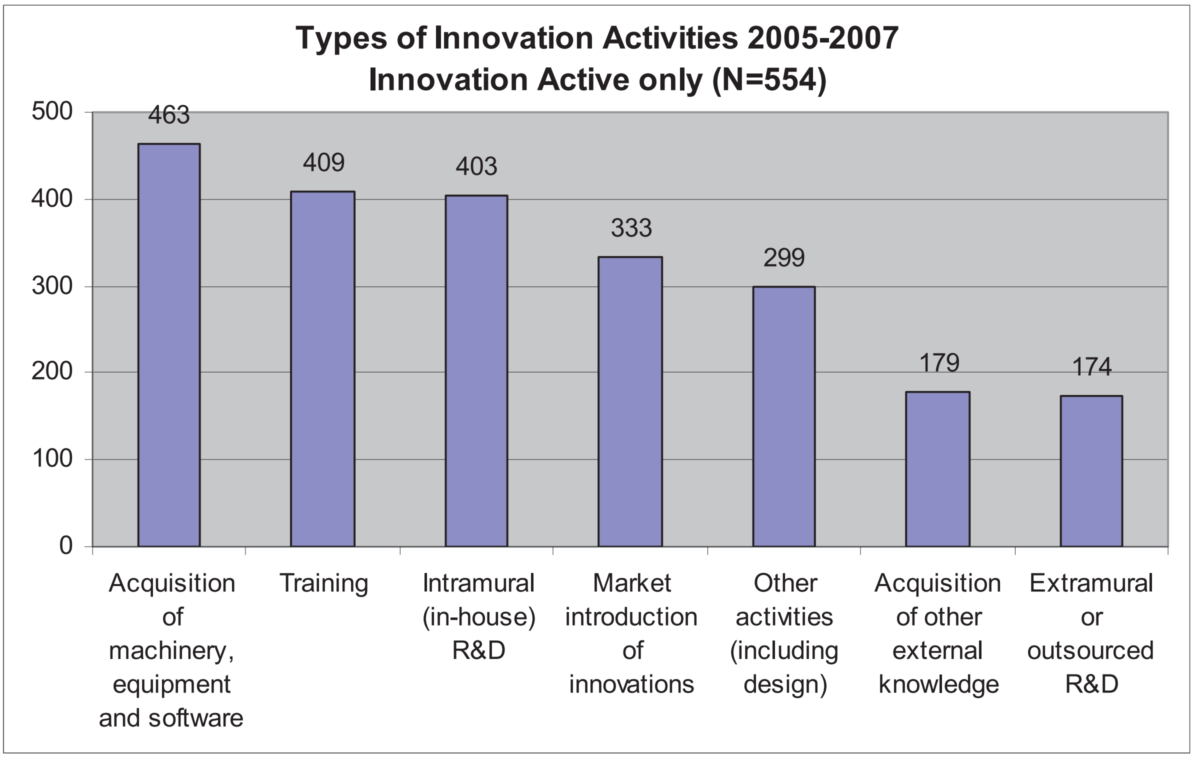

Fig. A - 17: Types of innovation activities in the years 2005 till 2007 in total numbers (innovation active companies only)

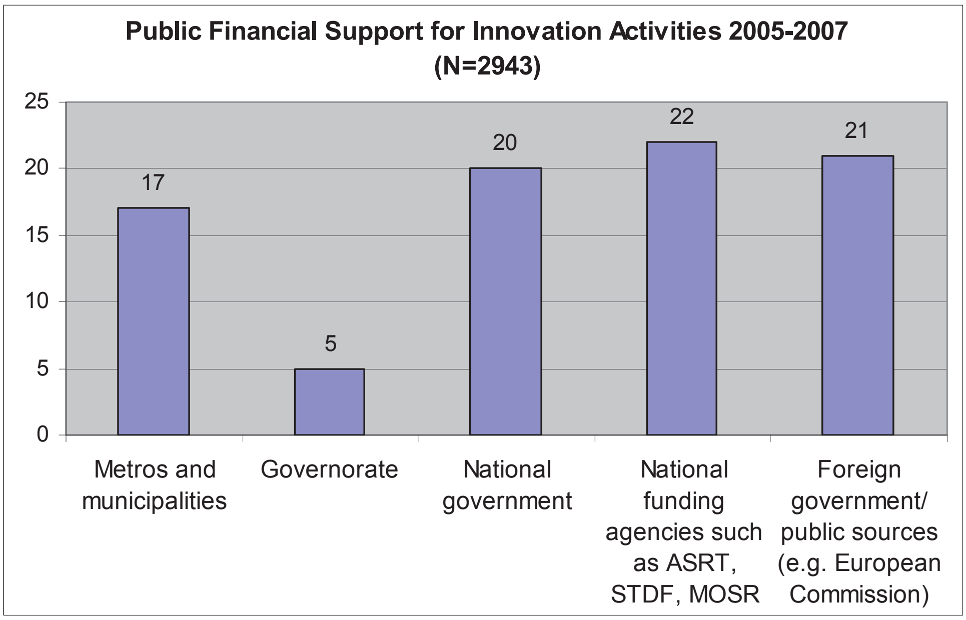

Fig. A - 18: Public financial support 2005-2007 in total numbers (all companies)

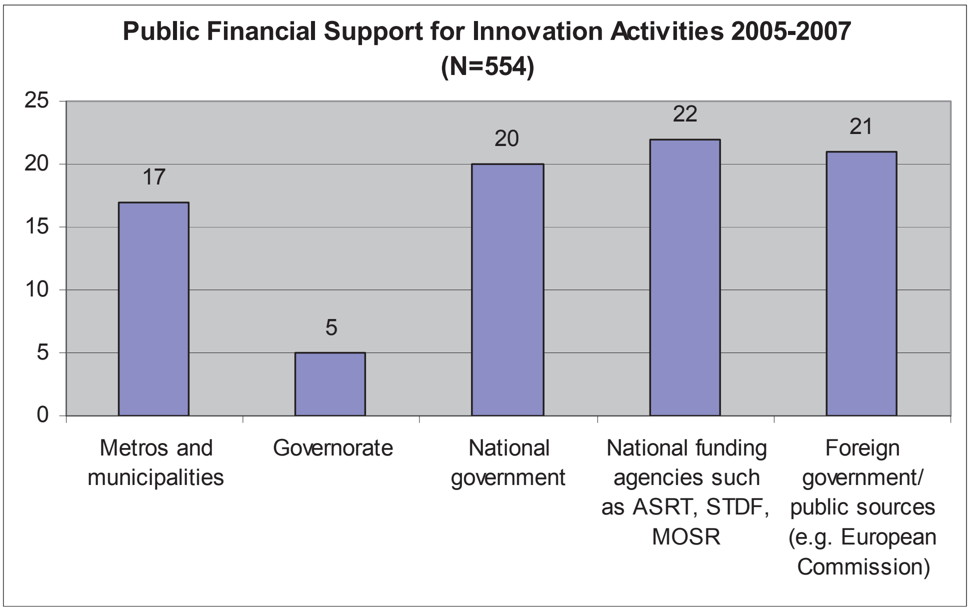

Fig. A - 19: Public financial support 2005-2007 in total numbers (innovation active only)

Fig. A - 20: Highly important factors that hampered innovation in the years 2005 till 2007 in total numbers (innovation active companies only)

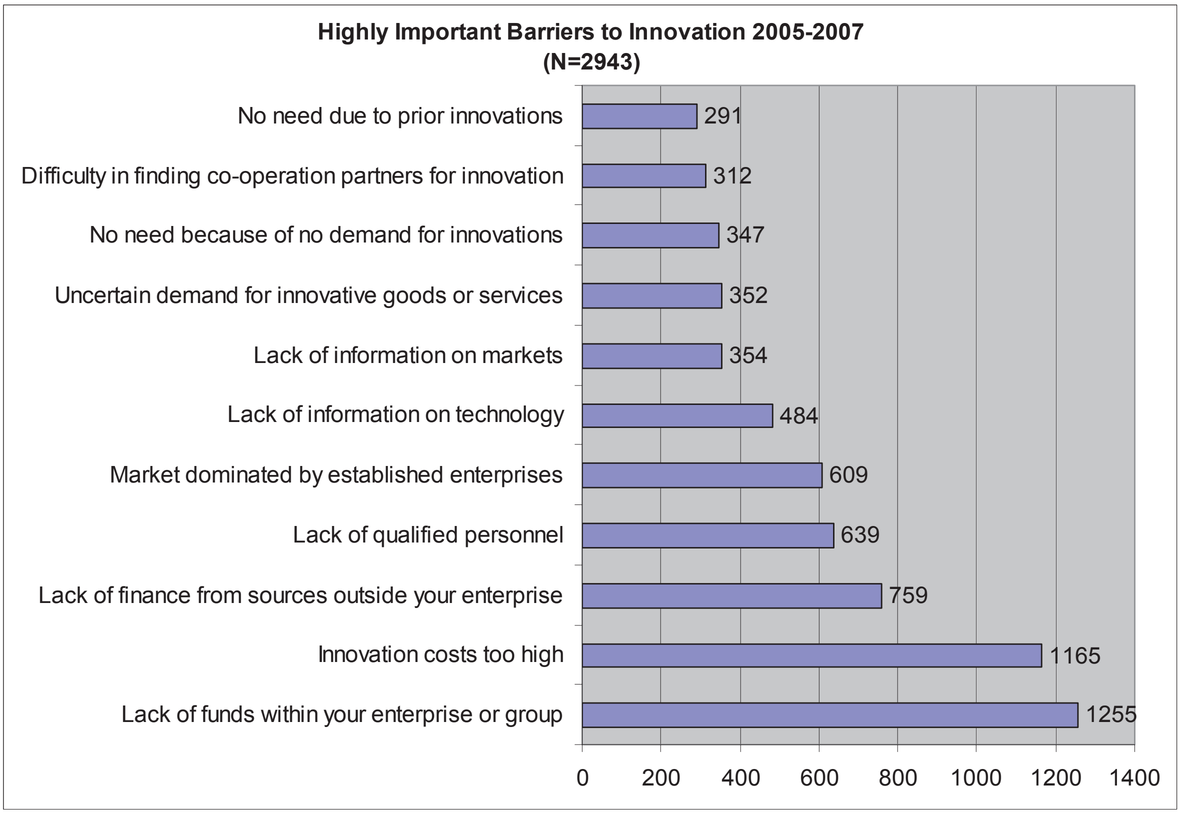

Fig. A - 21: Highly important barriers to innovation

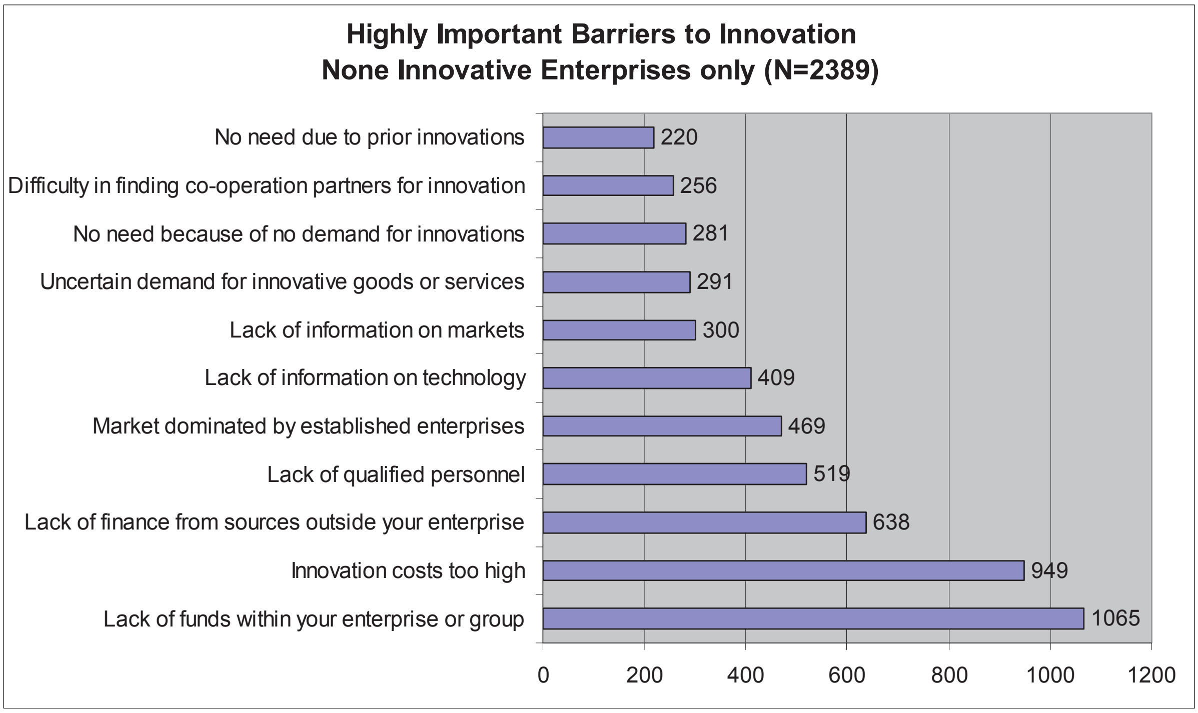

Fig. A - 22: Highly important factors hampering innovation in total numbers (none innovation active companies only)

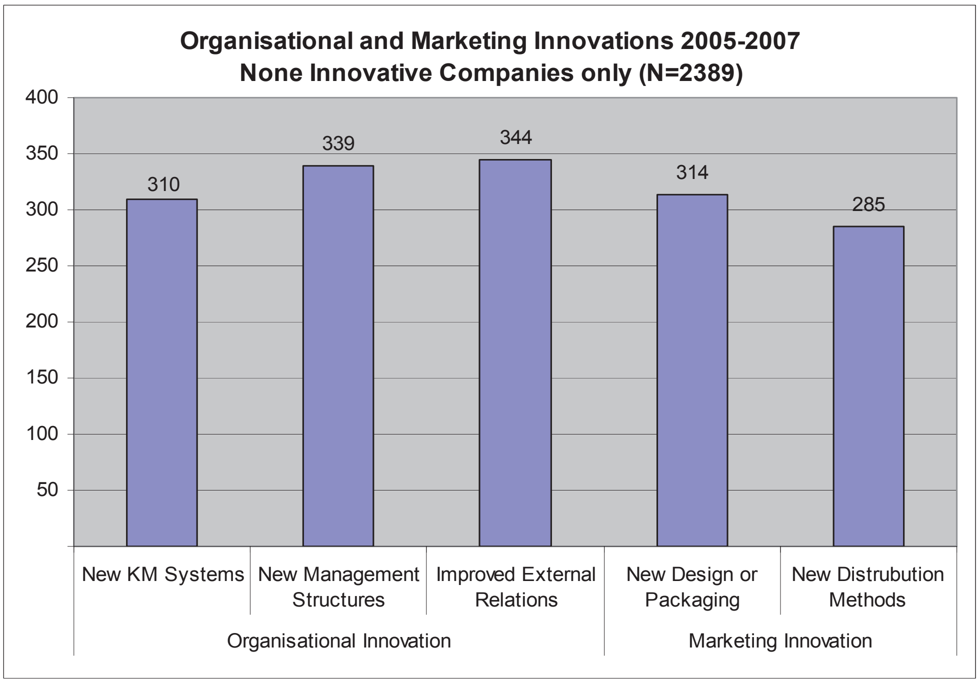

Fig. A - 23: Organizational and marketing innovation 2005 – 2007 in total numbers (non innovation active companies only)

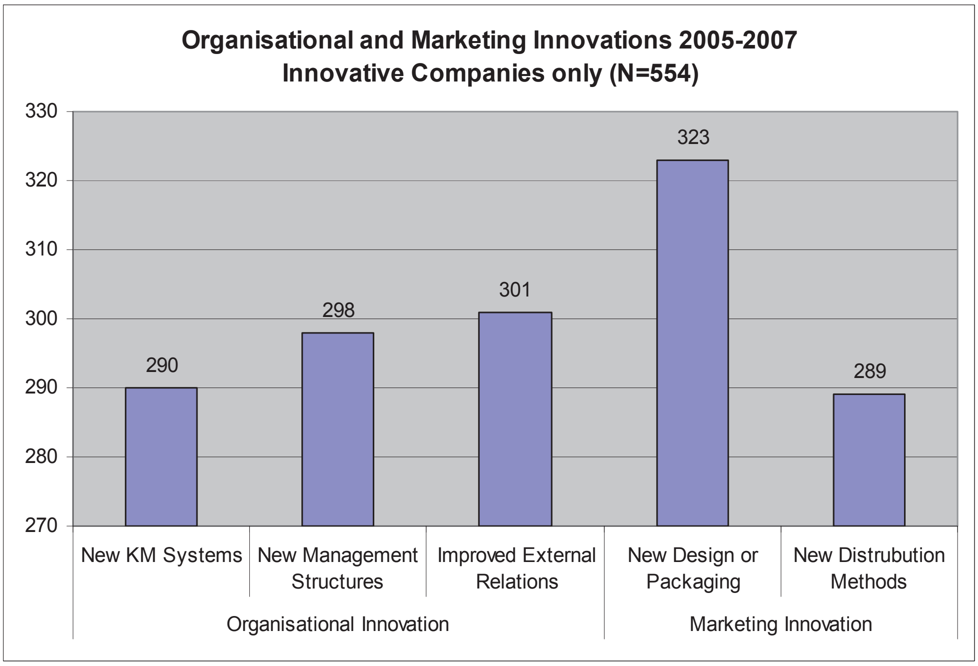

Fig. A - 24: Organizational and marketing innovation 2005-2007 in total numbers (innovation active companies only)

Annex 2: Questionnaire of Egyptian National Innovation Survey 2008

Ministry of Scientific Research

Survey ID number

Egyptian National
Innovation Survey 2008
Manufacturing, IT and Services

In line with the European Union (EU) Fourth Community Innovation Survey (CIS IV), this survey is being undertaken in all EU and numerous other countries in 2009.

PLEASE NOTE
In order to be able to compare enterprises with and without innovation activities, we request ALL enterprises to respond to ALL questions, unless otherwise instructed.

Please change address label if necessary

Ministry Of Trade and Industry

Central Agency for Public Mobilization and Statistics

CEFRS

UNESCO

European Union

Egyptian National Innovation Survey 2008

About this survey: This survey collects information about product and process innovation as well as organisational and marketing innovation during the three-year period 2005 to 2007 inclusive.

Scope: The statistical unit for the survey is the enterprise as defined by CAPMAS. An enterprise refers to a business, company or firm and can range from a very small concern with only one or two employees to a much larger and more formal business or firm.

Authority: The Ministry of scientific Research (MOSR), as a component of the National Statistics System, commissions the CEFRS to perform this survey.

Confidentiality: All information gathered by this survey will be held in strictest confidence. Under no circumstances will the CEFRS, MOSR or CAPMAS, release or disclose any information on or identifiable with, individual firms or business units.

If you have any problems in completing this form and/or meeting the due date, please do not hesitate to contact the Survey Call Centre Operators listed below for assistance:

Name of Operator	Sector of responsibility	Telephone	E-mail

Governate

City

Address

Person completing this questionnaire:

Name:

Job title:

Phone:

E-mail:

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Egyptian National Innovation Survey 2008

1. General information about the enterprise, business, company or firm

1. Short description of your main business activity:

1.1 **Is your enterprise part of a larger group?**
A group consists of two or more legally defined enterprises under common ownership. Each enterprise in the group may serve different markets, as with national or regional subsidiaries, or serve different product markets. The head office is also part of an enterprise group.

1-Yes ☐ 2-No ☐

In which country is the head office of your group located?

**If your enterprise is part of an enterprise group, please answer all further questions only for your enterprise in EGYPT.
Do not include results for subsidiaries or parent enterprises outside of EGYPT.**

1.2 In which geographic markets did your enterprise sell goods or services during the three years 2005 to 2007?

a. Egypt ☐
b. Rest of Africa ☐
c. Europe ☐
d. United States ☐
e. Asia ☐
f. Other countries ☐

1.3 **What was your enterprise's total number of employees in 2005 and 2007?**
Annual average number of employees, both full-time and part-time. If not available, give the number of employees at the end of each year.

a. 2005 ☐☐☐☐☐☐
b. 2007 ☐☐☐☐☐☐

1.3.1 **Approximately what percentage of your total employees had a university or technician degree or diploma in 2007?**

☐☐☐ %

1.4 **What was your enterprise's approximate total turnover for 2005 and 2007?**
Turnover is defined as the market sales of goods and services (Include all taxes)
Please give turnover in Thousands ('000s) of L.E

a. 2005 ☐☐☐☐☐☐☐☐☐ 000
b. 2007 ☐☐☐☐☐☐☐☐☐ 000

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Egyptian National Innovation Survey 2008

2. Product (goods or services) innovation

A product innovation is the introduction to market of a new good or service or a significantly improved good or service with respect to its capabilities, such as improved user-friendliness, components, software or sub-systems. The innovation (new or improved) must be new to your enterprise, but it does not need to be new to your industry sector or market. It does not matter if the innovation was originally developed by your enterprise or by other enterprises.

Please note: The latest terminology classifies "products" as consisting of both "goods" and "services". For example a firm in the financial services sector may talk of a "new financial product". The provision of innovative services is of increasing importance in competitive economies and the survey aims to cover both manufacturing and services orientated firms.

2.1 During the three years 2005 to 2007 , did your enterprise introduce:

a. → New or significantly improved goods. — 1- Yes ☐ 2- No ☐
Exclude the simple resale of new goods purchased from other enterprises and minor changes that only alter the appearance of the product.

b. → New or significantly improved services. — 1- Yes ☐ 2- No ☐

↳ If no to **both** questions, please go to question **3.1**

2.2 By whom were these product (goods and services) innovations developed?

1. → Mainly your enterprise or enterprise group ☐
2. → Your enterprise together with other enterprises or institutions ☐
3. → Mainly other enterprises or institutions ☐

Select the single most appropriate option only

2.2.1 Did these innovations originate mainly in Egypt or abroad? — 1-Egypt ☐ 2-Abroad ☐

2.3 Were any of your goods and service innovations during the three years 2005 to 2007 new to your market or new to your firm?:

a. → New to your market? — 1-Yes ☐ 2- No ☐
Your enterprise introduced a new or significantly improved good or service onto your market before your competitors (it may have already been available in other markets).

b. → Only new to your firm? — 1-Yes ☐ 2- No ☐
Your enterprise introduced a new or significantly improved good or service that was already available from your competitors in your market.

2.4 Using the definitions above, please estimate the percentage of your total turnover in 2007 :

	2007 TURNOVER DISTRIBUTION
a. → Goods and service innovations introduced during 2005 to 2007 that were **new to your market**	☐☐☐ %
b. → Goods and service innovations introduced during 2005 to 2007 that were only **new to your firm**	☐☐☐ %
c. → Goods and services that were unchanged or only marginally modified during 2005 to 2007 *Include the resale of new goods or services purchased from other enterprises.*	☐☐☐ %
	+ 1 0 0 %

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Egyptian National Innovation Survey 2008

3. Process innovation

Process innovation is the use of new or significantly improved methods for the production or supply of goods and services. The innovation (new or improved) must be new to your enterprise, but it does not need to be new to your industry sector or market. It does not matter if the innovation was originally developed by your enterprise or by other enterprises. Exclude purely organisational innovations such as changes in firm structure or management practice – these are covered in question 10.

3.1 During the three years 2005 to 2007, did your enterprise introduce any:

	1-Yes	2-No
a. → New or significantly improved methods of manufacturing or producing goods or services?	☐	☐
b. → New or significantly improved logistics, delivery or distribution methods for your inputs, goods or service?	☐	☐
c. → New or significantly improved supporting activities for your processes, such as maintenance and operating systems for purchasing, accounting or computing?	☐	☐

↳ If no to **all** questions, please go to section **4**

3.2 By whom were these process innovations developed?

1. → Mainly your enterprise or enterprise group ☐
2. → Your enterprise together with other enterprises or institutions ☐
3. → Mainly other enterprises or institutions ☐

Select the single most appropriate option only

3.2.1 Did these innovations originate mainly in Egypt or abroad? 1- Egypt ☐ 2-Abroad ☐

4. Ongoing or abandoned innovation activities

Innovation activities include the acquisition of machinery, equipment, software, licenses, engineering and development work, training, marketing and research and experimental development (R&D) when they are specifically undertaken to develop and/or implement a product or process innovation.

4.1 Did your enterprise have any innovation activities to develop product or process innovations that were abandoned during 2005 to 2007 or still ongoing by the end of 2007?

	1-Yes	2-No
Abandoned	☐	☐
Still ongoing	☐	☐

↳ If your enterprise also had no product or process innovations or innovation activity during 2005 to 2007 (no to **ALL** options in questions 2.1, 3.1, and 4.1), please go to question 8.2. Otherwise, please proceed to question **5.1**.

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Egyptian National Innovation Survey 2008

5. Innovation activities and expenditures

5.1 **During the three years 2005 to 2007 , did your enterprise engage in the following innovation activities?**

	1-Yes	2-No
A. **Intramural (in-house) Research and Experimental Development (R&D)** Creative work undertaken on a systematic basis within your enterprise to increase the stock of knowledge and its use to devise new and improved products and processes (including software development).	☐	☐
B. **Extramural or outsourced R&D** Same activities as above, but purchased by your enterprise and performed by other companies (including other enterprises within your group) or by public or private research organisations.	☐	☐
C. **Acquisition of machinery, equipment and software** Acquisition of advanced machinery, equipment and computer hardware or software to produce new or significantly improved products and processes.	☐	☐
D. **Acquisition of other external knowledge** Purchase or licensing of patents and non-patented inventions, know-how, and other types of knowledge from other enterprises or organisations.	☐	☐
E. **Training** Internal or external training for your personnel specifically for the development and/or introduction of new or significantly improved products and processes.	☐	☐
F. **Market introduction of innovations** Activities for the market introduction of your new or significantly improved goods and services, including market research and launch advertising.	☐	☐
G. **Other activities (including design)** Procedures and technical preparations, including design, to implement new or significantly improved products and processes that are not covered elsewhere.	☐	☐

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Egyptian National Innovation Survey 2008

5.2 Please estimate the amount of expenditure in 2007 only for the first four innovation activities mentioned in 5.1 (A to D).

Include personnel and related costs.

Please provide expenditure in thousands of L.E e.g. Five hundred thousand L.E entered as 500 in the box provided: 5 0 0 000 =L.E 500 000.

Please enter 0 in the category box if your enterprise had no expenditures in 2008.

STRICTLY CONFIDENTIAL

Please report for 2007 only

A. Intramural (in-house) R&D in 2007. *Include labour costs, capital expenditures on buildings and equipment specifically for R&D.*	000
B. Acquisition of R&D. *Extramural or outsourced R&D.*	000
C. Acquisition of machinery, equipment and software. *Exclude expenditures on equipment for R&D.*	000
D. Acquisition of other external knowledge.	000
Total of these four innovation expenditure categories (A+B+C+D)	000

5.3 During the three years 2005 to 2007, did your enterprise receive any public financial support for innovation activities from the following levels of government?

Include financial support via tax credits or deductions, grants, subsidised loans, and loan guarantees.

Exclude research and other innovation activities conducted entirely for the public sector under contract.

	1-Yes	2-No
a. → Metros and municipalities		
b. → Governorate		
c. → National government		
d. → National funding agencies (such as ASRT, STDF, MOSR, IMC)		
e. → Foreign government/ public sources (e.g. European Commission)		

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6. Sources of information and co-operation for innovation activities

6.1 During the three years 2005 to 2007, how important to your enterprise's innovation activities were each of the following information sources?
Please identify information sources that provided information for new innovation projects or contributed to the completion of existing innovation projects.

INFORMATION SOURCE			DEGREE OF IMPORTANCE *Tick 'not used' if no information was obtained from a source.*			
			High	Medium	Low	Not used
Internal sources	a.	Sources within your enterprise or enterprise group	1- ☐	2- ☐	3- ☐	4- ☐
External sources						
Market resources	b.	Suppliers of equipment, materials, components or software	1- ☐	2- ☐	3- ☐	4- ☐
	c.	Clients or customers	☐	☐	☐	☐
	d.	Competitors or other enterprises in your sector	☐	☐	☐	☐
	e.	Consultants, commercial labs or private R&D institutes	☐	☐	☐	☐
Institutional sources	f.	Universities and Technician	☐	☐	☐	☐
	g.	Government or public research institutes	☐	☐	☐	☐
Other sources	h.	Conferences, trade fairs, exhibitions	☐	☐	☐	☐
	i.	Scientific journals and trade/technical publications	☐	☐	☐	☐
	j.	Professional and industry associations	☐	☐	☐	☐

6.2 During the three years 2005 to 2007, did your enterprise co-operate on any of your innovation activities with other enterprises or institutions?
Innovation co-operation is active participation with other enterprises or non-commercial institutions on innovation activities. Both partners do not need to benefit commercially.
Exclude pure contracting out of work with no active co-operation.

Yes 1- ☐ No 2 ☐

↳ If no, please go to question 7.1

Egyptian National Innovation Survey 2008

6.3 Please indicate the type of co-operation partner and their location. *Tick all that apply*

TYPE OF CO-OPERATION PARTNER	Egypt	Rest of Africa	Europe	USA	Asia	Other countries
A. Other enterprises within your enterprise group	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
B. Suppliers of equipment, materials, components or software	☐	☐	☐	☐	☐	☐
C. Clients or customers	☐	☐	☐	☐	☐	☐
D. Competitors or other enterprises in your sector	☐	☐	☐	☐	☐	☐
E. Consultants, commercial labs or private R&D institutes	☐	☐	☐	☐	☐	☐
F. Universities or technician	☐	☐	☐	☐	☐	☐
G. Government or public research institutes (e.g. NRC)	☐	☐	☐	☐	☐	☐

6.4 Which type of co-operation partner was the most valuable for your enterprise's innovation activities? ☐
Give corresponding letter from 6.3. For example, customers = C

7. Effects of innovation during 2005 - 2007

7.1 How successful were each of the following types of outcomes for your products (goods or services) and process innovations introduced during the three years 2005 to 2007 ? *Tick "Not relevant" if there were no innovation outcomes.*

LEVEL OF SUCCESS OF OUTCOMES

			High	Medium	Low	Not relevant
Product outcomes	a.	Increased range of goods or services	1 ☐	2 ☐	3 ☐	4 ☐
	b.	Entered new markets or increased market share	☐	☐	☐	☐
	c.	Improved quality of goods or services	☐	☐	☐	☐
Process outcomes	d.	Improved flexibility of production or service provision	☐	☐	☐	☐
	e.	Increased capacity of production or service provision	☐	☐	☐	☐
	f.	Reduced labour costs per unit output	☐	☐	☐	☐
	g.	Reduced materials and energy per unit output	☐	☐	☐	☐
Other outcomes	h.	Reduced environmental impacts or improved health and safety	☐	☐	☐	☐
	i.	Met governmental regulatory requirements	☐	☐	☐	☐

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8. Factors hampering innovation activities

8.1 During the three years 2005 to 2007, were any of your innovation activities or projects:

	1-Yes	2-No
a. → Abandoned in the concept stage	☐	☐
b. → Abandoned after the activity or project was begun	☐	☐
c. → Seriously delayed	☐	☐

QUESTIONS 8.2, 9 and 10 TO BE ANSWERED BY ALL ENTERPRISES:

8.2 During the three years 2005 to 2007, how significant were the following factors in hampering your innovation activities or projects or influencing a decision not to innovate? *Please also indicate particular factors that were not experienced.*

DEGREE OF SUCCESS

		High	Medium	Low	Factor not experienced
Cost factors	a. Lack of funds within your enterprise or group	1 ☐	2 ☐	3 ☐	4 ☐
	b. Lack of finance from sources outside your enterprise	☐	☐	☐	☐
	c. Innovation costs too high	☐	☐	☐	☐
Knowledge factors	d. Lack of qualified personnel	☐	☐	☐	☐
	e. Lack of information on technology	☐	☐	☐	☐
	f. Lack of information on markets	☐	☐	☐	☐
	g. Difficulty in finding co-operation partners for innovation	☐	☐	☐	☐
Market factors	h. Market dominated by established enterprises	☐	☐	☐	☐
	i. Uncertain demand for innovative goods or services	☐	☐	☐	☐
Reasons not to innovate	j. No need due to prior innovations	☐	☐	☐	☐
	k. No need because of no demand for innovations	☐	☐	☐	☐

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9. Intellectual property rights

9.1 During the three years 2005 to 2007, did your enterprise:

	1 Yes	2 No
a. → Secure a patent in Egypt ?	☐	☐
b. → Apply for a patent outside of Egypt ?	☐	☐
c. → Register an industrial design?	☐	☐
d. → Register a trademark?	☐	☐
e. → Claim copyright?	☐	☐
f. → Grant a licence on any intellectual property rights resulting from innovation?	☐	☐

10. Organisational and marketing innovations

An organisational innovation is the implementation of new or significant changes in firm structure or management methods that are intended to improve your firm's use of knowledge, the quality of your goods and services, or the efficiency of work flows.

A marketing innovation is the implementation of new or significantly improved designs or sales methods to increase the appeal of your goods and services or to enter new markets.

10.1 During the three years 2005 to 2007, did your enterprise introduce:

	1 Yes	2 No
Organisational innovations		
a. → New or significantly improved knowledge management systems to better use or exchange information, knowledge and skills within your enterprise *Exclude routine upgrades.*	☐	☐
b. → Major changes to the organisation of work within your enterprise, such as changes in the management structure or integrating different departments or activities	☐	☐
c. → New or significant changes in your external relations with other firms or public institutions, such as through alliances, partnerships, outsourcing or sub-contracting	☐	☐
Marketing innovations		
a. → Significant changes to the design or packaging of a good or service *Exclude routine/seasonal changes such as clothing fashions.*	☐	☐
b. → New or significantly changed sales or distribution methods, such as internet sales, franchising, direct sales or distribution licenses.	☐	☐

Egyptian National Innovation Survey 2008

10.2 If your enterprise introduced an organisational innovation during the three years 2005 to 2007, how important were each of the following results?

IMPORTANCE OF RESULTS

	1- High	2- Medium	3- Low	4- Not relevant
a. Improved market share	☐	☐	☐	☐
b. Reduced time to respond to customer or supplier needs	☐	☐	☐	☐
c. Improved quality of your goods or services	☐	☐	☐	☐
d. Reduced costs per unit output	☐	☐	☐	☐
e. Improved employee satisfaction and/or reduced rates of employee turnover	☐	☐	☐	☐

- Thank you for your participation. It is sincerely appreciated.
- Please make a copy of this questionnaire for your records and internal use which may also be referenced if we need to follow-up with any specific issues.
- Please return the completed questionnaire to the **CEFD** in the enclosed stamped, addressed envelope.
- Our Postal Address:

E-mail:
Website:

Annex 3: Questionnaire for the Evaluation of Research – Industry Cooperation

A Programme of the Ministry of Higher Education and Scientific Research funded by the European Union

برنامج تابع لوزارة التعليم العالي و البحث العلمي ممول من الاتحاد الأوروبي

Questionnaire for the Evaluation of Research-Industry Cooperation

Evaluation of the Egyptian Science and Technology Landscape

Research, Development and Innovation Programme (RDI)

Towards sustainable Development of S&T in Egypt

A Programme of the Ministry of Higher Education and Scientific Research funded by the European Union
برنامج تابع لوزارة التعليم العالي والبحث العلمي ممول من الاتحاد الأوروبي

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A Programme of the Ministry of Higher Education and Scientific Research funded by the European Union

1 General Data

All data and information are treated strictly confidentially and anonymous.

Title, first name, surname	....
Position	....
Organization	....
Address	....
Postal zip code	....
City	....
Telephone number	....
Fax number	....
E-mail	....
Date (of filling in the form/ interview)	....
Sub organizational units of the organization	....

A Programme of the Ministry of Higher Education and Scientific Research funded by the European Union

2 Internal General Information

At the beginning of the survey, we would like to ask you some general information in order to get an overall impression of the research institute.

Background When is the organisation founded?	
What was the reason for foundation?	
How is the organizational structure of the organization (divisions, departments)?	
Financing Annual turnover?	
Human Resources Number of employees?	
Trend in this respect?	
Orientation What are the main research fields and main products?	
What market segments is the research institute active in?	
Planning What kind of methodologies do you use for your planning?	
Are your clients involved in the planning process?	
Evaluation What kind of mechanisms of monitoring and evaluation have you already implemented?	
Is there any systematic external evaluation? If yes, by whom?	
Problems and Potentials Describe in short the main problems felt by the organisation. Additional, formulate strengths and weaknesses of your organization?	

4 Assessment of Research Institutes – Interview Questionnaire

A Programme of the Ministry of Higher Education and Scientific Research funded by the European Union

Nine Success-Factors for the Evaluation of Research Institutes (RI)

3 Strategic Orientation

3.1 Regarding the strategic business field planning

Does the RI perform any observation about the market development, technology development and/or global social, political and ecological trend to do a Strategic-Business-Field-Planning, and if yes, how is this observation being carried out?

1.	Is there any documentation of the Strategic-Business-Field-Planning?	☐ yes ☐ no	If yes, how is it documented?	☐ Formulated vision ☐ Formulated mission ☐ Formulated strategies ☐ Written long-term objectives ☐ Written mid-term objectives ☐ Written short-term objectives ☐ Other methods/ comments: ....
2.	Does the RI perform any observation about the **market development** to do a Strategic-Business-Field-Planning?	☐ yes ☐ no	If yes, how is this observation being carried out?	☐ Analysis of specific demand & supply ☐ Analysis of various economy statistics ☐ Other methods/ comments: ....
3.	Does the RI perform any observation about the **technology development** to do a Strategic-Business-Field-Planning?	☐ yes ☐ no	If yes, how is this observation being carried out?	☐ Analysis of specific demand & supply ☐ Analysis of relevant technology indicators ☐ Other methods/ comments: ....
4.	Does the RI perform any observation about the **global social, political and ecological trend** to do a Strategic-Business-Field-Planning?	☐ yes ☐ no	If yes, how is this observation being carried out?	☐ Analysis of specific demand & supply ☐ Analysis of various social-, political- or ecological-statistics ☐ Other methods/ comments: ....

3.2 Regarding the strategic competence planning

Based on a strategic-business-field-planning, the staff must be adjusted to the near future conditions. It is of an utmost importance, that the RI are performing their competence planning founded on the future needs and demands of industry as well as on the supply of basic research by the universities or other basic research institutes/ organizations.

Does the RI perform any strategic competence planning based on its strategic business field planning? In addition, if yes, how does this planning look like?

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7.	Is there any strategy for staff development to achieve competences for future business fields?	☐ yes ☐ no	If yes, which? ☐ Trainings by own experts ☐ Trainings by experts from industries ☐ Trainings by experts from universities ☐ Trainings by experts from other institutions ☐ Internal education program ☐ Other methods/ comments …………………………………… ……………………………………
8.	Are there any procedures to achieve competent or experienced personnel for future activities maybe from universities or industry?	☐ yes ☐ no	If yes, which? • …………………………………… • …………………………………… • …………………………………… • ……………………………………
9.	Does the RI execute any organizational planning like the creation of new groups or teams or division for future research activities?	☐ yes ☐ no	If yes, which? • …………………………………… • …………………………………… • …………………………………… • ……………………………………

3.3 Regarding the Development of Strategic Alliances

Strategic alliances are a very efficient possibility to achieve the results of basic research organisations and to combine these demands and needs of industry. To do effective research and development one can describe the foundation of national and international alliances as the possibility of organization to work jointly on the continuously increasing complexity of technology and research fields. Therefore, it is necessary for RI does know about relevant and reliable organizations, which can be, used as potential partners in various research activities. Out of this joint research between basic research, applied research and industry, the results are more efficient for all person concerned.

10.	Does the RI have any strategies, concepts or contract with others like universities or industry or others for **national alliances** in any business fields?	☐ yes ☐ no	If yes, how do they look like and what is the amount of enterprises and institutes for national alliances? • …………………………………… • …………………………………… • …………………………………… • ……………………………………
11.	Does the RI dispose of any experiences regarding **national alliances**?	☐ yes ☐ no	If yes, which? • …………………………………… • …………………………………… • ……………………………………
12.	Does the RI know about potential national partners for possible future national alliances?	☐ yes ☐ no	If yes, how is the knowledge stored (databases, papers, …)? • …………………………………… • …………………………………… • ……………………………………

13. Does the RI have any strategies, concepts or contract with others like universities or industry or others abroad for **international alliances** in any business fields?	☐ yes ☐ no	If yes, how do they look like and what is the amount of enterprises and institutes for international alliances? • .... • .... • .... • ....
14. Does the RI dispose of any experiences regarding **international alliances**?	☐ yes ☐ no	If yes, which? • .... • .... • ....
15. Does the RI know about potential international partners for possible future national alliances?	☐ yes ☐ no	If yes, how is the knowledge stored (databases, papers,....)? • .... • .... • ....

4 Technology-Management

4.1 Regarding Technology-Performance

One major field of a RI is its existing technological competence to develop complete system solutions for especially enterprises. This does not mean "just" to apply patents or licenses in very specialised technology areas. Rather the ability to combine various technologies should be a focus of RI. The regular R&D process position of a RI lies between basic research (usually universities) and industry, therefore they can be seen as the interface between the demand and supply site of R&D results. Hence, this confirms the role of RI not to work on isolated single topics but to use their strength in the connecting of various research fields with several key players.

16. Does the RI have any experiences in the development of complete system solutions?	☐ yes ☐ no	If yes, in which fields? • .... • .... • .... • ....
Does the RI have any concept for the development of complete systems solutions?	☐ yes ☐ no	If yes, how do they look like and how are they communicated within the RI? • .... • .... • ....
17. Does the RI dispose of any fields/ concepts for the support of technology interweaving?	☐ yes ☐ no	If yes, what are these fields and how do the concepts look like? • .... • .... • ....
What are the overall experiences regarding the support of technology interweaving?	• .... • .... • .... •	

18.	Has the RI any experiences concerning the creation or construction of prototypes or demonstrators?	☐ yes ☐ no	In which technological fields were these prototypes or demonstrators settled and what is the overall amount of created or constructed demonstrators? • ... • ... • ... • ...
19.	Does the RI apply any patents and licenses within the last years?	☐ yes ☐ no	If yes, were the patents and licenses in technology fields applied and what is the overall amount of patents and licenses? • ... • ... • ... • ...

4.2 Regarding the Participation on technology support programs

The participation in governmental financed or partly financed technology support programs can be seen as an essential element of RI for a successful Technology Management, because these programs are mostly based on key and high technologies. A small participation in those programs could imply that a RI already is in an advanced stadium, so the programs are less important for it, or that a RI is behind other RI. Furthermore, the subjects of the participating programs can indicate, whether a RI is just focused on their main research fields or also involved in projects with wider focus. The role as a coordinator within these programs can prove that a RI possesses an active role and disposes of sufficient competences to fulfil complex problems.

20.	Does the RI participate in any technology support program?	☐ yes ☐ no	If yes, what are the technology fields of the support program? • ... • ... • ... • ...
21.	What is the amount of support programs and what is their share regarding the overall budget?	• ... • ... • ...	
22.	What is the relation between regional, national and international support programs?	• ... • ... • ...	

4.3 Project Management

A successful technology management requires an effective project management, especially of the steering of the project's progress. Concepts with fixed milestones must be implemented to achieve the necessary results. Particularly in times of shrinking budgets and increasing costs of R&D, RI must guarantee an effective project management.

23.	Does the RI dispose of a standardized project management approach?	☐ yes ☐ no	If yes, and how does this approach look like (milestone-concept, ...)? • ... • ... • ... • ...

24. What are the expenditures of the project management related to the overall project budgets?	• … • … • …	
25. Is there any project networking, like thematic interfacing to other related projects?	☐ yes ☐ no	If yes, what is the number of project-networks and how often do they meet to exchange relevant information about related projects? • … • … • … • …
26. Does the RI have any staff plan to increase the interdisciplinary within the support programs?	☐ yes ☐ no	If yes, and how does this approach look like? • … • … • … • …

5 Industry Relationship

5.1 Regarding Cooperation with Enterprises

The decisive characteristic for applied research institutes is the relationship with industry. The most important element of the relationship is the direct cooperation with enterprises in R&D projects. A useful measure for the successful cooperation with enterprises is the continuity of clients throughout several periods, which indicates also a high quality of R&D. Additionally, network-projects between RI and industry are essential to transfer knowledge from research towards economy. Another fundamental function of RI is the supply of consulting services and technology cooperation without fixed contractual bindings. These forms of collaboration between RI and industry are a significant factor for the stabilization of relationships and can improve the confidence in RI and in their ability to solve the problems of enterprises.

27. What are the amount and the volume of industry orders (incl. consortium studies)	…	
Who are the clients?	…	
What is the rate of orders regarding amount and volume, which are coming from SME?	…	
28. Of what kind of research fields are these orders coming from?	• … • … • …	
29. Are there any follow-up orders of enterprises?	☐ yes ☐ no	If yes, what is the rate regarding the amount and the volume among the overall orders? • … • … • …

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30. Does the RI perform any cooperation projects with industry and science?	☐ yes ☐ no	If yes, what are the specific research fields and who are the partners on both sides, industry and science? • .... • .... • .... • ....
What is the overall amount and volume of such cooperation projects?	• .... • .... •	
31. Are the any consulting-services or technology-cooperation, which does not have any contractual-bindings?	☐ yes ☐ no	If yes, what are the topics and who are the partners? • .... • .... • .... • ....
32. Does the RI commercialise any R&D-results in cooperation with enterprises?	☐ yes ☐ no	If yes, how does the concept look like and what is the amount of income out of these R&D-results? • .... • .... • .... • ....
How often has the RI commercialise such R&D-results?	• .... • .... •	

5.2 Regarding Innovation performance

"Innovation" is not the task of RI but of industry. Therefore, the innovation performance of a RI can be indicated by their degree of contribution in introducing new products through industry to the market. RI should support and strengthen the innovation process by providing the needed know how. Furthermore, the time lag between invention and innovation can indicate the performance of RI to support the introduction of new products.

33. Does the RI contribute to any innovation-processes?	☐ yes ☐ no	If yes, what is the level of the RI regarding the contribution to innovation-processes? • .... • .... • .... • ....
In what types of innovation has the RI been involved?	• .... • .... •	
34. How would the RI indicate the time lag between the invention of a product/process and the innovation/market introduction of the product?	• .... • .... • .... •	

5.3 Regarding Know how transfer via heads

RI dispose of comprehensive know how in various fields. Therefore, the staff of RI can be seen as a good potential to transfer knowledge from R&D to industry. On the one hand, the exchange of staff can increase the trust of industry in RI and on the other hand, it supports the transfer of comprehensive know how.

35.	Does the RI supports the transfer of staff in both directions industry to RI / RI to industry?	☐ yes ☐ no	If yes, how often does the RI transfer staff and how long is the duration of the staff transfer? • ...... • ...... • ......
36.	How does the qualification of staff, which has been, transfer look like?		• ...... • ...... • ......
37.	What is the purpose of the RI by exchanging staff?		• ...... • ...... • ......

5.4 Regarding further education offer

Enterprises, especially SME mostly do not have the access to new technologies/ processes. The daily work of enterprises mostly does not allow dealing with current R&D-results or new approaches in their own business. Therefore, it is of utmost importance that RI distributes their specific knowledge through trainings, seminars, conference and other public relation activities to inform enterprises about the current status of R&D as well as of technologies, products, processes and services. A reliable further education offer indicates also a strong industry relationship of RI.

38.	Does the RI perform any training, seminars, conferences or any other offer to transfer relevant R&D-information to industry, especially to SME?	☐ yes ☐ no	If yes, how do the concepts of such offer look like? • ...... • ...... • ...... • ......
39.	Who are the clients/ participants of these offers and what is the amount of clients/participants?		• ...... • ...... • ......
40.	How often does the RI perform those events to transfer knowledge of the current results to industry?		• ...... • ...... • ......

5.5 Regarding Technology Based Spin-Offs

Another reference concerning industry relationship is the amount of technology based spin-offs, which were founded by RI staff. Such spin-offs can strengthen the industry binding because they mostly still continue their relation to the RI and are in close connection to industry. Therefore, the spin-offs are a good opportunity for the RI to expand their industry network.

40a.	Were their any technology based spin-offs, which were founded by RI staff?	☐ yes ☐ no	If yes, what is the amount of Spin-Offs? ....

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	In which technology field or markets did these spin-offs take place?	....
	What is the age of the spin-offs?	....

5.6 Regarding the Collaboration of RI-Staff in Specific Associations

To contribute to current R&D topics it is relevant for RI to take part in several associations like bodies of experts, committees or professional associations. To expand the view of the RI it can be relevant not only to participate in associations, which are focused on the main R&D fields of the RI. Furthermore, regarding the internationalisation of markets it is also important for RI to participate besides regional and national, in international associations.

41.	In what kind of associations does the RI participate?	• ...... • ...... •		
	What is the amount and what are the topics of these associations	• ...... • ...... •		
	How does the position and activity of the RI in these associations look like?	• ...... • ...... •		
42.	Is the focus of the associations rather on a regional, national or on an international level?	☐ regional	☐ national	☐ international

6 Relationship to Science

6.1 Regarding Scientific Performance

To be successful in forwarding applied research results to industry, RIs must also have a good scientific performance. RI should partially but regularly participate in scientific projects, in which they achieve scientific findings by themselves. These findings give RI the opportunity to publish their own scientific results and to increase their overall reputation. In addition to the scientific results and the publications, the number of appeals for professor or lecturer can also indicate the scientific performance of a RI.

42a	Does the RI execute any scientific project?	☐ yes ☐ no	If yes, what are the amount and the volume of the scientific projects? ....
	What kind of projects are these and in what scientific fields are they located?	....	

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42b	Did the RI produce any new scientific findings?	☐ yes ☐ no	If yes, how do they look like and what were the specific research fields of these findings? ………… ………… …………
42c	What is the amount and what are the research fields of scientific publication and citations of the RI?	………… ………… ………… …………	
42d	In what kind of newspapers/journals/magazines/etc. were these publications published?	………… ………… …………	
42e	Are there any appeals for professors or lecturers?	☐ yes ☐ no	If yes, which universities did announce the appeals? ………… ………… …………

6.2 Regarding Scientific Cooperation

Beside the realization of scientific project independently, RI should jointly realize scientific projects with universities or other basic research organizations. The connection to basic research can also take place through an institutional connection between RI and universities. A well-functioned scientific cooperation can also promote an efficient staff transfer between science and applied research.

43.	Does the RI perform any joint research projects together with universities or other basic research institutes?	☐ yes ☐ no	If yes, what are the research fields and what is the amount and volume of these research projects? • ………… • ………… • …………
44.	Does the RI have any institutional interweaving with universities?	☐ yes ☐ no	If yes, how does this interweaving look like (staff, institute management, direct institutional connection)? • ………… • ………… • …………
45.	Does the RI perform any scientific conferences?	☐ yes ☐ no	If yes, what is the amount and number of participants • ………… • ………… • …………
	What are the topics of theses conferences including the target group?	• ………… • ………… • …………	
46.	Does the staff of the RI regularly participate in scientific conference?	☐ yes ☐ no	If yes, what are the scientific fields of the conferences? • ………… • ………… • …………

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47. Does the RI perform any personnel exchange with basic research institutes, like guest scientist?	☐ yes ☐ no	If yes, what is the institution, purpose, qualification, frequency & duration of staff transfer? • .... • .... • ....
If yes, what is the amount of sent/taken staff	• .... • .... •	

6.3 Regarding University Education

An important factor beside the direct contribution to the university education through lectures by professors or lectureship is the support of master degrees, doctorates or university lecturer qualifications. The scientific education performance is a major element of the relationship between applied and basic research.

48. Does the RI have any direct contribution to the university education through lectures by professors or lectureships?	☐ yes ☐ no	If yes, what is the amount of lectures and the number of professors and lectureships at the RI? • .... • .... • ....
49. Does the RI support the conclusion of master degrees, doctorates or university lecturer qualifications of their staff?	☐ yes ☐ no	If yes, how do the support concept look like? • .... • .... • ....
What is the amount of achieved master degrees, doctorates or university lecturer qualifications of their staff?	....	

6.4 Regarding the participation in Scientific Associations

The observation of current tendencies in relevant research fields must be a basic task of RI. Therefore, the staffs of RI has to take part in relevant scientific associations as well as to actively contribute to associations, which decide on the allocation of funds for support programs. The appointment to such a body of experts indicates a high professional acknowledgement of the appointed person.

50. Does the RI participate in any specific scientific associations, like bodies of experts, committees or professional associations?	☐ yes ☐ no	If yes, in how many scientific associations is the RI involved and what are the subject fields of those associations and what is the position/activity of the RI? • .... • .... • .... • ....
51. Does the RI have any activities in specific scientific designated expert committee, like associations, which decide on the allocation of funds for support programs?	☐ yes ☐ no	If yes, in how many specific scientific designated expert committees is the RI involved and what is the role of the RI in such association? • .... • .... • .... • ....

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7 Communication Competence

7.1 Regarding the Communication to Industry

The communication to industry is a major topic of the communication competence of each RI. Questions regarding this fact should already be achieved by success factor 3 (relationship to industry).

7.2 Regarding the Communication to Science

The communication to science is also major topic of the communication competence of each RI. Questions regarding this fact should already be achieved by success factor 4 (relationship to science).

7.3 Regarding the establishment and maintenance of External Contacts

RI is depending on their customer relationships. Because normally RI is mostly working on a contractual basis, they have to be in a continuous conversation with their clients. Therefore, the communication with external must be consisting of an efficient structure.

52. Are there any specific hierarchical levels, which define the contact to external?	☐ yes ☐ no	If yes, which? • .... • .... • .... • ....
53. What are the types of communication with external clients?		• .... • .... • ....
How does the process of communication look like?		• .... • .... • .... • ....

7.4 Regarding Corporate Identity

As mentioned above, a corporate identity is very important to achieve a common understanding of the tasks and targets of a RI.

54. Does the RI possess of any concept or process to promote or to establish a corporate identity?	☐ yes ☐ no	If yes, how does the concept or process look like? • .... • .... • .... • ....

7.5 Regarding Public Relations

To achieve a satisfying external view, RI must introduce sufficient public relations.

55. Does the RI already implement a specific kind of public relations?	☐ yes ☐ no	If yes, how does concept look like and who is responsible for it? • .... • .... • .... • ....

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56. Does the RI dispose of any press service, information material (like institution flyer, annual report, …)?	☐ yes ☐ no	If yes, which? • …………………… • …………………… • …………………… • ……………………
57. Does the RI perform any fairs, seminars or other events to increase the relation to already existing and potential new clients?	☐ yes ☐ no	If yes, which? • …………………… • …………………… • …………………… • ……………………

8 Organization and Management

8.1 Regarding Strategic Organization Planning

The Strategic Organization Planning is also major topic of the Strategic Orientation of each RI. Questions regarding this factor should already be achieved by success factor 1 (Strategic Orientation).

8.2 Regarding Organizational Structure

This criterion emphasises the organizational structure of a RI. The key element is to achieve information about the number and kind of the different hierarchy levels. RI should establish flat hierarchies and should spread the responsibility in various people, project directors, head of groups or head of departments. In addition, the size of a group can indicate how flexible and creative a RI can operate. The administration, the accountancy and other internal services influence the overall costs of a RI by the overhead-costs. Therefore, the administrative structure and processes must also be adapted to the interests of RI.

58. How does the organisational structure, especially the levels of hierarchy look like?	• …………………… • …………………… • …………………… • ……………………	
Does the RI dispose of any organisation-plan?	☐ yes ☐ no	If yes, which? • …………………… • …………………… • …………………… • ……………………
59. How does the specific organizational structure of the RI look like (flat/ pyramid/ …)?	Drawing	
60. What is the overall number of staff in the different areas?	Total number:	

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61. Are there any flexible R&D departments/groups/project structures?	☐ yes ☐ no	If yes, how do the concepts look like? • .... • .... • .... • ....
62. How are the administrative processes organized?	• .... • .... • .... •	
How can the resources for general administration be described (centralized / decentralized)?	• .... • .... • .... •	
What is the percentage of overheads regarding the overall costs?	• .... • .... • .... •	

8.3 Regarding Organization Process

The organisation process should enable the staff to act in the necessary surrounding of creativity. Therefore, there must be a decentralized organisation process that allows defining short and mid-term developments by the departments, groups and project-teams themselves. Open horizontal and vertical information flows may make possible the needed knowledge exchange between different levels of hierarchy. Also important is an accessible know how abut the various competences within the institute. R&D projects mostly consists of a complex scope, so the project teams must comprise staff of different departments to ensure the needed inter-disciplined project structure.

63. Is there any central planning process for the future development of the RI?	☐ yes ☐ no	If yes, how does this process/ concept look like? • .... • .... • .... • ....
Who is responsible for the development of the RI?	• .... • .... • .... •	
64. Who is responsible/ competent for the decision-making processes, regarding project-responsibility, acquisition- responsibility, investment-responsibility and staff-responsibility?	• .... • .... • .... • .... • .... •	
Is there a decentralized or centralized responsibility-structure?	• .... • .... • .... •	

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65. Who has the financial-responsibility and how the overall RI organized (profit centre/ cost centre/ ....)?	• ...... • ...... • ...... •	
66. How can the information flows be described?	• ...... • ...... • ...... •	
Are there any processes defined to support open information flows?	☐ yes ☐ no	If yes, how do the defined processes look like? • ...... • ...... • ...... • ......
67. Are there any organizational-boundaries between project-teams, departments and research groups or does the RI promote a matrix-structure between the different units?	☐ yes ☐ no	If yes, how do the organizational-boundaries look like? • ...... • ...... • ...... • ......

8.4 Regarding Controlling

Another major part of the process organisation is the controlling, e.g. the project controlling. The staff planning should also be a part of the controlling, because the RI has to assure that the staff can process future developments.

68. Are there any other project controlling tools, e.g. for budget/cost-control?	☐ yes ☐ no	If yes, how does it function and who is normally responsible for the maintenance of the figures? • ...... • ...... • ...... • ......
If yes, how is the controlling organized?	☐ centralized	☐ decentralized
69. Does the RI perform any specific personal planning strategy?	☐ yes ☐ no	If yes, how can this strategy be described • ...... • ...... • ...... • ......
If yes, how is this planning organized?	☐ centralized	☐ decentralized

8.5 Regarding Project Management

The Project Management is also major topic of the Strategic Orientation of each RI. Questions regarding this factor should already be achieved by success factor 2 (Technology Management).

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9 Human Resources

9.1 Regarding Strategic Human Resource Development

The Strategic Human Resource Development is also major topic of the Strategic Orientation of each RI. Questions regarding this factor should already be achieved by success factor 1 (Strategic Orientation).

9.2 Regarding Personal Structure

The Personal Structure meets a couple of different terms. The most important topics are regarding disciplines, qualifications, internal flexibility/fluctuation, project cooperation, number, and age structure and renewal rate.

70.	How can the overall structure of staff be describes?	• …… • …… • …… •
	Is there an inter-disciplined structure regarding qualification of professionals (scientists, engineers)?	☐ yes ☐ no
	Does the RI dispose of a specific qualification-matrix?	☐ yes ☐ no
71.	What is the number of professionals, technicians and assistances and what the ration between them?	• …… • …… • ……
72.	Does the RI have an internal flexibility in staff planning?	☐ yes ☐ no
	Are there any internal fluctuations of staff or does the RI promote the project-cooperation between departments, groups or teams?	☐ yes ☐ no
73.	How does the age structure of the staff look like?	• …… • …… • …… ……
	Is there any strategy to achieve a well-balanced age structure?	☐ yes ☐ no If yes, how does the strategy look like? • …… • …… • …… • ……
74.	How does RI achieve a specific renewal rate of staff to get new ideas and knowledge in the RI?	• …… • …… • …… • ……

9.3 Regarding Incentive Systems

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Incentive Systems are very useful to stimulate the potential of staff. Most RI disposes of fixed payment structures, which do not allow introducing incentive systems, which are based on monetary payments. Therefore, incentive systems in RI should be focused on other topics, like a specific grade of liberty, the ability to take part in seminars, conferences or other thematic events. Furthermore, the promotion of achieving a master or doctor's degree as well as the providing of modern facilities and equipment are possible incentive systems for RI.

75. Does the RI dispose of any incentive systems?	☐ yes ☐ no	If yes, how does the incentive systems look like and what are the fields of incentives? • .... • .... • .... • ....
76. What was the reason to introduce such an incentive system and how is the experience with the system?	• .... • .... • .... •	

9.4 Regarding Education and Training Procedures

The Education and Training of staff pursues two different objectives. On the one hand it may increases the qualification of staff to master the task of the RI and on the other hand, it should increase the career prospects of each employee after the research career.

77. Does the RI perform any education and training procedures?	☐ yes ☐ no	If yes, what kind of procedures has the RI implemented and what is the content of the education and training? • .... • .... • .... • ....
78. What are the expenditures for the education and training?	• .... • .... • .... •	

10 Scientific Technical Equipment

10.1 Regarding the Building and the Room Equipment

RI, which is focusing on current R&D topics must provide suitable basic equipment, like a minimum standard of office equipment and communication technique. In particular, fax, telephone, internet access as well a sufficient standard of electronic data processing must be provided to the staff for an efficient and effective R&D-Work.

79. In what kind of building is the RI located?	• .... • .... •	
Is the building suitable for the objectives and purposes of the RI?	☐ yes	☐ no

	What is the size and what is the age of the building?	• ...... • ...... • ...... • ......
80.	How do the technical and room equipment of the RI look like, e.g. communication techniques and standard equipment per working place?	• ...... • ...... • ...... • ...... • ......

10.2 Regarding Technical Equipment

As mentioned above, the technical equipment is the core of a RI. Therefore, the RI must be focus on a its consciously renewal and must effect strategic investments.

81.	How does electronic data processing of the institute look like and what is their technical position?	• ...... • ...... • ......
	What kind of investments does the RI effect to keep a specific standard?	• ...... • ...... • ......
82.	What kind of laboratories, measuring instruments and testing apparatuses does the RI have?	• ...... • ...... • ......
	How attractive is this equipment for industry?	• ...... • ...... • ......
	What kind of investments does the RI effect to keep a specific standard?	• ...... • ...... • ......
83.	What kind of workshops and production technology does the RI have?	• ...... • ...... • ......
	What kind of investments does the RI effect to keep a specific standard?	• ...... • ...... • ......

10.3 Regarding Maintenance, Quality Assurance and Capacity

To secure the function and have the machineries, the RI must implement a well-organized maintenance system as well as a concept for quality assurance. Furthermore, the capacity is relevant to use the machineries in an efficient way.

84. Is there any concept of maintenance for the technical equipment?	☐ yes ☐ no	If yes, how does it look like? • .... • .... • .... • ....
What are the costs and what is the time spend for the maintenance?	• .... • .... •	
85. Is there any concept for the quality assurance?	☐ yes ☐ no	If yes, how does it look like? • .... • .... • .... • ....
86. What is the capacity, rate of usage of the technical equipment?	• .... • .... •	
Is the technical equipment suitable for the objectives and purposes of the RI?	☐ yes	☐ no

10.4 Regarding Scientific and Informative equipment

To make it possible for the staff to achieve sufficient basic information about specific topics, the RI must dispose of an effective and efficient information system. Especially for desktop research and literature analyses, the RI must provide the needed infrastructure.

87. Does the RI have access to relevant databases in various fields?	☐ yes ☐ no	If yes, what kind of databases is this (fields, investigation-type)? • .... • .... • ....
88. Does the RI have any network connection (internal/external)?	☐ yes ☐ no	If yes, and what kind of networks are these? • .... • .... • ....
89. Does the RI possess an own library?	☐ yes ☐ no	Is it centralized or decentralized library? ☐ centralized ☐ decentralized •
If yes, what is the amount of books, magazines?	....	
What kinds of research fields does the library cover?	• .... • .... •	
90. What are the investments for the libraries per research fields?	• .... •	

91 Are there any possibilities to access to external library?	☐ yes ☐ no	If yes, what kind of libraries are these? • …… • …… • ……

11 Financing

11.1 Regarding Sources of Funds

The development of institutional and project-based funds is very important for the RI and has to observe. Especially after the first years of existence, the RI must construct an efficient way or getting ready for an almost self-financing-strategy. There must be a good mixture between several kind of income, basic/ public income, project-based income (big enterprises as well as SME) and maybe other sources.

92. How does the basic/ public financial support look like?	• …… • …… • …… • ……	
Is the RI supported through national and regional funds?	☐ yes ☐ no	If yes, which funds are these? • …… • …… • ……
93. Are there any special grants from a national or regional level?	☐ yes ☐ no	If yes, how does is look like? • …… • …… • ……
94. What are the amount and the volume of order from industry?	…… …… …… ……	
What rate of SME within the orders from industry?	…… …… …… ……	
95. Is the RI take involved in any governmental funded projects?	☐ yes ☐ no	What are these projects about? • …… • …… • ……
About what kind of governmental funded projects is the RI informed?	• …… • …… • …… • ……	

96. Are there any other public funded projects, like international projects or projects which are financed by other organisations or institutions?	☐ yes ☐ no	If yes, and what kind of public funded projects are these? • .... • .... • .... • ....
97. Are there any clients who are frequently ordering projects?	☐ yes ☐ no	What are kind of client are these? • .... • .... • ....
How would the RI describe the continuity and diversity of their clients?		• .... • .... • ....

11.2 Regarding Sources of Income

As mentioned above, a good mixture between the different types of income are useful to secure a specific grade of independency.

98. What are the amount and the volume of R&D projects?	• .... • .... • ....
99. What are the amount and the volume of construction projects?	• .... • .... • ....
100. What are the amount and the volume of consulting services and studies?	• .... • .... • ....
101. What are the amount and the volume of education & training?	• .... • .... • ....
102. What are the amount and the volume regarding licenses and patents?	• .... • .... • ....

11.3 Regarding Structure of Expenses

Not only the sources of income, also the sources of expenses must be taken into account. Especially the cost factors like staff expenses, material costs and other investments must be adapted to the income.

103. What is the volume of the overall staff expenditure according their different types (professionals, technicians, assistants, ...)?	• .... • .... • .... • .... • ....
104. What is the volume of the staff expenditure for external staff?	• .... • .... • ....

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105. What is the volume of material costs?	• .... • .... •	
106. Is there any external R&D expenditure?	☐ yes ☐ no	If yes, how do they look like? • .... • .... • ....
107. What kind of investments has the RI performed? Are there any regular or special investments?	• .... • .... •	

Five Performance Criteria for the Evaluation of Research Institutes (RI)

12 Strategic Business Field Planning and Industrial Needs

No	Topic	Yes	No	Relevance
1	Does the RI pay sufficient attention to current and foreseeable **market developments** (supply- and demand markets)?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
2	Does the RI pay sufficient attention to current and foreseeable **technology developments** in their surroundings?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
3	Does the RI early react to new topics (not technical) global, social, political and ecological trend?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
4	Does the RI take actively influence on technological objectives of the economy (sensitisation for technological challenges)?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
5	Does the strategic business field development (research groups, performance supply) correspond to challenges of No 1-4?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
6	Does the technological and industrial "networking" (e.g. strategic alliances, etc.) corresponds to challenges of No 1-4?	☐	☐	high →→→→→→→ low ☐☐☐☐☐

13 Scientific and Technological Competence

No	Topic	Yes	No	Relevance
1	Is the RI in sufficient present in the national and international professional public (e.g. publication, conferences, associations)?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
2	Did the institute produce any significant scientific findings within the **last 10 years**?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
3	Does the RI have produced any important scientific developments within the **last 5 years**?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
4	When and how did the RI enter in new technology fields (early/ active vs. late/ reactive)?	☐	☐	high →→→→→→→ low ☐☐☐☐☐

	• Projects from regional- or national programs		high →→→→→→→ low ☐☐☐☐☐
	• Projects from international program		high →→→→→→→ low ☐☐☐☐☐
2	**Types of turnover (except institutional funding)**		high →→→→→→→ low ☐☐☐☐☐
	• R&D orders		high →→→→→→→ low ☐☐☐☐☐
	• Construction		high →→→→→→→ low ☐☐☐☐☐
	• Consulting services / studies		high →→→→→→→ low ☐☐☐☐☐
	• Education and training		high →→→→→→→ low ☐☐☐☐☐
	• Licences and products		high →→→→→→→ low ☐☐☐☐☐
	• Maintenance and other services		high →→→→→→→ low ☐☐☐☐☐

16 Human Resources and Scientific-Technical Equipment

No	Topic	Yes	No	Relevance
1	Does the RI (e.g. the working-groups) have the critical mass regarding human resources?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
	• Inter-disciplined structure of professional?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
	• Suitable ratio between professionals/ technicians & assistance?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
	• Internal flexibility regarding staff deployment?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
	• Well-balanced structure of age?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
	• Well-balanced grade of staff renewal?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
2	Does the RI have the critical mass regarding the scientific-technical equipment?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
	• Suitable technical equipment (laboratories, electronic data processing, measuring instruments and testing apparatuses, workshops and production technology)?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
	• What is the investment share regarding the overall budget?	%		high →→→→→→→ low ☐☐☐☐☐
	• Is there any material-donation from industry?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
	• Scientific-informative equipment (databases, libraries, access to external libraries)?	☐	☐	high →→→→→→→ low ☐☐☐☐☐

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17 Glossary

Terms	Explanation
RI	University and Non-University Research Institute/ Institutes
SME	Small and Medium-Sized Enterprise/ Enterprises

5	Does the RI cooperate sufficiently with universities and other scientific institutions?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
6	Is the RI initiator or coordinator of important national or international joint research program/ projects?	☐	☐	high →→→→→→→ low ☐☐☐☐☐

14 Success in the Solutions of Economic Problem

No	Topic	Yes	No	Relevance
1	Which phases of the innovation process is the institute mainly active in?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
	• Basic research	☐	☐	high →→→→→→→ low ☐☐☐☐☐
	• Applied research	☐	☐	high →→→→→→→ low ☐☐☐☐☐
	• Development	☐	☐	high →→→→→→→ low ☐☐☐☐☐
	• Industrial realization	☐	☐	high →→→→→→→ low ☐☐☐☐☐
2	Does the RI realize sufficient system solutions, which are desired by industry?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
3	Does the RI fulfil the industrial orders in a satisfactory quality?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
4	Dos the RI dispose of permanent customers (share of SME)?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
5	Were there any **new business customers** achieved within the last 5 years?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
6	Has the RI successfully coordinated & mediated prob-lems between various industrial partners?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
7	Does the RI successfully produce innovation-support by services?	☐	☐	high →→→→→→→ low ☐☐☐☐☐
8	Is there any know how transfer carried out through staff transfer in businesses?	☐	☐	high →→→→→→→ low ☐☐☐☐☐

15 Profit Situation

No	Topic	%	Tendency
1	**Sources of funds of the RI**		
	• Basic funding (international/ national/ regional)		high →→→→→→→ low ☐☐☐☐☐
	• Special grants (international/ national/ regional)		high →→→→→→→ low ☐☐☐☐☐
	• Order from businesses, share of SME		high →→→→→→→ low ☐☐☐☐☐
	• Projects from industrial associated research		high →→→→→→→ low ☐☐☐☐☐

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