ERAWATCH COUNTRY REPORTS 2012: Tunisia

ERAWATCH Network

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Acknowledgements and further information:

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Executive Summary

Tunisia is a Northern African country. It is bordered by Algeria to the west, Libya to the southeast, and the Mediterranean Sea to the north and east. Its area is 163,610 square kilometres, with an estimated population of 10.7 million. Tunisia became the cradle of the 2011-12 "Arab spring".

The country has a diversified economy, ranging from agriculture and mining to manufacturing and tourism. In 2012 the GDP amounted to €35,12b (€81,6b purchasing power parity)[1]. The per capita GDP (PPP) reached €7,663 in 2012, which is one of the highest in Africa. The agricultural sector stands for 8% of the GDP, industry for 32% (including extractive industries like phosphate, petroleum and gas) and services for 60%.[2] The manufacturing sector is mainly made up of clothing and footwear, spare parts for the automotive industry and electric machinery. Although Tunisia achieved an average annual growth of 5% over the last decade, it continues to suffer from high unemployment especially among young people.

In 2011 Tunisia was ranked the most competitive economy in Africa and the 32nd in the world by the World Economic Forum.[3] Tunisia has managed to attract many international companies such as Airbus and Hewlett-Packard. GDP growth reached 2, 2% in 2012 after the difficulties of 2011, the year of the revolution, when GDP fell by 1.8%. The main engines of growth, namely tourism and the phosphate industry continue facing difficulties and this is the main cause of the weakness of the economic growth. Foreign owned enterprises continue to leave Tunisia; at least 200 European enterprises decided to leave Tunisia since January 2011.[4]

Crucial changes are expected now to support economic policies, aiming to broaden structural transformation, revising economic regulations and governance. Enhancing the regulatory environment and governance calls for eliminating obsolete rules and complex bureaucratic procedures, reducing controls on business and encouraging market competition.

Tunisia has an association agreement with the European Union and is a member of the Arab Maghreb Union, the Arab League and the African Union. The European Union remains Tunisia's main trading partner, currently accounting for about 75% of Tunisian exports and imports. Tunisia is one of the European Union's best established trading partners in the Mediterranean region, while it ranks 30th among EU's trading partners in the World. Tunisia was the first among Mediterranean countries to sign an Association Agreement with the European Union, in July 1995. It dismantled tariffs for industrial products in 2008 and therefore was the first Mediterranean country to enter in a free trade area with EU.

The building of an effective National System of Innovation became one of the leitmotivs of the governments' policy since the late 1990s. The Tunisian Innovation System is fairly centralised, with the national government playing the leading role in science and technology policy as well as in funding development and education initiatives. Tunisia's R&D intensity, at 0.71% of GDP in 2009[5], is high compared to

[1] WDI 2013
[2] WDI 2013
[3] The Africa Competitiveness Report 2011 © 2011 World Economic Forum, the World Bank and the African Development Bank
[4] Tunis Afrique Presse (TAP)
[5] Data to be published by the Bureau of Studies and Programming in the Ministry of Higher education and Scientific Research.

the other countries of the Middle East and Africa. The share of BERD in the national effort is estimated at 16% of GERD. Public research organisations and universities' research units are the main actors in the research system, absorbing more than 80% of government appropriations for R&D and performing 79% of R&D. The target of the government is to raise GERD to 1.5% of the GDP by the end of the development Plan (2016), of which nearly one third should be funded by the business sector. A significant feature of the national R&D system in the last five years was the high share of funding allocated to infrastructures: new equipment, buildings for new research centres and new centres of technological expertise in the techno parks. Funding from abroad, at 5% of GERD in 2009, quite low compared to other countries of the region, comes mainly from the EU Framework Programme for Research and Development and the bilateral cooperation programmes (principally France, Italy and Spain).

Human resources are a key challenge. A mere 36.9% of the population aged 18 to 24 attained tertiary educations in 2011.[6] In 2010 there were 4.16 FTE researchers per 1000 total employed and 12.8% of all university graduates have degrees in science and engineering (range of age 20-29).

Tunisia has a large number of research entities (33 research centres, 13 universities, 139 laboratories and 624 smaller research units), eight technical centres and a growing portfolio of techno parks (five in operation and three at the starting phase in 2012). The techno park of El Ghezala, specialised in information technologies, housed 90 companies employing about 1,900 staff by the end of 2012.[7] The national system includes also an institute for standards and intellectual property protection, a large programme for upgrading the equipment and the organisation of industrial firms as well as numerous public programmes subsidising investments in innovation.

The National Development Plans set the objectives of the research and innovation policies for a period of five years. Formally, policy planning and implementation are based on a rich network of policy design, implementation and advisory bodies as well as on evidence creation. However, efficient coordination of stakeholders in the overall process has not been achieved so far.

Scientific production is increasing significantly: with 2,584 published articles, Tunisia came close to double its output over the period 2006-2010[8]. This performance places Tunisia third in Africa after South Africa and Egypt and second among Arab countries; it is leading Africa in publications per million population. In 2012, the total number of patent applications in the US Patent Office was five (against two in 2006).[9] The most important barrier to R&D investment is the low technology profile of the SMEs dominating the economy with limited R&D investments and capabilities. However, recent R&D surveys have identified about 100 companies that seem to position themselves in high technology niches. The existing incentives have limited impact on the transfer of the research results to the private sector and on the creation of new businesses through the commercialisation of research results.

The level of training of human resources employed in R&D is another critical barrier: 40% of the researchers in FTE are second year Masters' students.[10] Moreover, the brain drain of Tunisian researchers reduces the availability of researchers in the national education and research systems. Finally, the lack of private funding for R&D

[6] http://www.mes.tn/francais/donnees_de_base/depliantfr11_12.pdf
[7] http://www.elgazala.tn/
[8] Source: Thomson Reuters Inc,
[9] http://www.uspto.gov/web/offices/ac/ido/oeip/taf/st_co_12.htm
[10] ISCED5A

and innovation, venture capital and business angel investments minimise the potential for research commercialisation.

Knowledge Triangle

	Recent policy changes	Assessment of strengths (+) and weaknesses (-)
Research policy	· Increased focus on research priorities (although the dominant pattern is still a broad range approach); · Creation of the High level Committee for Science and Technology in February 2010 chaired by the Prime Minister. Launch of the MOBIDOC/PASRI programme providing PhD students with a salary if the thesis is undertaken in a business context.	· (+) Increasing public funding, even in real terms; · (-) Current economic crisis increases the difficulties to reach the 1.5% target; · (-) Low level of R&D awareness and RTD capability in the private sector are not sufficiently addressed. · (+) Decree reorganising the creation of research entities in 2009.
Innovation policy	·Technology is, since 2010, under the responsibility of the Ministry of Industry. A new General Directorate of Technology was created for this purpose; ·Promoting Innovation in the industrial sectors is one of the principal components of the national upgrading programme; · The Promotion of the Investment Agency's new mission addresses also Innovation.	· (-) Limited R&D capabilities and absorptive capacities in the private sector, particularly in SMEs, can undermine the increase of BERD; · (-) Current policy instruments are complex and cumbersome for SMEs; · (-) Need to develop R&D capabilities and raise awareness on the benefits R&D and innovation in SMEs not sufficiently addressed. · (-) Need to develop creativity in schools; university teaching methods not sufficiently addressed
Education policy	· Reform of the Universities (framework law, August 2008); A national consultation was launched in June 2012 on the LMD system; · Increased government funds for education; · New universities and faculties, including "regional faculties"; · Expansion of the post-graduate courses in the universities; · Involvement of industry professionals in the educational processes.	· (+) The target for increasing the number of the S&E graduates is about to be achieved; · (-) Mismatch between the skills of university graduates and the needs of the labour market; · (-) High level of unemployment, particularly among the highly educated working population; · (-) Brain drain · (-) Absence of quality assurance mechanisms in higher education and research.
Other policies	· Promotion of economic sectors with high added value (ICT, services for the industry,) · Policy for renewable energy.	· (+) ICT is a highly growing area in the country with an annual increase of investment of 15,1% for the period 2007-2009; it has a potential to become one of the first priorities for demand-driven research; · (+) Megaprojects to improve solar energy production with the partnership of European countries like France and Germany. · (-) Other policies do not consider RTDI · (-) Lack of cooperation between research and business sector · (-) Lack of venture capital to support innovative business

Assessment of the national policies/measures

	Objectives	Main national policy changes over the last year	Assessment of strengths and weaknesses
1	Labour market for researchers	· Universities' mission to support students and graduates entering the job market; ·Increasing recruitment of researchers; · Improvement of the financial situation of researchers.	·(+) The recruitment of researchers increased significantly the last two years 2011 and 2012; most are PhD holders; ·(–) Relatively low salaries and unsatisfactory overall working conditions, accompanied recently by political instability, intensify brain-drain (particularly to Saudi Arabia, United Arab Emirates and Qatar) ·(+) Decision to increase substantially the researchers' salaries in the end of 2012
2	Research infrastructures	Investments in RIs increased over the past eight years, mainly for upgrading existing infrastructures as well as for setting up new ones in areas such as engineering, life sciences, renewable energy, nanotechnologies, ICT and health biotech.	·(–) The national system is lacking critical mass of researchers in fields like microelectronics and nanotechnologies ·(+) Emphasis was given on strengthening national infrastructures in areas of established competence (e.g. ICT, engineering, health) and building facilities for newly created centres.
3	Strengthening research institutions	Universities and research institutes were granted relatively more autonomy thanks to the amendment of the framework law of research (2006) and the law for the universities of 2008.	·(+) Progressive increase of the public budget for higher education and research over the past years. ·(–) Universities still need reinforcement. ·(+) Reconsideration of the requirements for organising research entities
4	Knowledge transfer	·Continuous support to university-industry R&D consortia. · Creation of the National Agency for the Promotion of Scientific Research to boost knowledge transfer; · Introduction of a Clusters initiative.	·(–) Linear approach, assuming that knowledge may be 'transferred' as such, instead of being shared and changed/ adapted through inter-action (systemic approach); ·(–) Valorisation units in the technical centres are not playing effectively their role. ·(+) Programme to create TT bureaus in the universities
5	International R&D cooperation with EU member states	· Agreement for scientific and technological cooperation between the European Union and the Government of Tunisia; · An assessment of the EU-Tunisia cooperation was made in 2012.	·(+) Structure for research and technological collaboration in scientific areas; ·(+) Other types of agreements are in force for scientific cooperation with individual European countries.
6	International R&D cooperation with non-EU countries	· Agreement for scientific and technological cooperation with India. · Agreement for scientific and technological cooperation with Pakistan.	·(-) Cooperation with North American and Far East countries is not significant; The total number of research projects with all these countries is still weak; ·(-) The type of agreement in force with all these countries is the same even if the goals are very different.

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1 INTRODUCTION

The main objective of the ERAWATCH International Analytical Country Reports 2012 is to characterise and assess the evolution of the national policy mixes of the 21 countries with which the EU has a Science and Technology Agreement. The reports focus on initiatives comparable to the ERA blocks (labour market for researchers; research infrastructures; strengthening research institutions; knowledge transfer; international cooperation). They include an analysis of national R&D investment targets, the efficiency and effectiveness of national policies and investments in R&D, the articulation between research, education and innovation as well as implementation and governance issues. Particular emphasis is given to international research cooperation in each country.

2 PERFORMANCE OF THE NATIONAL RESEARCH AND INNOVATION SYSTEM AND ASSESSMENT OF RECENT POLICY CHANGES

2.1 MAIN POLICY OBJECTIVES / PRIORITIES, SOCIAL AND GLOBAL CHALLENGES

The five-year National Development Plan contains a chapter dedicated to Scientific Research. The Plan is formally debated in the Parliament and is enforced by law. The purpose of the Plan is to establish a long-term vision of the economic policy but does not commit financial resources to the priorities or objectives. After its adoption the Plan is specified through annual programmes which provide also for research and technological development.

The goals of the current research policy are highlighted in the 11th National Development Plan (2007-2016). The governmental change has delayed any additional action; hence the goals remain the same. They address the following issues:

- Orientating the research activities towards national priorities and socio-economic needs and avoid further fragmentation of human and financial resources.

- Networking research entities to ensure the most efficient use of the available human resources and to promote interdisciplinary research addressing specific developmental issues.

- Allocating funds on a contract basis, introducing evaluation and increasing accountability to raise research efficiency and effectiveness and improve research management.

- Exploiting and valorising research results.

Additionally, the policy aims to increase and improve investments in knowledge and excellence, with the following means:

- Develop the national system of research and innovation, particularly by creating units and laboratories in research organisations and enhancing the mechanisms of follow-up, consultation and assessment;
- Reinforce relationships with the business environment, by establishing research and innovation units in enterprises, up-grading the role of technical centres as sectorial innovation partners, running the National Agency for the Promotion of Research and Innovation created in 2008, establishing sector-based networks, as well as pursuing the creation of techno parks and business incubators;
- Implement *Federated Research Programmes* (FRP) (section 2.3.3), particularly in the energy sector, agriculture, health, and manufacturing;
- Develop scientific information programmes by establishing a common research network and reinforcing linkages to international networks;
- Take advantage from Tunisian competence abroad by strengthening cooperation with Tunisian scholars living and working in foreign countries.

At the same time, the government's objective is to increase GERD to 1.5%[11] of GDP by 2016, of which nearly 30% would be funded by the business sector. The huge investments, compared to the national financial capabilities, allocated to the national R&D policy over the past few years, linked to the above target, were justified by increased expectations for positive impact on economic and social development. This rationale was stated in several documents, particularly in the last three (unpublished) annual reports of the Higher Council of Scientific Research and Technology (2006, 2007 and 2008), the national economic and social development programme and the recommendations report of the "National Days of Scientific Research and Technological Innovation proceedings" in 2007. All these documents anticipated that, in the new programming period (2012-16), most of R&D funding will be directed to specific priority sectors, crucial for the competitiveness of the economy and for specific national policies, in response to the major national challenges.

The identified priority areas are ICT, Agriculture, food and cereals culture; Biotechnology; Water Resources, Health and Energy. These priority areas are still quite broad and need to be specified further. Some of these priorities correspond to specific problems in Tunisia such as the lack of water resources, the increasing dependence on oil imports and the vertiginous rise of the foodstuffs' prices. Work to better focus priorities began in mid-2008 with two ad-hoc committees on Energy and Biotechnology. In 2012, the Ministry of Public Health introduced a project to define the research priorities with the help of experts from the World Health Organisation (WHO). All these thematic areas will be supported by mechanisms already in operation (section 2.3.3), including cooperation with third countries. At the same time they are constantly supported through the techno parks programme, which is following some of the thematic priorities (section 2.6.1):

- ICT: Elgazala and Sfax Techno parks
- Water, Energy, Plant Biotechnology: Borj Cedria Techno Park
- Health, Human and Animal Biotechnology: Sidi Thabet Technopark.

2.2 STRUCTURE OF THE NATIONAL RESEARCH AND INNOVATION SYSTEM AND ITS GOVERNANCE

Tunisia is a Northern African country. Its area is 163,610 square kilometres, with an estimated population of 10.705 million. The country has a diversified economy, ranging from agriculture and mining to manufacturing and tourism. In 2012 the GDP amounted €35.12b (€81,6b purchasing power parity)[12]. The per capita GDP (PPP) reached €7,667, which is one of the highest in Africa.

Tunisia's R&D intensity, at 0.71% of GDP in 2009,[13] is high compared to the other countries of the Middle East and Africa. The share of BERD in the national effort is estimated at 16% of the GERD. Public research organisations and universities' research units are the main actors in the research system, absorbing more than 80% of government appropriations for R&D and performing 79% of R&D. The target of the

[11] This figure was claimed by the former president Ben Ali in his last presidential campaign in 2009. The new government has not yet adopted a new target.
[12] WDI 2012
[13] Bureau of Studies and Planning in the MHESR. Document to be published
http://stats.uis.unesco.org/unesco/TableViewer/document.aspx?ReportId=3587&IF_Language=eng&BR_Country=7880&BR_Region=40525

government is to raise GERD to 1.5% of the GDP by 2016, of which nearly one third should be funded by the business sector.

A mere 36.9% of the population aged 18 to 24 attained tertiary educations in 2011.[14] In 2010 there are 4.16 FTE researchers per 1000 total employed and 12.8% of all university graduates have degrees in science and engineering (range of age 20-29).

Main actors and institutions in research governance

Tunisia's public research system encompasses most of the actor and institution types that operate in EU Member States. Established in 1997, the Higher Council for Scientific Research and Technology (HCSRT) is the highest official body, determining, directing and coordinating research and innovation policies. The HCSRT is headed by the Prime Minister and composed of other competent ministers, heads of relevant public and private bodies, universities and non-governmental organisations. The number of members and the duration of the mandate are not predetermined (at mid-2012 they amount 16). The Technical Committee of Scientific Research and Technology (TCSRT), created also in 1997, are affiliated to the MHESR, acts as an interministerial coordinator of various programmes and prepare the annual report to the HCSRT.

The National Advisory Council of Scientific Research and Technology (NCCSRT), created in 2002 are consulted particularly in selecting national priorities. The National Evaluation Committee of Scientific Research Activities (NECSRA or *CNEARS*, see section 2.5.2), created in 1997, is evaluating scientific research programmes, projects and results, public research organisations, laboratories and research units.

The policy makers turned their attention in particular to the effectiveness of the decision making process. This led to the establishment of the National Observatory of Science and Technology (NOST) and the National Agency for the Promotion of Research (NAPR) in 2006 and 2008 respectively. The two bodies are located in the MHESR but did not manage to play an effective role so far. The High Level Committee for Science and Technology (HLCST) was created in 2010, under the aegis of the Prime Minister, for the promotion of FDI in high technology sectors. The overall coordination of this system is based on the central role of the Prime Minister and not on inter-linkages among its components.

The Ministry of Development (MoD), in charge of the national Development Plan, is also an important factor in the design and implementation of research and innovation policies. Moreover, the Higher Education Council prepares and implements education and training policies and coordinates them with research and innovation policies. The Ministry of Finance (MoF) is actively involved in the formulation of policies and in policy implementation as the main funding source of the relevant programmes.

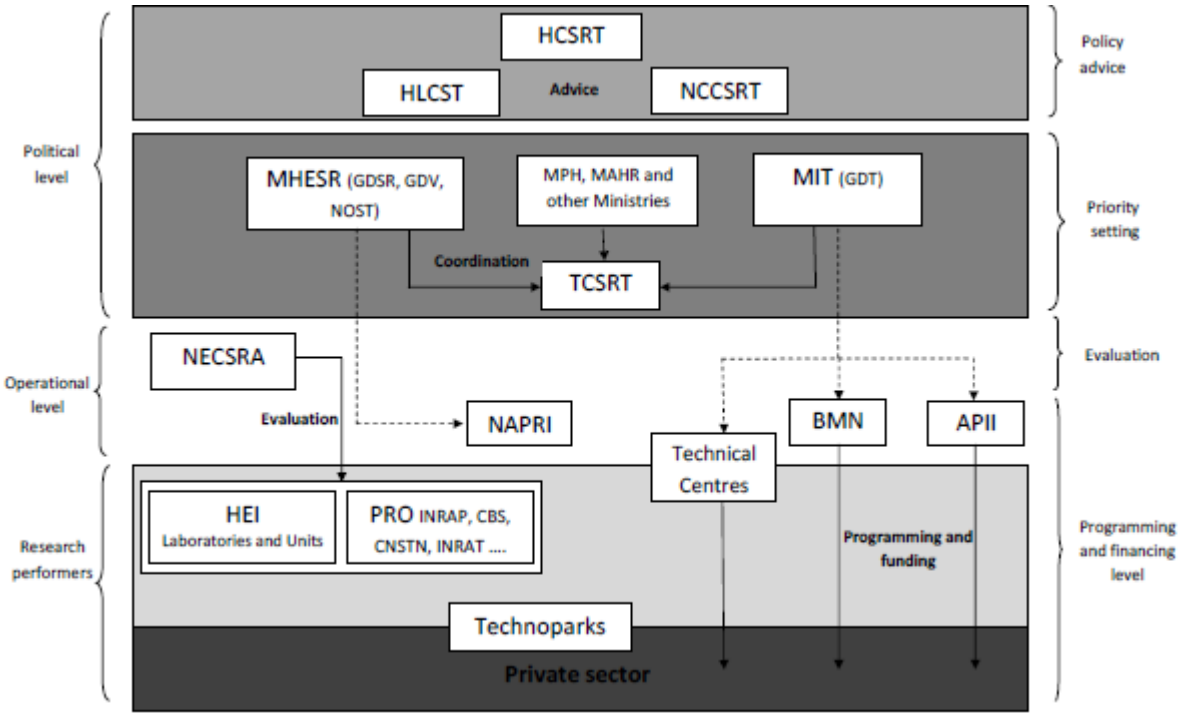
The Directorate-General of Technology of the Ministry of Industry and Technology (MIT), the Bureau of upgrading industrial programmes and the Directorate-General of Valorisation in the Ministry of Higher Education and Scientific Research (MHESR) are the main bodies implementing industrial R&D support programmes. All of them use government resources for stimulating R&D and innovation in private companies.

[14] *http://www.mes.tn/francais/donnees_de_base/depliantfr11_12.pdf*

The Directorate-General of Scientific Research in the MHESR has a dominant role in the creation and funding of new research entities (PROs, doctoral schools, laboratories, and units).

There are eight Technical Centres, affiliated to the MIT, each for a specific sector (Mechanics and Electronics, Leather and Shoes, Packaging, Building materials, Ceramic and Glass-making, Agro-food, Textile, Wood and Furniture, Chemistry). Most of them are in place since the early nineties. Their role is to supply R&D and innovation services to businesses, in particular SMEs.

Figure 2.1 Overview of the Tunisian research system governance structure



Source: compiled by the author.
HCSRT: Higher Council of Scientific Research and Technology ; HLCST: High Level Committee for Sciences and Technology ; NCCSRT: National Consultative Council of Scientific Research and Technology ; TCSRT: Technical Committee of Scientific Research and Technology ; MHESR: Ministry of Higher Education and Scientific Research; NOST: National observatory of Sciences and Technology; GDSR: General directorate of Scientific Research; GDV: General Directorate of Valorisation; MIT: Ministry of Industry and technology; GDT: General Directorate of Technology; MAHR: Ministry of Agriculture and Hydraulic Resources; MPH: Ministry of Public Health; NECSRA: National Evaluation Committee of Scientific Research Activities ; HEI: Higher Education Institutes; PRO: Public Research Organisations; NAPRI: National Agency of Promotion of research and Innovation; BMN: Bureau of "Mise à Niveau"; APII: ; Agency for the Promotion of Investments and Innovation.; INRAP: National Research Institute in Physical and Chemical Analysis; CBS: Centre of Biotechnology of Sfax ; CNSTS: National Technological and Nuclear Sciences Centre ; INRAT: National Institute of Research in Agriculture in Tunisia .
Note: The Technical Centres (TC) conduct research when they participate to NPRI even if it's not their primary role, and hence the dual role of TC is indicated by their position in the frontier between "Operational level" and "Research performers" in the figure. Components of Techno parks are: Public HEI, PRO, Centre of technological resources, and Private area for economic activities ... this is why they are placed in the frontier between "Private sector" and other "Research performers".

The National Institute for Standardisation and Industrial Property (INNORPI) is an autonomous body affiliated to the MIT, implementing industrial and intellectual property rights (IPR) policies and informing and guiding the public on IPR issues. INNORPI provides for the accreditation of organisations and laboratories enforcing national and international standards.

The National Metrology Agency (ANM), established as one of the institutes of the Ministry of Commerce and Crafts (MoCC), carries out scientific metrology, supplies services and infrastructures for measurement, training and consultancy, and disseminates information. The Union of Chambers of Commerce of Tunisia (UTICA) is an autonomous body representing the private sector in the process of research and innovation policy making and implementation.

The institutional role of regions in research governance

There are 24 regions ("Governorates") in Tunisia strongly depending on the central administration. There has been no regional approach on research and innovation policy making and there exist no S&T data at regional level. Nevertheless, there are four best performing university and research cities that create regional poles: Tunis, Sousse, Monastir and Sfax. Nearly 80% of the total number of public research and high education institutes are located in the costal side of the country, employing 80% of researchers. One can claim, until relevant data will be produced by the Ministry, that nearly the same percentage of the budget (80%) is invested in these same regions.

In the last few years, the government made an attempt to decentralise the higher education and research infrastructures. Consequently, new faculties have been established in inland cities as well as new universities in Jendouba, Gafsa and Kairouan (section 3.4.2). These actions, together with the national programme of techno parks, are expected to generate regional research policies in the future.

In addition, the Fund for the Promotion of Industrial Decentralisation (FOPRODI) is an instrument to promote zones of regional development.

Main research performer groups

In 2005, 50.8% of the GERD was performed by the Higher Education sector. The Government sector performed an additional 34.8%. Both shares were considerably higher than the EU average (22% and 13% respectively)[15]. More recent data show that in 2009 the cumulative share of these two sectors (higher education and government) decreased in four years from 85.6% to 80% of the GERD[16].

At present there are 13 universities in Tunisia, five of them in the capital city. The Universities of "Carthage" and "El Manar" in Tunis and Monastir are the largest and more successful universities in the country. There are also, 33 research centres. The National Technological and Nuclear Sciences Centre (*CNSTN*) and the National Research Institute in Physical and Chemical Analysis (*INRAP*) are the most important research centres in Tunis.[17] The Centre of Biotechnology of Sfax (CBS) is another leading research centre in Tunisia and Africa.[18]

The business enterprise sector accounted for 16% of GERD in Tunisia in 2009[19]. This share is considerably lower than the EU average of 64%, but it is continuously increasing. However, reaching the EU targets in the foreseeable future is rather unlikely, given the structure of the Tunisian economy.

[15] All higher education institutions performing research activities are public ones.
[16] Bureau of Studies and Planning in the MHESR. Document to be published
[17] The two research centers are located in Sidi Thabet's Techno Park in the north of Tunis.
[18] *http://www.cbs.rnrt.tn/en_accueil.php*
[19] Bureau of Studies and Planning in the MHESR. Document to be published

2.3 RESOURCE MOBILISATION

2.3.1 Financial resource provision for research activities (national and regional mechanisms)

As outlined in the strategic document "Tunisia in the future 2010", drafted in 1995, research and innovation (R&I) would sustain economic growth in areas with potential for creating added value in the Tunisian economy. Over the past fifteen years, this vision was translated into a significant boost of the resources committed to strengthening research infrastructures and human capacity building in science and technology.

Due to political changes RTDI data is not regularly gathered and the most recent data available are for 2009. R&D expenditure increased rapidly from €175m in 2005 at current prices to attain €231m in 2009, in view of the 1.5% target[20, 21]. BERD is estimated to have attained 16% in 2009 (see section 2.2 Main research performer groups). Funding from abroad is relatively weak (5%), thanks to bilateral cooperation programmes (mainly with EU, France, Italy and Spain) and international organisations such as the World Bank and the Arab Fund for Economic and Social Development. A mere 95% of foreign funds flows to public research entities.

The total government budget appropriations or outlays for R&D (GBAORD) increased by 300% from 2002 to 2009. Institutional funding is predominant compared to project funding, nearly 80% to 20%. Institutional funding to laboratories and units of higher education organisations and to public research centres is secured mainly by the MHESR. This budget mainly covers the salaries of the permanent staff and other running costs (65%); the remaining (35%) is allocated to investments. Project funding is channelled mainly through three schemes: National Programme for Research and Innovation (*NPRI*), Valorisation of Research Results (*VRR*), The Federative Research Programme (*FRP*). Collaboration among the participants is a prerequisite in most of these schemes. No new measures were introduced recently.

Funding is also channelled to research and innovation activities by the "Support Project to Scientific Research and Innovation" (known as PASRI), financed by the European Commission for an amount of €12m and managed by the national authorities. The overall objective of this project is to improve the contribution of research and innovation to growth and employment in Tunisia, by strengthening the link between scientific research and business. PASRI promotes the three following specific objectives:

- Strengthen the mechanisms governing the relationship between public and business research

- Expand the research community and its interfaces with the economic environment to promote greater synergy among the players

- Develop cooperation in projects designed to meet the sectorial priorities and business needs and promote innovative projects,

- Develop "networking" activities at national and international levels and strengthen the capacity of Tunisia to join the European research programmes.

[20] GERD in 'PPP$' is about USD1b, in 2009. GERD in 'PPP$' per capita reached 102$.
[21] Source: MHESR

The project will benefit ministries, research centres, universities, public and private enterprises and their representative bodies (UTICA), technology parks, clusters and technical centres, specialised agencies and support organisations (ANPREV, APII, INNORPI, SAGES .), venture capital companies (seed capital and pre-seed) etc.

Targeted or thematic funding, representing approximately 1% of GBAORD, is provided by the MHESR in the form of R&D programmes focusing on predefined areas. As indicated above (section 2.1), a significant feature of the national R&D system in the last five years is the high share of funding allocated to infrastructures: new Techno parks, buildings for new research entities and access to international scientific information centres and databases.

All economic and social actors consider the 11th Plan (section 2.1) as a step towards the effective integration of the country in the global economy before the end of the current decade. Human resources are considered of primary importance to guarantee the establishment of a knowledge-based economy, in conformance to the announced objectives. The main goals of the research policy as to the human resources provide for mechanisms of assessment/evaluation, reinforcement of the relations with the business environment, creation of S&T information programmes and taking advantage from the Tunisian competence abroad.

Table 2.1 Investments allocated to the research sector during the 11th Plan (2007-2011) by type of project

Investments (in €m)		Main projects
Investment under the supervision of Higher Education and Scientific Research	140.4	Research organisations
		Federated research programmes
		Technological innovation
		Scientific information
		Competence development
		Infrastructure
		Scientific equipment
		Academic research
Sector-based research programmes	150.5	Agriculture
		Health
		ICT
Technological parks	70,1	Parks: Borj Cedria, Sousse, Sfax, Elghazala and new ones
		Development and studies of parks

Source: Economic and Social Development in Tunisia (2007-2011): toward a higher stage of Growth. Project Data sheets. Ministry of Development and International Cooperation. Republic of Tunisia

The main national thematic priorities, as already stated, are ICT, Agriculture, Food and Cereals, Biotechnology; Water Resources; Health and Energy. These priority areas are still quite broad and have to be further specified. They reflect the need to tackle specific problems, such as the scarcity of water resources, the dependence on oil imports and the sharp increase in wheat prices on the international market.

Work to identify more focused priorities began in the mid 2008 with two ad-hoc commissions on Energy and Biotechnology. In the same year, the Ministry of Public Health introduced a project to define the priorities of this sector with the help of experts from the WHO (World Health Organisation) (see section 2.1). Mechanisms to support all these thematic areas are already in place and described in section 2.3.3. There are no specific priorities at regional level, as mentioned in section 2.2. Incentives are offered in the form of direct grants, while tax allowances are not considered in the policy mix. Similarly, there is no focus on activities aiming to build mutual trust between science and society.

2.3.2 Providing qualified human resources

Education absorbs 20% of Tunisia's State budget (7% of GDP). A mere 36.9% of the population aged 18 to 24 had attained tertiary education in 2011 and about one third of the total number of students is enrolled in S&E fields. Their number more than doubled in the last decade. A 12.8% of all university graduates have degrees in science and engineering (age 20-29). These figures slightly converge to the EU averages. The government's ambition is to accelerate the rate of "production" of scientists and engineers in the years to come. However, a key issue to address is the quality of the educational process.

In 2010, there were 4.16 researchers per 1000 total employment. However, only 10% of the FTE 13,300 researchers were employed on a full time basis and nearly 900 researchers were employed in private firms (section 3.1.1). This confirms the dominance of Higher Education in scientific research (section 2.2).

Management procedures in universities and engineering schools are in practice over-centralised, reducing the flexibility university managers need to take informed and quick decisions (see section 3.3.2). In 2004, the government launched a reform to enhance the autonomy of universities and adopt the LMD system (Licence-Master-Doctorate of the Bologna Process). This reform was implemented gradually since 2007. The post revolution government decided in 2012 to conduct a revision of this reform suggesting that it was not successful. The process of revision will be managed by sectorial committees composed by faculty members named by the minister himself.

The 2008 law states that universities shall be able to compete for private funds, both through contract research and fees. It seeks also to combine learning in universities and vocational training centres in enterprises as well as to increase the time allocated to IT, entrepreneurship and English learning. These reforms respond to identified needs but effective implementation will be of critical importance.

A greater flexibility of the labour market is needed to enhance the mobility of talent across sectors and with firms and increase the visibility of research jobs. The labour regulation provides for the employers to have full flexibility in hiring; but firing after four years of service becomes complex and lengthy. In principle, this is a barrier to labour mobility since talents risk to be trapped in stagnant sectors creating shortages in the dynamic ones. However, labour market surveys suggest that the rigidity in firing laws is short-cut by offering short-term employment and sometimes informal jobs. Furthermore, the structure of the pension system does not allow the transfer of pension contributions from one fund to the other, hampering mobility.

There are no identified shortages in graduates of any disciplines.

Although various decisions on restructuring the national education refer to aspects such as creativity, critical thinking, problem solving, teamwork, and communication skills, delivery mechanisms for effective implementation are not put in place so far. Neither is there related appropriate training of teachers and an organised lifelong learning activity.

2.3.3 Evolution towards the national R&D&I targets

The RTDI policy is currently supported by direct public funds in the form of institutional funding, and to a lesser extent of project funding. As already mentioned, the objective of GERD at 1.5% of GDP by 2016 is accompanied by the requirement that nearly one third would be funded by the business sector (see section 2.1). The share of BERD is slowly increasing, reaching 16% of GERD in 2009[22] from 11% in 2004. BERD as a percentage of GDP also increased, reaching 0.11% in 2009[23] from nearly 0.08% in 2002. In terms of absolute value, business expenditure tripled from €22m in 2002 to approximately €37m in 2009.[24]

There are four main instruments used to support business research activities, which were developed at the end of the 20th century and continue. There are no recent initiatives:

- The Premium for Investment in R&D (*PIRD*) is a competitive grant instrument, addressing firms, aiming to co finance R&D projects. Half a million euros are allocated each year to this instrument by the Ministry of Industry and Technology. Four to five firms benefit from these grants annually;

- The National Programme for Research and Innovation (*NPRI*) is a competitive grant scheme addressing firms, aiming at identifying technological needs or support innovation development with the help of the corresponding sectorial technical centres. Research organisations are supported for finding specific solutions to company problems. Half a million euro are allocated each year to this instrument by the Ministry of Industry and Technology;

- The Valorisation of Research Results (*VRR*) is a competitive grant instrument used by researchers to exploit commercially their research results. For this purpose, they need to involve an industrial partner interested in the project and able to implement the idea. So far, there has been no industry prioritisation. Half a million euros are allocated each year to this instrument by the MHESR. Four to five projects benefit from this grant annually;

- The Federative Research Programme (*FRP*), is the most important competitive grant scheme for research priority themes which are generally implemented by multidisciplinary teams involving all types of actors (researchers, public or private firms, NGOs etc.). FRP projects are covered by public funds at 100% of the cost. The MHESR allocates more than one million euro to this programme annually. More than 100 research teams and more than 50 economic or social entities participated in the programme since its launch in 2003.

The opening up of PIRD, probably the most important industrial scheme, to RDI investments is a promising decision for anchoring these types of activities in the business behaviour of Tunisian SMEs. The initiative is too recent (mid 2010) to be evaluated. The aim of this programme, started in 1998, is to improve the international competitiveness of Tunisian firms.

Young Tunisian entrepreneurs and university graduates can benefit from the Regime for Innovation in Information Technology (RITI), designed to encourage the creation

[22] Bureau of Studies and Planning in the MHESR. Document to be published
[23] Author's estimation from BIRD and GDP of Tunisia in the same year
[24] Author's calculation from the values of the in 2004 and BIRD estimation for 2009

of innovative companies in the ICT field. The instrument provides for funding new projects as well as growth projects with a maximum cost of €250,000 including net fixed assets. Participation of RITI funding can reach 49% of the project total budget, with a ceiling of €60,000. The minimum contribution of the promoter is fixed to 2% of the budget[25], probably to be adapted to the capacity of young potential participants.

Industrial enterprises and business services, active for at least two years, can participate to the "Investment technologically priority" (ITP) scheme of FODEC (Industrial Competitiveness Development Fund). Investments eligible for financing through FODEC are classified in two categories: (1) Material (tangible) investment (design equipment: CAD R&D equipment Laboratory and control equipment DTP, CAM) and (2) Immaterial investment (technical assistance, implementation of quality assurance and certification system: ISO, HACCP, etc. and software relative to computer assisted design, control and laboratory equipment of information technologies). Grants for material investments, in priority technology, may reach 50% of the cost, with an aid ceiling of €50,000 by enterprise, renewable every five years; for intangible investments the corresponding shares are 70% of the cost, with an aid ceiling of €35,000 by enterprise, renewable every five years.[26] All the support mechanisms and R&D policy measures apply horizontally to all types of organisations.

The government does not use public procurement for supporting new technology development and innovation.

The uptake of the grant schemes and R&I measures is highly contingent to the culture for innovation in the business sector, dominated by the structure of the productive sector[27] and of the general business culture; companies do not apply to the incentive schemes as expected. In addition, delays in the creation of incubators and technology parks undermine the confidence of the business managers. Moreover, the limited access of R&D companies to bank loans, due to rather insufficient interest of the banking sector in risky R&D ventures, as well as weak coordination mechanisms further worsen the situation.

In the middle of the national economic crisis inherent to the "Jasmine revolt" and the international crisis, companies are constraint by the lack of own funds and often perceive innovation as an additional high operating cost activity. This is especially the case of SMEs that tend to adopt low risk strategies. The government is seeking to simplify administrative procedures for start-up firms and for running businesses, establishing a "one stop shop" in each regional APII office.[28] However, there are delays in implementing the aid schemes generally related to:

- Limited capacity of the beneficiaries to provide co-funding,
- Bureaucracy affecting access to finance,
- Inexperience of some project managers in the management of public funding.

Venture capital is a fairly new concept in Tunisia. Nevertheless there are more than 30 such companies, mainly affiliates of banks. An internal survey of the former Ministry of Scientific Research, Technology and Development of Competencies (MSRTDC) in 2005 revealed that less than 20 % of the financing of these institutions

[25] http://www.eriti.mincom.tn/index.php?id=100&no_cache=1 *for more information*
[26] http://www.tunisieindustrie.nat.tn/en/doc.asp?docid=552&mcat=12&mrub=93
[27] Services:60%, industry: 24% and agriculture: 16%
[28] http://www.tunisieindustrie.nat.tn/en/doc.asp?mcat=13&mrub=96

was allocated to innovative projects. There is also one "business angel" operating with very limited impact.

In a nutshell, the policy mix can be described as based on increased public R&D funding with efforts to creating new technology based firms in the technology parks and stimulating greater R&D investment in R&D performing firms.

2.4 KNOWLEDGE DEMAND

Tunisia was already an attractive site for foreign investors. Net FDI inflows reached 3% of GDP in the period 2000-2007, against a regional average of 2.1%. ST-Microelectronics, LG Electronics and Kromberg & Schubert set up in Tunisia each an R&D centre since 2006. However, more than 50% of FDI inflows to Tunisia are channelled to the energy sector while FDI inflows into manufacturing go predominantly to low value-added textile and clothing, mechanical and electrical sectors. Furthermore, foreign investment is not linked to the rest of the indigenous economy and does not enrich the value chain in the country. In these circumstances, technological spill over potential is limited.[29]

In Tunisia, there are a handful of “big” players (as in most countries) and two hundred small investors in R&D. The largest public company in the country producing phosphates and derivatives financed approximately 5% of the BERD in 2007.[30] Very few multinational companies are involved in R&D. The leading multinational company financed 8% of the BERD in 2007 (latest available year).

As regards economic specialisation, the sector responsible for the highest share of Tunisia’s research expenditures in 2007 was manufacturing (39.3% of total BERD), with emphasis on agro-food, textile, electric and electronic and chemical industries. Business services sector ranked second, with some 18.8% of BERD in 2007. A significant contribution to the BERD came from the extractive industries sector,[31] with 18.5% and Communication sector (14.3%). In general, nearly two thirds of BERD were accounted by the industrial (manufacturing and extractive) sector and one third by the services sector (mainly ICT).

2.5 KNOWLEDGE PRODUCTION

2.5.1 Quality and excellence of knowledge production

Scientific production of Tunisian researchers is significantly increasing. According to Thomson Reuters Inc., the percentage of Tunisian publications in its database increased from 0.15% in 2006 to 0.22% in 2010. By reaching 2,584 published articles, Tunisia came close to double its output over the period 2006-2010.[32]

Today in the Arab world, only Egypt, with a population eight times larger, exceeds Tunisia in the number of publications. It should be mentioned that during the past

[29] R. Baccouche, J. Bouiyour, H. Mhenni and S. Moulay (2008) «Investments Dynamic, sectoral mutations and capital account convertibility: impacts of the liberalization measures and Tunisia-Morocco comparative experiences ». Report for the European Commission (FEMISE).
[30] Tunisia is one of the world's largest producers of phosphate.
[31] Tunisia produces the third of its oil needs and more than two third of its gas needs.
[32] Knowledge, Networks and Nations: Global scientific collaboration in the 21st century, Royal Society, March 2011.

decade, Tunisia outreached Morocco and Algeria (countries with three times more inhabitants each). The impact factor is high in genetics and molecular biology and is increasing significantly in chemistry, clinical medicine and engineering (Thomson Reuters Inc.).

These data are confirmed by the last NSF report (June 2012) like shown by the table 2.2.

Table 2.2 Number of publications

Country	1995	2000	2005	2009
Algeria	146,3	211,3	350,3	606,5
Egypt	1387,8	1432,8	1658,2	2247,3
Morocco	239,8	466,1	443,2	390,7
Tunisia	**143,0**	**292,3**	**571,3**	**1022,4**
Saudi Arabia	753,2	590	576,3	710,2
South Africa	2350,7	2220,7	2395,4	2863,6

Source: NSF report 2012

The larger share of publications of Tunisian researchers is in engineering, medicine and chemistry. The H Index is 80 and the number of citations per document is 6.65 for the period 1996-2011. The world share of Tunisian publications increased from 0.04% in 1996 to 0, 21% in 2011.[33] Out of the 4,597 publications (Scimago data base) issued by Tunisian scientists in 2011, nearly 44.08% was co-authored by scientists outside Tunisia.[34]

Performance in terms of patent applications and exploitation of research results by firms are limited despite relative improvements recently achieved. In 2012, the number of patent application was 5 in the US Patent Office (which is the best performance since 2006). The data published recently by the US Patent Office showed that Tunisia registered 16 patents before 1998 and 17 since that year.[35]

Table 2.3 Number of patents in the USPTO

Date	Before 1998	1998-2005	2006	2007	2008	2009	2010	2011	2012
Tunisia	**16**	**3**	**2**	**0**	**2**	**0**	**2**	**3**	**5**
Algeria	9	2	1	0	0	0	1	0	0
Egypt	56	39	4	12	2	3	16	21	28
Morocco	54	8	3	1	4	1	1	3	2

Source: Utility Patents by Country, State, and Year (December 2012). U.S. PATENT and TRADEMARK OFFICE

2.5.2 Policy aiming at improving the quality and excellence of knowledge production

Tunisia has tried to strengthen the governance of research activities (mainly in project funding) since 1996, by creating a national evaluation entity, the National Evaluation Committee of Scientific Research Activities (*CNEARS*, see section 2.2). CNEARS is responsible for the evaluation of scientific research programmes, projects and results. It also evaluates the public research organisations and research

[33] http://www.scimagojr.com/countrysearch.php?area=0&country=TN&w
[34] http://www.scimagojr.com/countrysearch.php?country=TN
[35] http://www.uspto.gov/web/offices/ac/ido/oeip/taf/reports.htm

programmes of private companies that benefit from State support and incentives, in order to promote scientific research and technological development.

CNEARS has full scientific autonomy to ensure impartiality. It guarantees the strict implementation of procedures and the application of the ethical rules that govern peer evaluation. The evaluations organised by CNEARS are based on the following criteria:

- Achievement of pre-defined objectives,

- Number of diplomas (PhD, "habitations", and advancements) received by the members of the research team (scientific background),

- Number of publications (national and international)

- Awards (national and international),

- Number of patents (domestic and international),

- Participation to international cooperation projects,

- Participation to studies funded by international organisations (World Bank, IMF, FAO, UNESCO),

- Participation to national R&D programmes,

- Number of partnership agreements with businesses.

2.6 KNOWLEDGE CIRCULATION

2.6.1 Knowledge circulation between the universities, PROs and business sectors

Re-enforcing collaboration between universities, public research organisations and industry is one of the priorities of increasing importance identified in the National Development Plan. This is shown by the rise of relevant measures and the higher level of funds allocated to support collaborative research.

The strategy for inter-sectorial collaboration runs along three axes. The first is a problem-driven top-down approach where specific research projects are funded in topics of national importance (the FRP scheme is responding to this challenge). The exploitation of the research results, as the second strategic issue, is supported by the VRR scheme, which provides funding for projects aiming at valorising research results. The third component of the strategy supports the emergence of clusters in order to encourage research and innovation activity in industry through the Techno park programme. The creation of Techno parks is the largest and the most ambitious S&T programme ever launched in Tunisia. It aims at establishing an appropriate environment for the transfer of research results to industry and the diffusion of technological know-how. Some corrective interventions have been introduced at the governance level to overcome the difficulties encountered in the first three years of implementation (2003-2006), because, among other, of (a) the lack of working experience and (b) the dependence on the MHESR for project management of technology and innovation activities.

In August 2007, decisions taken to enhance the governance and the structures of Techno parks led to setting up management and exploitation companies. The participation of banks and other public or private organisations is expected to

facilitate the identification of business opportunities and raising the awareness for investors. These companies play the role of a single liaison office supplying services to firms willing to locate in the parks.

The selection of specialisation fields for Techno parks (see section 2.1) took into account the economic specificity of each region and the national agenda, as follows:

- Strengthening of strategic industrial sectors (textiles, food processing, mechanics and electronic),
- Development of service sectors (ICT),
- Support sustainable development (water, energy, environment),
- Fostering activities related to agriculture and health.

Although there is no formal evaluation the first Techno park has already 90 tenants and is considered to be successful and meeting its objectives.

Inter-sectorial mobility is encouraged by fixed-term placements of academic researchers in industry, as well as by the mobility programme of researchers (see section 3.4.2) allowing researchers from the public sector to create their own business firm.

2.7 OVERALL ASSESSMENT

Even though the Tunisian National Research and Innovation System are considered as one of the best structured and effective in North Africa, considerable weaknesses remain. Some challenges persist, particularly those related to enhancing the demand for new knowledge, and improving coordination, excellence and "return on investment". Although there is limited evidence and evaluation data, in the last years the general feeling can be summarised as follows:

- Lack of continuity of the STI policy governance structures that have been frequently reorganised to adapt to international good practices;

- Lack of involvement of the stakeholders and citizens in general in the identification of the key societal challenges to be addressed by the research policy, while the dominant pattern remains a broad range approach;

- The formal coordination mechanisms are probably not sufficiently effective;

- The centralised, top-down nature of the Tunisian policy system, which offers strengths in ensuring coordination, can create difficulties in accessibility by potential users;

- The mobility programme of researchers allows researchers from the public sector to create their own business firms. Nevertheless, Tunisia has relatively few demand-side incentives;

- Practices for research exploitation are rather ineffective;

- The business interest for RTD funding opportunities for SMEs is still low, due to structural features of the economy.

3 NATIONAL POLICIES FOR R&D&I

3.1 LABOUR MARKET FOR RESEARCHERS

3.1.1 Stocks of researchers

Tunisia, compared to countries of similar development level, has a relatively high stock of research personnel with nearly 28,274 researchers (in headcounts HC) equivalent to 13,300 researchers (in full time equivalent FTE) and 4, 16 researchers (in FTE) per 1,000 active populations in 2010 (not very far from the EU27 average). The vast majority of researchers are employed in the higher education sector (90% in HC) (see section 2.3.2).

Trends indicate that the population of doctoral students is increasing; this may be an important factor contributing to raise the researcher stock in the HE, but not in the business sector. Statistics released by the MHESR indicate that the number of PhD students reached 8,178 in 2011[36] not including 11,198 in medicine, pharmacy and veterinary. Some 959 graduates (plus 1,454 in medicine, pharmacy and veterinary) were awarded their PhDs in 2011. A mere 1000 students returned to Tunisia with a foreign masters' or doctoral degree in the same year and 500 with an engineering degree.

There are no reliable data on the balance of inward and outward flows of researchers. Higher education statistics indicate that Tunisia has more outgoing students (10,411 students in 2009) than incoming (4,740 foreign students in 2010). This is only a vague proxy to researchers' mobility. Foreign students mainly come from countries such as Mauritania, Morocco, Palestine, Oman and many African countries. Half of them are enrolled in private HEIs like the Private University of Tunis, the Central Private University and Ibn Khaldoun Private University. Foreign students represent nearly 30% of the total number of students in the private educational organisations and less than 1% of the public universities[37].

3.1.2 Providing attractive employment and working conditions

The annual wages of university professors and researchers were well below the EU27 average both in nominal (€12,500 vs. €37,948) and in PPS terms (€24,450 vs. €40,126) in 2011. But in December 2012 negotiations between university professors and researchers and the MHESR led to an agreement stipulating an increase of about 40% of the salaries divided into three years. The A professor's salary amounts the double of the average earnings of civil servants with a tertiary education degree[38]. Competition among candidates in the initial selection process is quite strong, particularly in the universities of Tunis. Promotion is dependent on scientific performance. At the same time, tenure is guaranteed by law while the academic staffs are not subject to open selection promotion processes[39].

[36] The total number of students in Tunisia in 2011 is 339,619 and 61.6% of them are female.
[37] MHESR
[38] Own estimations
[39] I.e. A PhD student could become Assistant and then never finish his thesis while serving for life

The law determines the salaries of the professional staff in the public research sector, according to position in the academic ladder. Researchers may raise additional income from various projects or scholarship schemes with no ceiling enforced by the university or the Ministry. There are no readily available figures to assess the relative weight of these sources of income. In general, however, researchers employed in the public institutions are modestly paid (for example half the salary of an equivalent researcher in Morocco or Algeria), and therefore (i) salary is not a key motivating factor for a scientific career; (ii) Earning additional income from research and/or consultancy projects is necessary for living decently.

As already mentioned, foreign researchers (academic staff) employed in Tunisia accounts for about 1.5% of the total number of researchers. Most of them are coming from Arab, East European and African countries, where overall working conditions and earnings are roughly at the same level or slightly less favourable to Tunisia. Regulation does not allow flexibility in wages paid by PROs.

As already indicated brain drain is a serious issue.

There are no specific provisions for female researchers. Gender quotas have been discussed in various occasions in order to reduce the gap between men and women in various professions and bodies, but are not yet introduced. Nowadays the gap is diminishing (47.7% of researchers are female, while in fields such as literature, law, biology and management they are the majority). The general provisions of the Labour Code safeguard the restoration of the employee at the same position after maternity leave.

In sum, relatively low salaries and unsatisfactory overall working conditions, accompanied recently by political instability, accelerate brain-drain and professional shift to other, more attractive sectors in Tunisia.

3.1.3 Open recruitment and portability of grants

There are no legal barriers for recruiting foreign researchers for both permanent and temporary positions in the Tunisian universities. Teaching is given in Arabic,[40] French and in two organisations in English. Invited foreign professors teach generally in English if they are not from a French speaking country. However, employing researchers in public organisations and in the private sector is hampered by the bureaucratic and time-consuming regulations regarding the employment of foreigners.

The granting of equivalence/validation to foreign academic degrees is regulated by the Law on Higher Education.

There are no specific targets or measures in the national S&T strategy for opening up the national market to researchers from third countries. In principle, there is no international advertising of research vacancies, unless there is a specific reason to employ foreign researchers. Moreover, there are no provisions allowing the transfer of research grants by researchers from one organisation to another in the country or abroad.

[40] Mainly in Social Sciences and Humanities

3.1.4 Enhancing the training, skills and experience of researchers

The number of students in master's and doctorate has increased considerably in recent years. They were 44,472 master's students in 2010, 46,738 in 2011 and 56,536 in 2012. The implementation of the LMD system at the same time has led to an increase in the demand for masters and PhD training. To meet this demand academic organisations have increased their offers in the master degree. In 2011, the number of Masters granted reached 419 while they were only 225 a year before.

Since November 2004, the Ministry of Scientific Research and Technology, was entrusted a new remit in the development of competencies and skills. This new orientation was split in two parallel and complementary actions: the development of local competencies and the attraction of Tunisian experts living abroad. These actions were further detailed as follows:

1- Reinforcing the training of Tunisian researchers:

- Creation of doctoral schools, based on researcher excellence groups (including PhD students) working on complementary and coherent doctoral courses or on national S&T priority themes.

- Introduction of a scheme granting post-doctoral scholarships in foreign organisations to implement research activity for a period of six to ten months.

- Implementation of a training programme for enhancing scientific competencies according to the needs of research units of different techno parks in the country. Within this framework, it was decided to train 30 researchers in Japan in the fields of biotechnology, renewable energies, water and the environment for the three research centres of the Borj Cedria Techno Park.

- Diffusing the concepts of intellectual property protection and patenting through the organisation of training courses and workshops.

- Organising training sessions and workshops for young researchers on scientific writing techniques, especially in English, creation of innovative companies and patenting.

- Organising a training programme for higher education graduates addressing the maintenance of scientific equipment.

- Encouraging the implementation of graduation projects within industrial companies

- Implementing an action plan for skills development within industrial companies.

In 2003 the MHESR launched a programme of cooperation with Tunisian experts living abroad which financed their research activity in Tunisian host organisations for a period of one to six months to establish joint research programmes. The grants are awarded on the basis of a yearly call for proposals. In 2005 the Ministry of Scientific Research, Technology and Development of Competencies[41] created a database of Tunisian scientific and technical experts from abroad (researchers, university teachers, doctors, engineers…), in collaboration with other Ministries and the Office of Tunisians Abroad. Tunisian experts living abroad participated in preliminary

[41] In August 2005 the Ministry of Scientific research, Technology and Development of competencies was created. This Ministry disappeared in January 2007 and the SRT department returned to the Ministry of Higher Education

studies related to important national projects, such as techno parks, in the creation of new research centres and the evaluation of Federative Research Projects.

The programme to attract Tunisian experts living abroad is based on:

- Setting up a network of Tunisian experts abroad and linking their research entities in the countries of residence to their Tunisian counterparts.
- Implementing new incentives for enhancing the contribution of Tunisian experts abroad to the national research and innovation system and developing scientific partnerships between foreign and Tunisian institutions.
- Creating international associated laboratories.
- Motivating Tunisian experts abroad to contribute in training of trainers, to co-supervise doctoral theses and evaluate laboratories and research units for the development of local scientific expertise.
- Encouraging Tunisian scientists from abroad to create innovative companies within different techno parks.
- Implementing a programme for granting national post-doctoral scholarships to young Tunisian or non-Tunisian researchers abroad, allowing them to participate in research projects within research organisations in Tunisia.
- Establishing a partnership between the competent Tunisian Ministry for research and technology and Tunisian scientific associations abroad, by supporting them financially and by encouraging them to contribute to the development of the country; and the empowerment of local Tunisian researchers as well as participating in annual meetings in Tunisia.

This programme of attracting Tunisian researchers living abroad was considered relatively successful in the early years of its launch. Thirty researchers were invited every year. Administrative restrictions were introduced in 2005. They were of two types: (a) the activity periods should not coincide with the summer holidays and (b) the local research laboratories and units had limited possibilities to purchase certain types of equipment. These decisions led to a substantial decrease in the number of applications that reach today hardly four or five per year.

In December 2012, the MHESR decided to organise the "National symposium on the Integration of Tunisian competencies residing abroad" in February 2013. Due to political instability in that month, the symposium was postponed to mid-August 2013.

3.2 RESEARCH INFRASTRUCTURES

The National Development Plan 2007-2016 published in 2006 (see sections 2.1, 2.3.1) is a guide for a) the areas of specialisation and b) the roadmap for building national research infrastructures (RIs). Investments allocated for the research sector during the 11th Plan amount to approximately €360m (TND680m), as presented in table 2.1. The tangible research investments are based on the rationale that Tunisia needs to strengthen its existing research base and build capacity in new areas of strategic importance in order to participate in activities and programmes at international level.

Research infrastructure is associated with the creation/development of research centres. During the 11th planning period, many research centres have been renovated while some new ones were built. This was the case of the four research centres in Borj Cedria Techno park in the areas of water, energy, biotechnology and materials. In the

same site were built a new Centre of Technological Resources, a business incubator and a Platform for technological resources. In the techno park of Sousse were built a Microelectronics and nanotechnology research centre, an incubator and a Technology Resource Centre. In Sfax, the construction of the new Centre for Research in multimedia computing and digital data processing is quite advanced.

There are no plans for building new research facilities or for participating to joint research infrastructures in cooperation with other countries.

3.3 STRENGTHENING RESEARCH INSTITUTIONS

3.3.1 Quality of National Higher Education System

The higher education sector in Tunisia consists of 13 state universities which include some 195 units of education and research and 24 Higher Institutes of Technological Studies (ISET). Among them 165 are under the supervision of the MHESR, and 30 under the joint supervision of the MHESR and other Ministries (Health; Communication Technologies, Agriculture and Water Resources, Social Affairs, etc.).

There are no private universities but a number of private institutes offering higher degree programmes (at Bachelors' and Masters' levels)[42] with accreditation from foreign universities. There are 44 private organisations of higher education, three of which are dominating: "Université Libre de Tunis", "Université Centrale" and "ESPRIT" with a little more than 1,000 students each. The total population of students in the private institutions of higher education is 17,773 which represent 5.23% of the total number of students (339, 619 students).

The enrolment at the universities follows a competitive process based on results from secondary education graduation and on scores set at the "Baccalaureat" (a country wide examination on multiple subjects at the end of secondary education).

In the academic year 2011/12 higher education employed 22,410 teaching staff (from 10,293 in 2001), 10,579 of them female. Only 8.47% of the teaching staff is accredited to supervise research activities.[43] “Carthage” in Tunis, the biggest state university, represents nearly 15% of the total students' population in the public higher education organisations.

The number of graduates in the academic year 2011/12 reached 74,133 (including postgraduates). The distribution of graduates by field shows the dominance of business administration and computer sciences and communication.

The Higher Education Budget grew rapidly from €45.5m in 1980 to €380m in 2005 (TND45.5m and TND651.16m respectively) and reached €618m in 2012 (TND1237m) which represent slightly less than 2% of the GDP and 4.9% of government budget, confirming the government's effort to invest in human capital.

The Law on Higher Education regulates uniformly the establishment and operation of universities supervised by the MHESR. Traditionally, the Tunisian HE focussed more on teaching than on research. Apart from a few large and prestigious universities, which carry out the bulk of HERD, the large majority of smaller universities and colleges (especially in the countryside) have negligible R&D activities. Nowadays, the

[42] No PhD diploma is delivered by any of the private institutes of higher education.
[43] Only full professor, "Maitre de Conferences" and "Maitre-Assistants habilités" are habilitated to supervise research for Masters and PhD students.

mission statements of the larger universities stress the importance of both multidisciplinary education and R&D of high quality according to international standards. Teaching time and research output, in terms of publications, are both increasing over time. Nevertheless, none of the Tunisian universities are listed among the most prestigious ones in the known ranking systems of Shanghai HE index and Times Higher Education Supplement (THES). This absence is subject to comments at both the national press and at the MHESR, which is considering measures to improve the current rankings.

As a matter of fact, the sector of public higher education is facing quality problems. A mere 99% of the current expenditure of the Government in public universities is based on a centralised and rigid budget line. The rest comes from students' tuition fees and is generally used for current expenses[44]. The predominance of that traditional practice of funding did not encourage the improvement of the academic quality, increasing efficiency and adjusting curricula to government priorities.

A major objective of the strategy on Higher Education is to introduce incentives in transferring government resources to public HEIs that would impact on the quality of education and of institutional management. The Government also aims to allow gradually larger institutional autonomy and management flexibility to public universities while increasing accountability in the use of public funds. Over the recent years, improving articulation between education and the labour market received greater attention. The law on university reform (2008) that provides greater autonomy to universities (see section 3.3.2) also reaffirmed the universities' mission to support students and graduates entering the job market.

The Support Programme for Quality (Programme d'Appui à la Qualité, PAQ) implements the Government's strategy by funding a range of competitive schemes. PAQ funds are awarded through two streams: (a) allowances for "Improving Management Capacity" €1,5m (TND3m), and (b) grants for "Improving the Quality of Education", totalling €8,5m (86%). All funds are awarded on a competitive basis to support the best proposals. PAQ grants are allocated for a period not exceeding three years.

There is no quality assurance for tertiary education activities or accreditation mechanisms in the country or any related debate for establishing them in the foreseeable future.

3.3.2 Academic autonomy

The university is totally dependent on state funds to support its teaching and research activities, since the research budget and recruitment processes are tied to the annual block funds of the MHESR. The new law, enhancing autonomy, is not implemented because the university administrations are not yet prepared and equipped for the corresponding tasks. Salaries of academic staff are governed by collective agreements. This state of operating is impacting on the research agendas that are linked to annual funding and staffing cycles for which provisions must be made in the university's budget proposal presented to the MHESR.

The universities and research organisations are self-governed as to the design of their research agendas and topics. Vacancies are opened by the research units while the University and the Ministry successively ratify the decision. The selection takes place

[44] Knowing that an annual tuition for a master student is 50 euros and for License student is 30 euros.

at national level and the Ministry decides on the final selection, based on national selection committees' recommendations. This process has led to an excessively broad spectrum of disciplines which is hindering prioritisation and contributes to the fragmentation of research efforts. At present, the university is urged to move from annual to multi-annual operating budgets that would increase its financial and managerial autonomy; and simultaneously seek more business and international project funding to complement the State support.

The need for establishing effective linkages between universities and industry is recognised in all policy documents and laws on higher education adopted since 1988. This includes the National Development Plan 2007-2016, the Law on the Higher Education of 2008 and its amendment of 2010. Furthermore, the establishment of the university-industry linkages is also part of all universities' strategies, which led to signing several memoranda of understanding and cooperation agreements between universities and chambers of commerce.

According to the Law on Higher Education the governance bodies are the Rector, the University Scientific Council and the Dean's Board. The Rector of the university is elected by the university scientific council, which is the supreme governing body of the university, composed of the faculty members of the same university, subject to approval by the MHESR. The election of the heads of departments and faculty deans is internal to the university system and must be approved by the MHESR[45]. The rectors of public universities are members of the Rector's conference headed by the Minister of Higher Education and Scientific Research.

The University Scientific Council (USC) consists of teaching staff[46] and students elected in each university. Two out of the 12 USC's members represent the students. The number and the procedures for election and dismissal of the USC's members are defined by the university's statute. Among other, the USC is competent for approving the curricula and the research programmes, monitoring and approving the financial statements of the university, as well as for adopting regulations for the scientific activities.

3.3.3 Academic funding

Government funding is the main financial source for public universities. Two thirds of the higher education budget goes to the Management budget (Title 1) and the rest to Equipment (Title 2). Only about 1% of the Universities' income is financed through government competitive funds. Block funding is given to the universities for both educational and research activities. In the latter case, funds are directed to research entities (labs and units in the HEI). The amount of the funds allocated to each research entity is determined by the number of researchers and the quality of research that is publications, patents etc. But the basic funding for research is based on the needs presented by the universities during the negotiation phase (investments' projects mainly). Part of the research undertaken in universities (no more than 10% according to our own estimates) is financed through external funding, via competitive bidding procedures for specific research programmes in the framework of either the RPF or the bilateral calls.

[45] This system was applied for the first time in June 2011 after the revolution. Before that faculty deans and president of universities were nominated by a presidential decree.

[46] Composed of two elements named: Body A (Professor and Maître de Conferences) Body B (Maître Assistant and Assistant)

Industry and non-governmental sector contribute only at 0.5% of the total budget. Public incentives aiming to support HEIs in their search for private funding and in their partnerships with the private sector are very limited. There is no tax allowance for companies' donations or other types of private funding to universities, or tax incentives for sponsors and private partners. Moreover, an organisation's capacity to obtain private funding is not taken into consideration when determining the amount of public funding.

There are specific criteria (number of students and scientific results) for defining the level of block funding allocated for research to universities.

3.4 KNOWLEDGE TRANSFER

3.4.1 Intellectual Property (IP) Policies

Intellectual property rights of the public sector researchers have been introduced since 1996 by the Orientation Law governing research and technological development. According to its provisions, research findings belong to the organisations where the research activities have been carried out. In case the research is funded by business firms or "abroad" the IPRs are governed by private law (the contractors are fixing the terms).

In order to promote innovation and valorisation of research findings, this law has been modified for the first time in July 2000[47] to allow researchers to exploit their inventions and preserving at the same time the research organisation's rights for commercialising the inventions or the new products. The same law adopted the principle of income sharing between the inventor(s) and the relevant research organisation. This income sharing takes into consideration the contribution of the researcher to the invention and the invention cost. The basic rules of sharing are fixed further by a decree.[48]

In order to improve the general framework for research exploitation by removing obstacles and creating incentives for patenting, the MHESR launched the programme "For a Patent culture". This scheme aims at motivating individuals, research organisations and enterprises to file patent applications. The scheme provides funding for initial and annual fees for two years, including drafting the application, filing, translation, defending the validity of the right during any legal dispute.

The programme aims mainly at increasing the number of patent applications of Tunisian research organisations and researchers and the commercial exploitation of these patents by individuals and economic entities. Annual funding for this action amounts €150,000 but is never entirely up taken.

As a member of World Trade Organisation (WTO), Tunisia started in 1999 a revision of its legislation on industrial property to adapt it to the increased needs for protection of inventions and of the foreign investors collaborating with Tunisian research organisations.

[47] Law 68 17 July, 2000
[48] Decree N2001-2750 26 November 2011

3.4.2 Other policy measures aiming to promote public-private knowledge transfer

Spinoffs, incubators

Business incubators were created since 2001, in industrial zones or within research centres and universities. They provided a locus for young entrepreneurs and researchers. The incubators provide advice and auxiliary services to the project carrier from preparing a business plan to legal, fiscal and marketing assistance. HEI and PRI incubators where implemented to create an appropriate framework to encourage the creation of spinoffs. In reality all the firms in these particular incubators are spinoffs.

Thirty six business incubators were developed from 2001 to 2011, but some of them are not fully operational. More than 2000 holders of projects benefited from the services of incubators in 2011 against 518 in 2005.

The way incubators support their tenants is criticised particularly because they lack clear regulatory framework. The creation of Techno parks in all the regions of the country is under way, but follows generally a slow pace.

Inter-sectorial mobility

There are no available data on the inter-sectorial mobility of researchers but the overall impression is that it is very limited. University professors have the right, within some limits, (i.e. get in advance a special authorisation from the Prime Minister, not exceed the fifth of the normal working time, cover an area of competence where the country is under-endowed) to work in parallel in the private sector and non-profit organisations (although the implementation is hardly monitored). This actually could offer opportunities to identify needs of the industry and better link the research and educational activity of the university to the specific needs of the business sector and the economy in general.

A programme named “mobility of researchers" was introduced in 2002.[49] It allows researchers to benefit from one or more years of leave to lead or to contribute to an innovative project undertaken by a private or public enterprise. The programme did not have the expected success, as only six researchers have benefited from this action since it was launched. There is no assessment explaining the reasons of this failure.

Promoting research institutions - SME interactions

The National Development Plan 2007-2016, supports public-private R&D partnerships in the form of collaboration between public academic institutes and private companies of all sizes, funded through competitive calls for applications. These partnerships are directly supported by the PNRI with the help of the "Technical Centres" and by the VRR measures. However, the last calls show that the uptake is limited to a few proposals per year. With no evaluation studies of these instruments one can speculate that researchers and firms are not aware of these instruments, while the Tunisian firms are predominantly very small, family owned and working in low added value sectors to be sufficiently interested.

[49] Law N2002-53 of June 3, 2002

The National Agency for the Promotion of Research (NAPR), created in 2008, could act as a liaison between industry and the various universities, since one of its initial roles was to improve collaboration between firms and research organisations. The new roles attributed to MHESR and the MIT in 2010 resulted in the reallocation of the tasks between NAPR and the Agency for the Promotion of Investments and Innovation (APII).

Involvement of the private sector in the governance bodies of HEIs and PROs

The framework law of higher education and scientific research introduced the involvement of the private sector in the scientific councils of the individual HEIs and PROs. The law provided for the participation of two external personalities with recognised competencies and contribution to HEIs and PROs, who are jointly selected by the other members of the council. This measure is rarely effectively applied by HEIs and PROs, as the personalities selected are hardly committed to the job and only occasionally participate to the meetings. Overall, it can be concluded that the participation of the private sector to the governance bodies of HEIs or PROs is negligible in Tunisia.

Regional Development policy

At the institutional level, reforms targeting enhanced pluralism within municipal councils and representation of the regions in the corresponding Assembly were implemented during the period from 1997 to 2010. The regions were also given greater responsibility for promoting private investment through regional committees set up to create companies and develop innovative projects and employment programmes, in view of doubling regional investment and company equity. The regions may create business areas in each administrative district since 2009 in application of the relevant presidential decision.

In order to boost private initiative and company set-up over the past ten years the following have also been achieved:

- Consolidation of incentives and advantages of regional development

- Creation of the Tunisian Bank of Solidarity to promote entrepreneurship for those lacking the financial means and necessary guarantees

- Establishment of a micro-credit system to foster local development initiatives and economic activity among low-income groups

- Setting up the National Employment Fund to improve qualifications of job seekers and provide employment opportunities.

Efforts were stepped up during the last decade to reinforce mainly transportation infrastructure. These investments contributed also to the development of human resources especially through further higher education decentralisation by establishing new universities (see section 2.2), and Higher Institutes of Technology, as well as the launch of a cyberspace in Le Kef, Siliana, Kasserine, Gafsa and Monastir. These entities are adapted to the specificities of each region.

The main component of the regional research policy is Technoparks. The objective is to create a “park of excellence” or a “specialised excellence park” in a territorial entity, which means that researchers, academics, businessmen and senior managers work closely together to find appropriate solutions to market or societal needs.

In 2012 Tunisia has an operational techno park specialising in IT and is setting up six new techno parks while other three are in the phase of preliminary study. The ultimate aim is to establish 10 techno parks by the year 2016.

These Techno parks are spread throughout the country as follows:

Techno parks	Specialty	area
Borj Cedria	Water and Environment Renewable Energy Plant Biotechnology Materials Science.	89ha
Sidi Thabet	Medical Biotechnology Pharmaceuticals	92ha
Sousse	Microelectronics, Mechanics, Nano-technology, IT	60ha
Sfax	Informatics and Multimedia	60ha
Monastir	Textiles and clothing	100ha
Bizerte	Food industries	87ha

Other planned techno parks include:
- Mednine (South): Desert resources;
- Jendouba (West): Forest products valorisation;
- Gafsa (South-West): Phosphates.

3.5 ASSESSMENT

Tunisia, compared to countries of the region, has a relatively high stock of research personnel with nearly 13,300 researchers (in full time equivalent FTE) and 4.16 (in FTE) per 1,000 active populations in 2010 (not very far from the EU27 average). The vast majority of researchers are employed in the higher education sector[50] and nearly 40% of them are PhD students which mean that they need to be trained further. Relatively low salaries and unsatisfactory overall working conditions, accompanied recently by political instability, encourage brain-drain and professional shift to other, more attractive sectors in Tunisia.

There are no specific targets or measures in the national S&T strategy for opening up the national market to foreign researchers and there is no international advertising of research vacancies, unless there is a specific reason to employ foreign researchers.

The success of the actual innovation policy is constrained by the:

- Limited R&D capabilities and absorptive capacities in the private sector, and particularly in SMEs, which are not supporting the increase of BERD;
- Complexity of the current policy instruments, too heavy for SMEs;
- Need to develop R&D capabilities and raise awareness on the benefits of R&D and innovation for SMEs;
- Minor role played by venture capital

Furthermore, the results of many programmes and projects were announced but not commercialised.

The techno park programme meets three essential needs: (1) provides an impetus for R&D and innovation in the private sector (2) strengthens links between university (and public) research and the productive sector and (3) promotes regional

[50] On three year contracts extended to five years

development. This is why setting up techno parks and/or business incubators in each administrative region constitutes a real challenge in a country where the number of highly competitive companies on an international scale is limited and where researchers and academics do not have the culture of working with companies.

4 INTERNATIONAL R&D&I COOPERATION

4.1 MAIN FEATURES OF INTERNATIONAL COOPERATION POLICY

The Tunisian R&D policy has been inspired by the Lisbon Agenda and the ERA targets (i.e. competitiveness and development of a knowledge based economy, GERD/GDP ratio, participation to INCO nets). The S&T strategy for international cooperation[51] consists of:

- Enhancing the cooperation with European countries and widening the participation of Tunisian research teams to the FPs; in particular to the networks of excellence, and increasing the Tunisian project coordinators.
- Consolidating the cooperation with North-African and Arab countries; launching joint calls for proposals and awareness campaigns for researchers.
- Strengthening the cooperation with strategic commercial and scientific partner countries; in particular, developing cooperation in biotechnology with Japan, foresight and priority setting methodologies with South Korea and fellowships in priority areas with USA.
- Diversifying partnerships by adopting a selective approach, to benefit from the international competitive advantages of certain countries (i.e. BRIC countries).

4.2 NATIONAL PARTICIPATION IN INTERGOVERNMENTAL ORGANISATIONS AND SCHEMES

In terms of S&T multi-lateral agreements, Tunisia has signed a number of S&T conventions and agreements some dating back to the early 1960s with the following international organisations:

- ALECSO (Arab League Educational, Cultural and Scientific Organisation)
- FAO (Food and Agriculture Organisation)
- FARC (Federation of Arab Research Councils)
- IAEA (International Atomic Energy Agency)
- ISESCO (Islamic States Educational, Cultural and Scientific Organisation)
- ICARDA (International Centre for Agricultural Research in Dry Areas)
- SSO (Sahel and Sahara Observatory)
- UNESCO (United Nations Educational, Scientific and Cultural Organisation)

In most cases the agreement leads to the establishment of joint scientific policy (FARC, ALECSO and ISESCO) or to the participation in joint research projects focused on regional issues of common interest (IAEA, ICARDA and SSO) or in training and skills improvement (UNESCO and FAO).

For example, the Sahel and Sahara Observatory is an independent international organisation based in Tunis, founded in 1992 to improve early warning and monitoring systems for agriculture, food security and drought in Africa. Ever since, the main objective is to give impetus to the combat against desertification and the

[51] See www.mes.tn (cooperation); interview with the general directorate of International Cooperation in the MHESR

mitigation of drought by organising for the member countries and organisations a forum where they can share experiences and harmonise the ways in which data are collected and processed to feed into decision-support tools. Today, the OSS community includes 22 member countries in Europe and North America (Germany, Canada, France, Italy and Switzerland), West Africa (CILSS and Ivory Coast), East Africa (IGAD) and North Africa (AMU and Egypt), a sub-regional organisation covering the whole circum-Sahara (CEN-SAD), regional organisations, as well as organisations part of the United Nations System and Civil Society.

4.3 COOPERATION WITH THE EU

4.3.1 Participation in EU Framework Programmes

The following table presents the main characteristics of cooperation with the EU in the field of research:

Table 4.1 EU - Tunisia actions of cooperation

Cooperation	Framework Main Actions of Cooperation
Article 47 of the Association Agreement signed in July 1995	- Technology transfer cooperation to upgrade Tunisian Industry Programme (UTIP) - Cooperation in technology transfer as part of the second phase of UTIP, called Industry Modernisation Programme (IMP). - Financial cooperation with the European Investment Bank for the national techno parks programme.
Barcelona Declaration, Nov. 1995 launching the Euro-Mediterranean process	- Connection of the four National Research Networks to the European network GEANT. - Participation in joint projects following the call for proposals of the 4th and 5th Framework Programmes on R&D of the European Union.
The Bilateral Agreement on R&D of June 2003	- Establishment of a National Information Bureau within MHESR. This bureau aims to provide information and assistance on cooperation opportunities with EU, and to support the participation of the Tunisian scientific community in R&D framework programmes. - Information seminars for Tunisian researchers on cooperation opportunities with the EU. - Participation in pilot projects in the framework of EUMEDIS initiative on Information Society. - Organisation of a dialogue and consultation meetings as part of the joint committee for scientific cooperation (established to monitor the implementation of the specific R&D Agreement) and the research-innovation sub-committee under the Association Committee. - Organisation of the 10th meeting of the Monitoring Committee piloting the Euro-Mediterranean partnership in R&D (MOCO) in June 2005 in Tunis. Participation in all the meetings of the MOCO since the creation of the committee.

The participation of Tunisian research organisations in various EU RTD programmes and projects is strongly encouraged by the national authorities, while the national committee of evaluation (*CNEARS*) takes into account in its evaluation criteria the capacity of national research organisations to join international (mostly European) networks.

Tunisia is one of the best performing countries in the South-Mediterranean region for its participation in the successive FPs and Eumedis. The overall number of participations in the FP7 for the period 2007-2012 is shown in tables 4.2 and 4.3. One

can notice the slowing down of the involvement of Tunisian research teams in proposal after 2009, but with improving rates of success in applications. Success rates are higher in INCO, Health, KBBE, ICT, ENV, ICT and PEOPLE, but null in SSH. SICA and CSA types of action are the most successful for Tunisian researchers (table 4.4).

Table 4.2 FP7 proposals with participation of at least one Tunisian organisation, by year, status end 2012

	2007	2008	2009	2010	2011	2012	total
Main listed	11	10	23	23	16	3	86
Reserve	6	4	19	7	7	3	46
ejected	72	30	83	51	26	25	287
Ineligible	6	2	4	2	5	0	19
Withdrawn	0	0	1	0	0	0	1
Total	95	46	130	83	54	31	439

Source: European Commission, DG RECH database

Table 4.3 the distribution of projects receiving grants under the 7th FPRD by proposal type is shown below (status May 2013):

Proposal Sub Funding Description	Number of Proposals	Number of Projects
Collaborative project for specific cooperation actions dedicated to international cooperation partner countries (SICA)	155	25
Collaborative project (generic)	16	1
Collaborative Project targeted to a special group (such as SMEs)	10	3
Coordinating action	50	17
Integrating Activities / e-Infrastructures	3	1
International Outgoing Fellowships (IOF)	13	1
International Research Staff Exchange Scheme (IRSES)	26	12
Large-scale integrating project	24	2
Research for SME associations/groupings	3	1
Research for SMEs	7	1
Small or medium-scale focused research project	67	9
Supporting action	109	29
Not identified	51	
Total (May 2013)	**534**	**102**

Source: DG Research and Innovation, European Commission

Table 4.4 FP7 proposals with participation of at least one Tunisian organisation by field/programme, year and evaluation status, end 2012

Proposal call identifier & nb of proposals	evaluation status	2007	2008	2009	2010	2011	2012	total
PEOPLE 59	ineligible			2		1		3
	main list		4	3		2	3	12
	Rejected	2	5	25	5	5	2	44
KBBE 81	Ineligible		1	1		1		3
	main list		3	3	5	1		12
	Rejected	10	7	10	4	6		37
	Reserve	6	4	15		4		29
ENV 64	Ineligible	4	1		1			6
	main list			5	5			10
	Rejected	15	5	15	6	1	4	46
	Reserve				1		1	2
ICT 36	main list	1	1			3		5
	Rejected	6	5	2	10	4	4	31
HEALTH 29	Ineligible	1						1
	main list	4		3	2	1		10
	Rejected	13	2	2	1			18
SSH 37	Ineligible	1		1		1		3
	Rejected	9		7	1	1	13	31
	Reserve				1	1	1	3
AFRICA 27	main list				5			5
	Rejected				18			18
	Reserve				4			4
INCO 26	Ineligible				1	1		2
	main list	2			3	3		8
	Rejected	4	1		1	7		13
	Reserve				1	2		3
ERANET 2	main list	1				1		2
REGPOT, REGIONS of K. 27	main list			5				5
	Rejected			18			1	19
	Reserve			3				3
Science in Society 8	main list		1		1			2
	Rejected	1		2	3			6
ENERGY 8	main list	1						1
	Rejected	5		1				6
	Reserve						1	1
ENV-NMP 1	Rejected				1			1
INFRASTRUCTURE 5	main list			1	1			2
	Rejected	2	1					3
NMP 7	main list	1		2				3
	Rejected	1	1	1			1	4
OCEAN 8	main list					5		5
	Rejected				1	2		3
SPACE 1	main list				1			1
SMEs 8	Ineligible					1		1
	main list		1	1				2
	Rejected	2	3					5
SST 3	main list	1						1
	Rejected	1						1
	Reserve	1						1
AAT 1	rejected	1						1
total 438		95	46	129	83	54	31	438

Source: European Commission, DG RECH data base
Not including one withdrawn

Table 4.5 Participation of Tunisia in FP7 cooperation projects by field (status May 2013)

Programme's identifier	Number of projects	Proposal Total Cost	Proposal Requested Contribution
AFRICA	5	15,984,192	12,328,724
ENERGY	2	10,930,233	7,525,747
ENV	10	49,206,364	38,199,083
ERANET	3	5,944,942	4,996,868
HEALTH	10	36,192,944	28,516,823
ICT	8	8,472,578	7,242,609
INCO	16	20,566,512	19,778,320
INFRASTRUCTURES	2	13,994,966	10,663,324
KBBE	13	60,898,964	45,245,471
NMP	3	15,642,067	11,334,877
OCEAN	5	72,146,668	55,863,718
REGPOT	5	4,998,552	4,825,151
SCIENCE-IN-SOCIETY	2	2,571,143	2,211,844
SME	2	3,755,090	2,812,572
SPACE	1	1,263,360	999,226
SST	2	2,654,811	2,648,478
PEOPLE	13	n.a.	n.a.
total	102	325,223,386	255,192,835

At regional level, Tunisia is member of the MOCO (Monitoring Committee) which brings together representatives of EU countries and south Mediterranean countries to define strategic orientations for EuroMed S&T collaboration. Tunisia participates to the INCO-NET platform MIRA launched in 2008, for improving dissemination of information and identifying opportunities for cooperation in FP7. In addition, the local Info-Point is involved in activities of capacity building (INCO-NET, BILAT) in order to facilitate cooperation between EU and Tunisian researchers.

Table 4.6 some examples of Tunisian participation in the 7th FP projects

REGPOT	ERAWIDE
1.Advancing Mediterranean Forest Research Capacities AGORA (National Institute of Research in Génie Rural, Water et Forests (INRGREF) 2. Network in solid waste and water treatment between Europe and Mediterranean countries SOWAEUMED ISA Chott Meriem; University of Sousse 3. Biotechnology from desert microbial extremophiles for supporting agriculture research potential in Tunisia and Southern Europe BIODESERT (Faculty of Sciences of Tunis) 4. Empowering Tunisian renewable energy research activities ETRERA (Centre de Recherches et des Technologies de l'Energie) 5. Building a cooperative strategy between Europe and Mediterranean Countries for upgrading tuberculosis research and control EUMEDNET vs Tuberculosis (Pasteur Institute of Tunis)	1- Capacity building for Direct Water Reuse in the Mediterranean Area CB-WR-MED, Research Centre of Research in the Water Technologies (CERTE) 2- Improve research capacities of the Centre of Biotechnology of Sfax in Bio-Processes for biotech applications, tying up with the European Research Area, BioProtech, Centre of Biotechnology of Sfax (CBS)

The Sub-Committee for Research & Innovation of September 2007 stressed the need for cooperation among the European Commission DG RTD, RELEX and the MHESR, to "*harmonise*" the reinforcement plan on research and innovation. This process led

to the "Support Project to Scientific Research and Innovation" (known as PASRI, see section 2.3.1).

Table: 4. 7: Tunisian participation in COST actions:

ACTION	TITLE	INSTITUTION
862	Bacterial Toxins for Insect Control	Centre of Biotechnology of Sfax
871	Cryopreservation of crop species in Europe	Faculté des Sciences de Sfax
E*45	European Forest Externalities	National Institute for Research on Rural Engineering, Water and Forests (INRGREF)
FA0605	Signalling control of stress tolerance and production of stress protective compounds in plants	Centre of Biotechnology of Sfax
FA0701	Arthropod symbiosis: from fundamental studies to pest and disease management	Faculté des Sciences de Tunis, Université de Tunis El Manar
FP0701	Post-Fire Forest Management in Southern Europe	National Institute for Research on Rural Engineering, Water and Forests (INRGREF)
*FP0801	Established and Emerging Phytophtora: Increasing Threats to Woodland and Forest Ecosystems in Europe	Higher Institute of Agronomy of Chott Mariem, University of Sousse
IC0803	RF/Microwave Communication Subsystems for Emerging Wireless Technologies (RFCSET)	Faculty of Sciences of Tunis

Source: *http://www.science.org.au/internat/europe/documents/COST%20attachment%20-%207.4.10.pdf*

Table 4.8 Distribution of the proposals and applicants by group of countries and status of evaluation 2007-2012 (proposals are counted as many times as they contain applicants from different origins)

	MAINLIST		RESERVE		REJECTED		Not eligible		Undefined & withdrawn		Totals	
	Appls	Props	Appls	Props	Appls	Props	Appls	Props	Appls	Props	Appls	Props
EUROPEAN UNION	731	446	335	222	1637	1124	104	71	420	279	3227	2142
ASSOCIATD COUNTRIES	38	32	21	16	86	67	4	4	8	8	157	127
Turkey	40	26	14	11	84	65	3	3	16	13	157	118
ARAB countries	180	138	95	79	469	378	18	14	198	144	960	753
RUSSIA & OTHER NIS	47	28	9	8	33	31			3	2	92	69
WESTERN BALKAN	9	9	6	6	12	12			6	3	33	30
USA, CAN, JAP, KOR, AUS	23	18	2	2	25	18	1	1	8	5	59	44
AFRICA	78	67	36	22	88	80	5	5	19	19	229	196
ASIA	21	16	7	6	46	32	6	5	10	10	90	69
LATIN AMERICA	29	26	11	7	37	28	4	4	12	11	94	77
OTHER	4	4	2	2	10	9	1	1	3	3	20	19
TOTAL	1200	810	538	381	2527	1844	146	108	707	501	5,118	3,644

Appls: number of applicants
Props: number of proposals

Since 2007, Tunisia is eligible to participate to the EU's Competitiveness and Innovation Programme (CIP). After concluding negotiations on a Protocol to the Association Agreement, Tunisia was allowed to take part in Union programmes. Since October 2010, Tunisia is member of the Enterprise-Europe-Network (EEN) programme of the CIP. EEN-Tunisia is a consortium grouping the APII, five technical centres and two techno parks (Monastir-el Fejja and El Ghazala).

At the start of 2010, the Tunisian participation in COST actions reached eight, against five Egyptian and four Moroccan participations. No EUREKA participations have been identified

4.3.2 Bi- and multilateral agreements with EU countries

By 2010, Tunisia signed eight bi-lateral science and technology agreements with EU Member States or FP7 Associated Countries (France, Italy, Spain, Belgium, Greece, Portugal, Germany, and Norway).

Table: 4.9 Bilateral S&T agreements of Tunisia with other countries

Country	Cooperation Framework	Main actions of cooperation
France	Convention of Cultural, Scientific and Technical Cooperation (1985). Agreements of Cooperation with French research centres (1992): Research Institute for the Development National Centre for Scientific Research French Research Institute for Sea Exploitation	Programmes in collaboration with the Action and Cultural Cooperation Service (ACCS) of the French Embassy in Tunisia. The ACCS participates in a support programme which offers; • Training and technical assistance actions and a contribution for the acquisition of scientific equipment by research centres under the supervision of the MHESR; • Research projects in collaboration with the Research Institute for the Development (IRD).
Spain	- Memorandum of Understanding creating the Programme of Inter-university and Research Centres Cooperation in 2002.	Tunisian-Spanish call for proposals: The Tunisian-Spanish call for proposals published annually (now in its 7th edition) has financed more than 200 projects since 2002.
Portugal	- Agreement on Cultural, Scientific and Technical Cooperation in 1992.	Tunisian-Portuguese call for proposals: The Tunisian-Portuguese call for proposals (now in its 8th edition) has financed more than 160 projects.
Italy	- Agreement on Cultural, Scientific and Technological Cooperation in 1997. - MoU for Cooperation with the Italian Ministry of Education, Universities and Research in 2005.	Tunisian-Italian call for proposals: The first call for proposals resulted in the financing of 38 joint projects.
Greece	- Agreement on Scientific and Technological Cooperation in 2002.	Tunisian-Greek call for proposals: The first Tunisian-Greek call for proposals was launched on September, 2005. A call for scholarships was launched in 2012.
Turkey	- Agreement on Scientific and Technological Cooperation in 2001. - Cooperation Agreement with the Turkish Council of Scientific and Technical Research (TUBITAK).	Tunisian-Turkish call for proposals: The second call for proposals was published in 2006.
Germany	- MoU for Scientific and Technological Cooperation in 1998	A joint Tunisian-German working group was set up per the MoU. Its remit is to monitor the implementation of cooperation actions.
Norway	- Agreement on Scientific and Technological Cooperation with the Foundation for Industrial and Scientific Research in Norway in 2003.	Technical and scientific assistance for the creation of a Tunisian Network of scientific centres in the field of marine science and fisheries

These agreements do not include specific research fields and budgets - and are open-ended. Budgets vary between 300,000 and 1 million euro for each country and per year (except for France which could reach €3m when adding the annual budgets of two research centres: IRD and IRMC).

4.4 COOPERATION WITH NON EU COUNTRIES OR REGIONS

4.4.1 Main Countries

Agreements have been signed with non-EU countries such as Turkey, USA, Japan, South Korea, Argentina, Pakistan, India, South Africa and nine Arab countries: Morocco, Algeria, Libya, Egypt, Jordan, Mauritania, Lebanon, Soudan and Syria. In most cases, these agreements provide for calls for joint projects between Tunisian researchers and foreign researchers. The number of projects does not exceed a dozen, in each joint call with the Arab or the Asian countries. Budgets for the non-European countries vary between 200,000 and 300,000 euro for each country by call of proposal every two or three years.

Table: 4. 10 Number of S&T bilateral agreements by region

Region	Number of bilateral agreements
Arab	9
Europe	8
America	2
Asia	5
South Sahara Africa	2
Total	26

Source: compiled by the author from the HCSRT 2009 and other reports

4.4.2 Main instruments

The legal framework governing bilateral cooperation in the field of scientific research and technology includes cooperation conventions, intergovernmental agreements, memoranda of understanding and inter-university agreements (more than 1000 actually).

Bilateral cooperation consists specifically of a broad range of initiatives undertaken at doctoral and post-doctoral level, joint calls for proposals, participation to the national programme of techno parks, international associated laboratories and the organisation of international scientific events.

4.5 OPENING UP OF NATIONAL R&D PROGRAMMES

Opening the Tunisian national research programmes to international participation is not addressed by the national policy. International R&D projects are financed by the MHESR. Each party finances its own research teams. These projects provide mainly for mobility actions.

4.6 RESEARCHER MOBILITY

4.6.1 Mobility schemes for researchers from abroad

There are no specific mobility schemes aiming at attracting third country researchers. Foreign researchers contracted by Tunisian research organisations can only benefit from the provisions on residence permits and tax and social security services. Bilateral agreements with third countries encourage the mobility of both students and professors. Mobility is mainly addressing research activity in the host country. The duration of secondments is usually limited to one month.

In 2003 the MHESR launched a cooperation programme with Tunisian researchers living abroad (section 3.1.4). The programme provides funding for their research in Tunisian host organisations and living in the country for a period of one to six months aiming to establish joint research programmes. The grants are awarded on the basis of an annual call for proposals to the host institutes.

Tunisian universities also receive between 350 and 450 visiting professors annually; 90% of them are Europeans. They are mainly involved in teaching in Master's Degree courses.

4.6.2 Mobility schemes for national researches

Mobility of national researchers is not clearly addressed by specific national actions or by initiatives of the universities and other research organisations. The Tunisian researchers benefit from the mobility schemes of the FP7. No particular incentives are offered to foreign researchers to work in Tunisia. On the other side, emigration of Tunisian researchers in practice is rather implicitly encouraged.

The Agency for Technical Assistance and Cooperation (ATCT) publishes information on all the international offers of employment proposed to Tunisian citizens. In some cases the Agency is active in selecting future candidates and participates in the preparation of the contracts.[52,53]

[52] Préparer l'avenir : Une perspective à long terme de la mobilité des personnes et des emplois pour le Moyen-Orient et l'Afrique du Nord. World Bank and European Commission. 2009.
[53] http://www.tunisie-competences.nat.tn/default.aspx?Lg=2

5 CONCLUSIONS

After a relatively limited evolution during the first four decades after independence (1956), scientific research policy was subject to a significant evolution since the mid 1990's, based on the allocation of financial and human resources policy and on the support to creativity and innovation. Building a dynamic system of research and technological innovation required the renewal and updating of legislation, the creation of new structures and the training of qualified human resources.

Despite these efforts and the fact that the most important structures of the National Innovation System have been set in place, the knowledge triangle is not yet operating effectively. The three components of the triangle need to be further developed with particular emphasis on innovation rather than education or research. The new reform of higher education providing for more management autonomy accompanied by public funding and the establishment of quality certification should allow this system to improve its performance, despite the continuing increase of student numbers.

The system of scientific research has been privileged in terms of public funding, while the orientation of academic research towards national priorities began to take shape. Innovation is the missing link in the triangle. Government efforts to improve the innovation system address institutional building (linking MHESR to MIT or creating a new agency as NAPR) while the difficulties are at the very structure of the economy and the perception of innovation among local entrepreneurs. In any case, an integrated policy approach to the 'knowledge triangle' is lacking.

Tunisia attaches great importance to the integration of local researchers in international networks and in particular those with an excellent performance. Beyond the transfer of know-how and technology, this partnership attracts extra financing which is channelled into the national system of research. International cooperation, in particular with the European Union and the Euro-Mediterranean area is therefore strongly supported.

In contrast to the weight of EU funding for R&D in Tunisia, other foreign funding sources (such as international organisations, foreign enterprises) play only a minor role in the GERD, but are more active in innovation promotion. For example, the World Bank was sought for the financing of certain projects of the Techno park programme and the UNDP has a minor contribution in some studies or capacity building actions.

One can also note that, since the revolution in January 2011, the political will to establish a new scientific research and technological development policy is relatively inconsistent and sporadic. National priorities seem to be elsewhere: solving the problem of unemployment of graduates of higher education, restoring regional balance for access to academic institutions, reviewing the LMD system.

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7 LIST OF ABBREVIATIONS

ANM	National Agency of Metrology
APII	Agency for Promotion of Investments and Innovation
ATCT	Agency for Technical Assistance and Cooperation
BERD	Business Expenditures on R&D
BNM	Bureau de Mise à Niveau (upgrading bureau)
BRIC	Brazil, Russia, India and China
CBS	Centre of biotechnology of Sfax
CIP	Competitiveness and Innovation Framework Programme
CNEARS	See NECSRA
CNSTN	National Technological and Nuclear Sciences Centre
EEN	Enterprise-Europe-Network
FDI	Foreign Direct Investments
FOPRODI	Fund for the Promotion of Industrial Decentralisation
FP	European Framework Programme for Research and Technology Development
FRP	Federated Research Programme
FTE	Full Time Equivalent
GBOARD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Expenditures on R&D
HCSRT	Higher Council of Scientific Research and Technology
HLCST	High Level Committee of Sciences and Technology
HEI	Higher Education institutions
HES	Higher Education sector
INNORPI	National Institute for Normalisation and Intellectual Property Rights
INRAP	National Research Institute in Physical and Chemical Analysis
INRAT	National Institute of Research in Agriculture in Tunisia
IPR	Intellectual Property Rights
MAHR	Ministry of Agriculture and Hydraulic Resources
MENA	Middle East and North Africa
MHESR	Ministry of Higher Education and Scientific Research
MIRA	Mediterranean Innovation and Research coordination Action
MIT	Ministry of Industry and Technology
MoCC	Ministry of Commerce and Craft
MPIC	Ministry of Planning and International Cooperation
MPH	Ministry of Public Health
NAPRI	National Agency for Promotion of Research and innovation
NCCSRT	National Consultative Committee for Scientific Research and Technology
NECSRA	National Evaluation Committee for Scientific Research Activities
NGO	Non-Governmental organisation
NOST	National Observatory of Sciences and Technology
NPRI	National Programme for research and Innovation
OECD	Organisation for Economic Cooperation and Development

PAQ	Programme to strengthen Quality
PASRI	Support Project to Scientific Research and Innovation
PIRD	Premium for Investments in Research and Development
PRO	Public Research Organisations
R&D	Research and development
SF	Structural Funds
S&T	Science and technology
THES	Times Higher Education Supplement
TND	Tunisian National Dinar
UIS	Unesco Institute for Statistics
USC	University Scientific Council
VRR	Valorisation of Research Results