



To Bridge the Gap: Relevant Policies for Establishing an Effective System of Strategic Innovation and Technology Transfer in Tunisia

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Glossary and List of Acronyms

ADRI	Innovation Research Development Association
ANPR	Tunisian National Agency for Research Promotion
APII	Promotion Agency for Industry and Innovation, Tunisia
BuTT	Technology Transfer Offices within the Universities and Research Centers
CNEAR	National Assessment of Scientific Research Activities Committee in Tunisia
ENIT	National Engineers School of Tunis
ENSI	National School of Computer Sciences, Tunisia
ESCWA	United Nations Economic and Social Commission for Western Asia
ETC	ESCWA Technology Center
FEDELEC	National Federation of Electricity and Electronics within UTICA
FOPRODI	Fund for Promotion and Decentralization for Industry
GEFI	Studies Group on Engineers Training, Tunisia
H2020	The research funding and innovation program in the European Union for the period 2014-2020, Horizon 2020
IKDAM	A public seed fund that aims to strengthen the innovative activities of startups
IN'TECH	Investment fund for Technology development
INNORPI	National Institute of Standardization and Industrial Property in Tunisia
Innovate UK	United Kingdom's Innovation Agency
IP	Intellectual Property
ITES	Tunisian Institute for Strategic Studies
ITP	Priority Technological Investment
KPI	Key Performance Indicator
MESRS	Ministry of Higher Education and Scientific Research, Tunisia
MOBIDOC	An allocations in favor of PhD students or PhD titular who have to develop their researches on issues interesting a company or a socio-economic organization
NIS	National Innovation System
NTRM	National Technology Roadmap adopted in 2002 in South Korea (NTRM).
NTTO	National Technology Transfer Office
OTDAV	Tunisian Office of Authors' Rights and Related Rights
PCAM	Program for the Competitiveness of Enterprises and Access to Markets
PIRD	Grant for Investment in Research and Development

PMN	A national upgrading industrial capacity program
PRF	Federated Search Program
R&D	Research and Development
RIICTIC	Incentive Regime for Creativity and Innovation in Information and Communications Technology.
SAGES	Society for Assistance and Asset Management of Spin-Off Funds
SICAR	Investment Companies in Risk Capital
SME	Small and Medium Enterprises
STI	Science and Technology Innovation
SWOT	Strengths, Weaknesses, Opportunities and Threats
TT	Technology Transfer
TuNIS	Tunisian National Innovation System
UTICA	Tunisian Union for Industry, Trade and Handicrafts, employers' organization in Tunisia
VRR	Valuation of Search's Results Program
WB-KEI	World Bank Knowledge Economy Index

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Executive Summary

Starting from the Technical Paper by ESCWA entitled “A study about the Technology Transfer: Economic models and means for success in the Arab countries” [1] and from the study entitled “How to harness the National Innovation System (NIS) in Tunisia. To enable Technology Transfer and strengthen the Innovation capacity” [2], realized by ESCWA&ANPR aiming to establish a National Technology Transfer Office (NTTO) in Tunisia, in the same frame than the present study, we present the national devices of assistance for Technology Transfer and Innovation in Tunisia classified according to the primary objective of each device at the moment of its creation into five classes as follows:

- a- Increase R & D capabilities of enterprises;
- b- Increase the economic impact of R & D activities of the Research Centers and Higher Education Institutions;
- c- Develop collaborative projects between the actors of the NIS;
- d- Promote the creation of innovative companies;
- e- Support the development of innovative projects within existing companies.

Using this classification, we detail the main existing 20 public devices, we make a SWOT analysis of the Tunisian NIS and present its principal strengths and weaknesses and principal opportunities to seize and threats to avoid.

Then we propose and discuss how to update the related public policies with the aim of encouraging stakeholders to effectively build or rebuild a NIS, including civil society, private and public economic sectors and academia, and aiming to permit to them to benefit collectively and each for his own account from the renewed NIS. Our proposals are presented under the following headings:

1- A global Governance with a formal Innovation Policy

Essentially by merging the current four governing structures, 3 councils and 1 committee, namely:

- The High-level Committee for Science and Technology,
- The High Council for Scientific Research and Technological Innovation,
- The Strategic Council for the Digital Economy,
- The National Advisory Council for Scientific Research and Technology

in an unique committee that can be called the Knowledge Based Economy Advisory Committee to the Head of the Government.

In addition, each ministry can create a specialized committee for innovation, as needed, and in order to fight bad behavior of some public administrations impeding innovation, we propose to create within ministries positions of scientific directors (Chief scientific advisers).

2- A readable STI strategy

This new governance permits to adopt a national Science and Technology Innovation strategy which will be clearly formulated and communicated to all stakeholders, by following a similar approach to that adopted in South Korea and has allowed the country to draw up in 2002 the National Technology Roadmap (NTRM) [12]. This strategy will be driven by the tool of a scoreboard consisting of key performance indicators, KPIs. To this end we propose to define a scoreboard inspired from the Innovation Scoreboard adopted by the European Union and from the Arab Innovation Scoreboard.

3- Adapting the regulatory for a more efficient and effective Governance

Some improvements of the regulatory rules are urgent to adopt even before the adoption of the new governance rules. Here we can mention:

- a- A higher education teacher who benefits from a leave for the creation of a company should be exempted from his teaching load; otherwise it's not a leave!
- b- A clear legal framework for public and private incubators, for technology resource centers and platforms and for the Technology Transfer Offices is urgent to be created;
- c- The financial amount of the Grant for Investment in Research and Development allocated by the Ministry of Industry (PIRD) should be increased;
- d- It is urgent to create a new breed of Laboratories and Research Units, which can be called Innovation Laboratories and Units, by adopting new criteria in which IP patents and Technology Transfer have more importance;
- e- We have to mention explicitly in the statutes of higher education teachers the valorization's mission of research results;
- f- Introduce in the general status of the civil service, the PhD Degree as a recruitment level, in order to facilitate the recruitment of PhD's in Public Administrations.

4- Placing the IP Value Stream in the core process of the NIS

Through a policy for IP with more coaching and financial incentives for researchers to encourage them to claim IP and valorize their ideas and for innovators to launch innovative startups.

5- Nurturing the Technology Transfer as an Industry

We propose to develop a greater use of compensation clauses in public contracts with foreign companies, by increasing the rate of local integration, by requiring the association of a local team which have to be trained to lead the future similar projects and by introducing a clause of sub-contracting of Research and Development, through contracts with Tunisian Research and/or Innovation Laboratories.

It is also urgent to transform the National Observatory of Science and Technology to become a more important structure with greater resources, radiant throughout the Tunisian NIS by its data and activities.

6- Easing the access to R&D funds and Innovation financing

The current behavior of Investment Companies in Risk Capital (SICAR) calls for a thorough reform of the system of financial support to innovative companies and more generally Small and Medium Enterprises (SME).

Tunisian law has to recognize the status of Business Angel and the shareholder agreement.

Some specific public financial and technical help have to be developed targeting Small and Medium Enterprises (SME) and we propose here to establish a mechanism similar to the British "Innovation Vouchers" permitting to British SMEs to consult a public research institution and to ask for advice on an innovative project.

I- Introduction

The present study was conducted as part of the project piloted by the ESCWA Technology Center (ETC) in cooperation with ANPR, the Tunisian National Agency for Research Promotion, aiming the establishment of a Technology Transfer Office in Tunisia.

This study falls under the Development Account project on “Establishment of National Technology Transfer Offices (NTTO) in 5 selected ESCWA Countries (Egypt, Lebanon, Morocco, Tunisia and Oman).

The project aims to enhance national innovation system capacity through updating related policies and the establishment of National Technology Transfer Offices (NTTO) linked to universities and research institutions facilitating the partnership between the research community and economic development sector, the industry and relevant governmental and nongovernmental actors. This is crucial for the development of a sustained and targeted national technology sector.

This sector can help to:

1. Delinking economic / industrial development from imported technologies in critical sectors thus reduce technological dependency;
2. Providing economic incentives to innovators;
3. Creating a new source of income for educational sector (including academic research) through proper licensing structures and property right structures;
4. Establishing a productive R&D culture that can go beyond basic research and into industrial applications.

NTTO will help to integrate capacity of innovators, investors, entrepreneurs and researchers who are developing new technological solutions to the sustainability challenges and strategic needs of the national economy.

NTTO can help provide services such as scouting IP value in research through working closely with researchers highlighting potential economic values in their activities and showing ways to valorize these potentials, patent drafting and protection, valuation and evaluation, and a set of other support activities in the field of technology commercialization and industrial consulting.

The NTTO must also contribute to linking and matching local capacity with multinational corporations seeking local partnerships and shared development and production values.

By feedback, NTTO will be able to provide policy advices to relevant government ministries and all stakeholders of the National Innovation System.

In this study, we will start from a description of the current innovation system in Tunisia and present the national public devices of assistance for Technology Transfer and Innovation classified according to the primary objective of each device. We also present an analysis of its strengths and weaknesses and then we propose new policy directions to improve its effectiveness, i.e. its ability to achieve the objectives assigned for it, and its efficiency, i.e. the attainment of targets by paying an optimized cost. To this end we will inspire ourselves from successful practices in other countries which have achieved excellent results in the fields of Innovation and Technology Transfer.

II- Methodology of the Study

In fact, the readiness to accommodate technology transfer system was clearly displayed through conducted activities and advisory requests received by ESCWA from targeted countries (Morocco, Tunisia, Egypt, Lebanon and Oman).

In the present study we start from:

- a) The analysis conducted by ESCWA Technology Center (ETC) where gaps characterizing the NIS in Arab countries was identified, based on a SWOT analysis [1];
- b) The study realized by Mondher Khanfir entitled “How to harness the NIS in Tunisia. To enable Technology Transfer and strengthen the Innovation capacity” [2], in the same frame of the ESCWA&ANPR project aiming to establish a NTTO in Tunisia;
- c) The report [3] entitled "A New Vision of the Engineers Training National System", commissioned by the Minister of Higher Education and Scientific Research in Tunisia in April 2015 and presented in October 2015 by the Studies Group on Engineers Training (GEFI, Groupe d’Etudes sur les Formations d’Ingénieurs) created by decision of the Minister;
- d) The report [4] presented by the Tunisian Ministry of Higher Education and Scientific Research entitled “The Development Plan (2016 - 2020) “, dated on December 2015 and prepared by the Sectorial Committee for Higher Education and Scientific Research as a participation in the preparation of the 5 years Tunisian Economical and Social Development Plan;
- e) Academic and gray literature on Innovation, Technology Transfer and Research &Development;
- f) And qualitative interviews on several occasions with key stakeholders and in particular with the following personalities:
 - a. Prof. Khaled Ghédira, Director General of the public agency ANPR, partner of ESCWA in the project, former Director General of Tunis Science City and former director of the National School of Computer Sciences at the University of Manouba (ENSI, Ecole Nationale des Sciences de l’Informatique);
 - b. Prof Néjib Lazhari, Director General of the General Direction for Scientific Research in the Ministry of Higher Education and Scientific Research (Direction Générale de la Recherche Scientifique au MESRS);
 - c. Prof Khémaies Zaiani, Director General of the General Direction for the Valorization of Research in the Ministry of Higher Education and Scientific Research (Direction Générale de la Valorisation de la Recherche au MESRS);
 - d. Mr Salah Hannachi, Member of the Tunisian High Council for Scientific Research and Technology, President of ATLAS, a Non-Government Organization for rural and urban development, former CEO of the Management Society of Borj Cédria Technopark, former Tunisian Ambassador in Tokyo, former Director General of Tunisian Institute for Strategic Studies (Institut Tunisien des Etudes Stratégiques, ITES) and former Director General of the Promotion Agency for Industry and Innovation (APII);

- e. Prof Mustapha Besbes, Emeritus Professor at the National Engineers School of Tunis (Ecole Nationale d'Ingénieurs de Tunis, ENIT), President of the Studies Group on Engineers Training (GEFI, Groupe d'Etudes sur les Formations d'Ingénieurs), former Director of ENIT, former President of the Natural Sciences Committee in the Tunisian National Commission for UNESCO and a former Member of the National Assessment of Scientific Research Activities Committee (CNEAR, Comité National d'Evaluation des Activités de recherche Scientifique);
- f. Mr Abdelaziz HALLEB President of the National Federation of Electricity and Electronics (FEDELEC) at the first employers' organization in Tunisia, namely, the Tunisian Union for Industry, Trade and Handicrafts (UTICA);
- g. Mr Habib Lazreg, Expert at the Tunisian Institute for Strategic Studies, (Institut Tunisien des Etudes Stratégiques, ITES), member of the National Advisory Council for Scientific Research and Technology (Le Conseil Consultatif National de la Recherche Scientifique et de la Technologie auprès du Ministre de l'Enseignement Supérieur et de la Recherche Scientifique), and former State Secretary for Energy and Mining in the Tunisian government;
- h. Mohammed Chaouch, Honorary Member of the Tunisian Association "Innovation Research Development Association" (Association Développement Recherche Innovation, ADRI), former Director General of the Promotion Agency for Industry and Innovation of Tunisia (APII , Agence de Promotion de l'Industrie et de l'Innovation).

Important worthy resources for this work was also found in official publications of national, regional and international organizations (public and private) in charge of relevant fields: Innovation, economic development, R&D, intellectual property, technology transfer, IP commercialization etc. in addition to project national partner institutional support and access.

In all these interviews and in the documentation research, we focused on national and international best practices in order to formulate practical and operational recommendations to the government and institutions of the country.

This has been the basis of the SWOT analysis that we will present and new policies that we will propose in the following two sections.

III- Public devices for Technology Transfer and Innovation in Tunisia

The national devices of assistance for Technology Transfer and Innovation in Tunisia can be classified according to the primary objective of each device at the moment of its creation into five classes as follows:

- a- Increase R & D capabilities of enterprises;
- b- Increase the economic impact of R & D activities of the Research Centers and Higher Education Institutions;
- c- Develop collaborative projects between the actors of the NIS;
- d- Promote the creation of innovative companies;
- e- Support the development of innovative projects within existing companies.

Using this classification, the main existing 20 devices are:

- 1- Increase R & D capabilities of enterprises
 - a. PIRD

It is a Grant for Investment in Research and Development allocated by the Ministry of Industry to private and public Entreprises (PIRD, Prime d'Investissement à la Recherche et Développement).

Currently this financial assistance is limited to 50% of the total cost of studies with a ceiling at 25,000 Dinars (12,500 USD) and 50% of the cost of experiments and prototypes achievements of technical tests as well as field experiments and acquisition of scientific laboratory equipment needed to conduct research and development projects with a ceiling at 100,000 Dinars (50,000 USD).

- b. MOBIDOC

The device MOBIDOC is managed by the ANPR. Since 2012 it aims at develop research on issues from companies and socio-economic organizations.

The first component of the MOBIDOC device funds allocations in favor of PhD students. It was materialized during the 2 first years by the selection of 167 MOBIDOC theses under partnership among more than 240 candidates.

In addition to this first component, a second one entitled MOBIDOC-Postdoc was subsequently launched. It aims to help to solve shorter-term problems for the benefit of a business by a young PhD titular from the appropriate specialty.

This first experience confirmed that if the needs of Tunisian enterprises are actually taken into account and if adequate support is given to them, the Tunisian companies engage in the dynamics of R & D and Innovation partnership as a win-win action that benefits to the national economy and the development of the country.

The perpetuation of this pilot device is discussed on the occasion of the establishment of the Economic and Social Development Plan of the country 2016-2020.

2- Increase the economic impact of R & D activities of the Research Centers and Higher Education Institutions

a. VRR

The Valuation of Search's Results Program (Programme de Valorisation des Résultats de la Recherche, VRR) was launched in 1992 and this was the first attempt of promoting the commercialization and the application of research's results to the socioeconomic environment. This program aims to placing on the market the results obtained by the research laboratories. The VRR projects are funded by the Ministry of Higher Education and Scientific Research MESRS following an open Call for Proposals. The beneficiaries are public research organizations (research centers, research laboratories, research units) with the possibility of partnership with economic enterprises. The duration of realization of a project VRR is 3 years. Up to 2012, it supported around 90 projects with a total value of about 5 million \$, where Agriculture represented 25 % of this investment, Information Technology 21%, Energy 15% and Biotechnologies 11%.

b. Supporting the costs of IP Patents in Tunisia and abroad.

The Ministry of Higher Education and Scientific Research covers protection fees of Intellectual Property at INNORPI in the case of Industrial Property, or at the Tunisian Office of Authors' Rights and Related Rights (OTDAV) in the case of Authors' Rights and Related Rights, or with the General Directorate of Protection and Control of the Quality of Agricultural Products (Ministry of Agriculture), if it is a Vegetal Obtaining.

The institution supervising the inventor has one year from the date of first filing of the patent application to request the extension of the protection abroad. This assumes that the application is written by a professional drafting of patent applications.

Before starting any national or international cooperation with private or public institutions or companies, an agreement have to be drawn up specifying in particular the owner or owners of the invention and practical conditions for intellectual property protection, with a section specifying the management costs supported by the MESRS, up to its share in the invention.

The agreement is necessarily signed by the three parties, namely the concerned institution, the co-owner partner of the invention and the ministry.

c. BuTT

The Office of Technology Transfer called BuTT is an interfacing structure within public research and higher education institutions. It is a skills center helping public researchers, serving the exploitation of research results, transfer and partnership between supply and technology demand. Up today 13 universities and research centers have been selected for the pilot phase of the implementation of the first generation of BuTT. Their main role is to set up a structured process of IP management in support to the Technology Transfer between the Academic environment and the Enterprise world. According to the strategy of the ANPR, the BuTT will be established in all research institutions, which will benefit from the ANPR financial support in the frame of agreements between the two parties.

d. Training on IP and TT.

In the frame of its activities to boost research and innovation in Tunisia, the National Agency for the Promotion of Scientific Research (ANPR) in collaboration with the technology transfer offices of universities BuTT, launches training sessions for researchers, project leaders and PhD students on topics related to domestic Technology's Transfer and International Cooperation. This consists essentially to:

- Transfer of Technology: Raise awareness of the actors about techniques for transfer of technology and innovation i.e. including intellectual property, the search of anteriority, drafting patent applications, commercialization of research results, contracting and engineering of innovative projects.
- Mounting research projects: Enclosing the H2020 program, to train actors in research and innovation to construct H2020 projects for optimal integration into the European Research and Innovation Area, and to benefit maximally of the status of associated H2020 country that Tunisia has.

3- Develop collaborative projects between the actors of the NIS

a. Federated Search Program

The establishment of the Federated Search Programs (Programmes de Recherches Fédérés - PRF) permitted to take a substantial step towards the organization of activities of the national R & D system and, through the mobilization of expertise and the creation of synergies between structures for research and their partners, public or private, concerned with the development of the sector of scientific research and technology.

These programs are funded under multi-year agreements that define the supporting structure of the project and associated partners, the objectives and expected results, the human and material resources to mobilize and the monitoring and evaluation procedures.

This device addresses national priority themes defined in consultation with the various operators in the concerned sector

b. PNRI

The National Program of Research and Innovation (Programme National de la Recherche et de l'Innovation, PNRI) is a program that finances R&D, innovation projects, improvement of industrial capacities and modernization of production processes, through the consolidation of the cooperation and the partnership between industrial companies, the research structures and the technical centers. The program is under the supervision of the Ministry in charge of Industry.

To be eligible for funding, a project must associate with the industrial company at least a technical center and a public research organization (center, laboratory or research unit) during a maximum of two years

It must also demonstrate significant innovation and prove a minimum contribution of the industrial partner of 20% of the project cost.

c. Digital Tunisia 2018

Digital Tunisia 2018 is the National Strategic Program of Digital Economy, under the supervision of the Ministry of Technology and Digital Economy. This project aims to move towards a new development model which favors the shift to a digital economy. This program is built around several pillars notably: enhancing the network communication technology infrastructure through enabling all Tunisian families to have access to internet services and to reach 80% of the Tunisian families by 2018; providing students with computer tablets to replace books and school supplies; in parallel with the development of digital public services and e-payment facilitation for all citizens specifically through post offices.

The success of this project will have very important positive impact on all economic activities in the country thanks to the acceleration of the Technology Transfer and Innovation in all areas of activities.

d. Technoparks,

Accommodation within the Technoparks (or Scientific Parks) is very helpful for Technology Transfer and Innovation. As a support to its industrial strategy based on Innovation as a key factor of competitiveness, Tunisian government has set up since the end of the 90s a strategy of developing a wide infrastructure of Technoparks to host in the same area different actors from the Universities, R&D institutions and the Companies, called "Pôle de Compétitivité" and "Pôle Technologique". This was supposed to enhance a better cooperation between enterprises, research centers in some targeted strategic sectors in order to stimulate the transfer of knowledge and technology and strengthen collaboration

across engineering R&D projects and clustering initiatives. With a specific sectorial focus, each Technopark was supposed to leverage the development of the region in which it is located. The management of each Technopark is generally ensured by a dedicated management company created under the umbrella of a public-private partnership, in order to fund the extension and the construction of the infrastructure, and to provide quality services to companies hosted in the Technoparks, which are generally positioned on a promising sector of value chain, in the fields of ICT, Environment, Water Resources, Renewable Energy, Textiles, Mechatronics, Agribusiness and Biotechnologies.

4- Promote the creation of innovative companies

a. FOPRODI

This is the Fund for Promotion and Decentralization for Industry (FOPRODI: Fonds de Promotion et de Décentralisation Industrielle). It aims to the creation of a new generation of entrepreneurs, to the promotion and the development of the small and medium-sized enterprises in the different fields of industry and services for industry and the implementation of incentive measures for the regional development.

b. IKDAM

IKDAM is a public seed fund that aims to strengthen the innovative activities of startups at the early stage. The fund operates mainly for exploiting patents, drafting technical and economic studies for projects, developing manufacturing processes, before the commercialization phase and completing the financing scheme at the early stage of the company.

c. SAGES

It is a Society for Assistance and Asset Management of Spin-Off Funds (SAGES Capital, Société d'Assistance et de Gestion des Fonds d'Essaimage). It is a public venture capital firm specialized in investments in early seed/startups, in growth capital and in leveraged buyouts, turnaround, and restructuring transactions. It invests in small and medium sized companies operating in all business sectors with a focus on biotechnology, agri-food, solar energy and technology sectors.

d. Accommodations in Public Startups Nurseries

Public Startups Nurseries are infrastructure spaces generally dependent to the public agency APII and equipped to host entrepreneurs when they start launching a promising business. They constitute now a network of 30 nurseries distributed throughout all the territory. They are generally located in the Higher Institutes of Technological Studies (ISET), in the Schools for Engineers, in Research Centers and in Technoparks. The called Incubation services are provided to incumbents who are the hosted entrepreneurs or newly created companies, in order to help them to realize their innovative ideas and transform them into operational projects. Public Startups Nurseries host for a limited period, generally one or two years, and help to relocate outside the nursery after the incubation period. With a capacity of 250 startups, this device represents an important component of the national innovation system. The national program for the establishment of Startups nurseries incubators started in 2001. Since 2011, we saw the establishment in the ecosystem of private Business Nurseries with different business models.

e. Leave to start a business

The status of the civil service permits to an employee to benefit from a granted leave to start a business during one renewable year and conserves during this period the half of his salary. The researcher and higher education teacher conserve their whole salary.

5- Support the development of innovative companies

a. PMN

It is an upgrading industrial capacity program. The process includes two phases; a first one triggered by the business demand and leading to the approval of its upgrade investment plan. And a second phase for the release of investment grant after complying with some governance rules.

The outcome of this program at the end of January 2016 can be summarized as follows:

Number of applications to join the PMN: 6229

Approved Applications: 5370

Total approved investments: 9321 MD

Total premiums approved 1234 MD

Total premiums distributed: 584 MD

The most significant stake of this investment was dedicated to production capacity and very little was allocated for the intangible assets.

b. ITP

In addition to the PMN Grant, the "Priority Technological Investment" (ITP) is a grant that insures the financial support of intangible investments, as the implementation of quality management system and also to certification. To be eligible to this program, the industrial companies, and those acting in the field of services to industry, have to be working for at least one year with no economic difficulties. Since its launch up to January 2016, ITP approved 8166 requests for a total investment of 417.2 Million TND including 176 Million TND of Grants and 84.7 Million TND of distributed premiums.

c. PCAM

PCAM is the support program for the Competitiveness of enterprises and the improvement of access to markets, under the supervision of the Ministry in charge of of Industry (PCAM: Programme d'Appui à la Compétitivité des entreprises et à la facilitation de l'accès aux marchés).

It is a program of technical assistance, training and awareness for industrial businesses and industry-related service providers. It revolves around coaching services on strategic corporate functions: Quality, R & D, marketing, production, information systems, business intelligence...

Actions supported in this frame are based on a national and international expertise, both pointed and specific that occurs throughout the implementation process: diagnosis and action plan previously defined, implementation, monitoring and evaluation and technical support & guidance.

These relevant actions to strengthen productivity of business are made in close collaboration with concerned technical centers.

Co-financing assistance missions, for each mission the program helps to fund 85% of the cost of expertise.

Technical support and provision of equipment to support the quality of technical centers, testing laboratories, testing and metrology are also covered by PCAM.

This in practice means the provision of equipment and expertise enabling organizations and institutions targeted to be in line with international standards and the needs of exporting companies, policy and quality control.

With a budget of 23 million Euros, the implementation of the PCAM operational structures was launched since December 2010. The overall objective of this tool is to facilitate access of Tunisian companies to international markets.

d. IN'TECH

It is a mutual investment fund giving an Investment Grant intended to support the investment, the innovation creation and the technology development. This fund is managed by SAGES Capital, a public asset management company.

e. RIICTIC

It is an Incentive Regime for Creativity and Innovation in the field of Information and Communications Technology. RIICTIC (Régime d'Incitation à l'Innovation et à la Créativité dans le domaine des Technologies de l'Information et de la Communication) supports projects in the innovative and high added value activities based on e-business.

All these 20 devices can be summarized in the following Table 1.

N°	Main objective referred	Devices
1	Increase R & D capabilities of enterprises	<ul style="list-style-type: none"> a. PIRD b. MOBIDOC
2	Increase the economic impact of R & D activities of the Research Centers and Higher Education institutions	<ul style="list-style-type: none"> a. VRR exploitation of research results b. Supporting the costs of IP Patents in Tunisia and abroad c. BuTT d. Training on IP and TT
3	Develop collaborative projects between the actors of NIS	<ul style="list-style-type: none"> a. Federated Search Programs b. PNRI c. Digital Tunisia 2018 d. Technoparcks
4	Promote the creation of innovative companies	<ul style="list-style-type: none"> a. FOPRODI b. IKDAM c. SAGES d. Accommodations in Public Startups Nurseries e. Leave to start a business
5	Support the development of innovative companies	<ul style="list-style-type: none"> a. PMN b. ITP c. PCAM d. IN'TECH e. RIICTIC

Table 1 : Main Devices for Technology Transfer and Innovation in Tunisia

IV- SWOT Analysis of the Tunisian NIS (TuNIS)

Despite efforts by the national community for the promotion of scientific research and the considerable efforts made by the Tunisian scientists and engineers to sit efficient and modern Universities, Research Institutes and Technical Centers, results in the science and technology sector are relatively modest, since the direct or indirect impact of scientific research on the development of the economy and the Tunisian society still remain without significant real substance.

Now, it is well established that the progress of scientific research and its ultimate drawn applications, the development of successful technology and knowledge transfer and advanced techniques to production sectors, play a key role in any process of socio-economic development. Investing ever more in science, technology and the transfer of know-how seems to be a prerequisite for sustainable socio - economic and cultural development in Tunisia. But the question remains "How to invest with better effectiveness and more efficiency?".

Here, measuring the efficiency allows knowing if the targeted results are reached and the effectiveness is an indicator of the optimality of the costs mobilized to reach the targeted results.

Investing more in financial terms is certainly a necessary condition, even if efforts in this direction have been more significant during the past two decades. The progress made by Tunisia in education and training capabilities and expertise, is remarkable. But these conditions alone are not sufficient: Today the bulk of the investment effort in the development and transfer of science and techniques must be oriented towards changing attitudes and behaviors. To accompany and support the future development efforts in Tunisia, the scientific research and technological development have now to adopt a more professional attitude, with more rationality, more rigor and consistency, leading to more tangible results, better return on investment, and contributing to more sustainable economic and social development.

Two decades after the reform initiated under the Framework Act No. 96-6 dated on 31st January 1996 on Scientific Research and Technological Development, (The famous Orientation Law of 1996), the inevitable conclusion is that there is an absolute necessity to intervene quickly, not only at the governmental institutions level, but also by associating private initiatives, in order to drive the needed change in the mentalities and especially by adopting new policies and strategies aiming to:

- Limit the lack of professionalism and the weak efficiency and effectiveness of scientific and technological development processes in place,
- Introduce new administrative and financial management rules that facilitate the development and commercialization of research results,

- Motivate engineers and scientists to the successful transfer of advanced technology to the application sectors,
- Motivate companies to the exploitation of research results and appropriation of technology transfer.
- Induce new international partnerships in technology development and transfer of know-how.

From these observations and analysis of national and international context, we propose the following SWOT analysis of the Tunisian NIS presented in Table 2:

Strengths	Weaknesses
<p>1-Mobilization of the national community for the promotion of knowledge society and considerable efforts made by Tunisian scientists and engineers to promote scientific research.</p> <p>2-Relatively strong performances on all the education indicators as evaluated by the World Bank Knowledge Economy Index WB-KEI 2012 Ranking, with a rank at 80/145, improved since 2000 by 9 positions.</p> <p>3-A national public structure of research centers and academic laboratories encouraging research activities.</p> <p>4-Strong performances in the field of research production measured by scientific publications.</p>	<p>1-Insufficient organic relations between the scientific and the economical communities and a Tunisian scientific production which is not followed by industrial and commercial innovations.</p> <p>2-Lack of a clear strategy, known by stakeholders in the technological development of the country, resulting from a lack of professionalism and lack of “return on investment approach” in the field of scientific research and innovation.</p> <p>3-Lack of a forward-looking vision and a national project crystallizing a broad national adhesion on the model of economic and social development to be built for the country.</p> <p>4- A high unemployment rate especially among the graduates threatening social sustainability of the gains recorded in the register of human development since the country's independence</p>
Opportunities	Threats
<p>1- An open economy that is naturally led to constantly follow global technological developments enabling it to consolidate and develop its external markets.</p> <p>2-A community of Tunisian competencies abroad enthusiastic to contribute to the technological development of the country by building on its acknowledged strengths.</p> <p>3-A great geographic and cultural proximity to a large center of scientific and technological development in the world, namely the European Union, and a strong partnership with it.</p> <p>4- The effective possibility of adopting governance rules based on a participatory approach, ensuring wider engagement and support of stakeholders to a national strategy for technological development leading to economic and social development.</p>	<p>1-The strong international competition in several foreign markets where Tunisia lost positions following the unrest and excessive claims that characterized the country during the last 5 years (phosphates & derivatives, textiles, leather and footwear, tourism, fisheries and aquaculture ...)</p> <p>2- A commercial aggressiveness of Foreign companies on the local market, following the free trade agreement for industrial products with the European Union.</p> <p>3-The depletion of fossil energy resources and the weakness of development of renewable resources in Tunisia.</p> <p>4-Climate changes which are likely to put Tunisia under the threat of water stress.</p>

Table 2: SWOT analysis of the Tunisian National Innovation System

In the following section we will propose and discuss how to update the related public policies with the aim of address weaknesses, build on the strengths, seize opportunities and reduce risks, leading to a more sustainable development, which has to be more inclusive for regions and populations.

V- Relevant policies for a renewed National Innovation System

In the consolidated report [2] of the National Stakeholders Workshop organized by ETC, the ESCWA Technology Center, in collaboration with ANPR, the Tunisian National Agency for Research Promotion, in Tunis in December 2015, we can find a detailed description of the Tunisian National landscape of the present national innovation system.

The report focuses on the following elements:

- a. A review of the available national innovation system various components;
- b. The national industrial and commercial competitiveness needs from R&D;
- c. The national present Intellectual Property management process;
- d. Available national capacity and gaps for commercialization of research outcomes.

The workshop organized by ETC and ANPR gathering the main stakeholders discussed and presented recommendations aiming to enhance national innovation system capacity.

The main task here is to propose and discuss how to update the related public policies with the aim of encouraging stakeholders to effectively build or rebuild a NIS, including civil society, private and public economic sector and academia, and aiming to permit to them to benefit collectively and each for his own account from the renewed TuNIS.

Following the report [2] of the National Stakeholders Workshop organized by the ETC and ANPR, our proposals will be presented under the following headings:

- 1- A global Governance with a formal Innovation Policy;
- 2- A readable STI strategy;
- 3- Adapting the regulatory for a more efficient and effective Governance;
- 4- Placing the IP Value Stream in the core process of the NIS;
- 5- Nurturing the Technology Transfer as an Industry;
- 6- Easing the access to R&D funds and Innovation financing.

V-1 A global Governance with a formal Innovation Policy

In fact there is a real need to clarify **innovation policy**, to break down barriers in the **governance** of the Tunisian NIS, and distinguish the functions of policy orientation, programming and execution.

Multiple structures for cross global national orientation and Governance of Research activities exist in Tunisia, but they are mostly not operational; some of them had not met for

over than 2 years. In addition the prerogatives of these structures intersect and are neither well defined nor well coordinated.

Remember that in Tunisia there are 6 Committees and transversal councils that are supposed to ensure good governance of the Tunisian NIS:

- The High-level Committee for Science and Technology, **an advisory committee attached to the Head of the Government** [5] (Le Comité de Haut Niveau pour la Science et la Technologie) ;
- The High Council for Scientific Research and Technological Innovation, by transformation in 2010 of the High Council for Scientific Research and Technology created in 1997, **an advisory council to the Head of the Government** [6] which secretary is assumed by the Ministry of Industry (Le Conseil Supérieur de la Recherche Scientifique et de l'innovation technologique - 2010, Conseil Supérieur de la Recherche Scientifique et de la Technologie - 1997 rattaché au département en charge de la recherche scientifique);
- The Strategic Council for the Digital Economy, **an advisory council to the Head of the Government** [7] which secretary is assumed by the Ministry of Communication Technology and Digital Economy, (Conseil Stratégique de l'Economie Numérique): Its role is to set up the pillars of the digital economy and lay the foundation for a true digital transformation of the national economy;
- The National Advisory Council for Scientific Research and Technology, **a council attached to the Minister of Higher Education and Scientific Research** [8] (Le Conseil Consultatif National de la Recherche Scientifique et de la Technologie) ;
- The National Committee for the Evaluation of Scientific Research, **a committee attached to the Minister of Higher Education and Scientific Research** [9] (Le Comité National de l'Evaluation des Activités de Recherche Scientifique) ;
- And the Technical Committee for Scientific Research and Technology, a committee supposed to prepare the works of the former High Council of Scientific Research and Technology, (Le Comité Technique de la Recherche Scientifique et de la Technologie).

To improve the readability and effectiveness of this system of governance in the service of a real human development of the country, based on a Knowledge Society for all, essentially through a substantial stream of knowledge and technology transferred between the academic world and the socio-economic world, and a transfer of technology from abroad which have to be more rewarding for the national economy, we propose to merge the top four structures in an advisory committee to the Head of the Government with a secretary insured by the Prime Ministry.

This new committee, which can be called the Knowledge Based Economy Advisory Committee to the Head of the Government, will cover the following missions:

- Follow the evolution of science and technology and the building of the Knowledge Society for all in the world, make argued proposals and give the general guidelines of the national policy of scientific research and technological development as needed for the country;
- Propose measures for the promotion of scientific research and technological development, ownership of technology in different sectors, and issue opinions regarding strategies to promote science and develop technology to make Tunisia a modern technology platform;
- Promote training and research in promising sectors and support for innovative projects with high technological value, particularly in the areas of information and communication technology, electronics, biotechnology, health, renewable energy, water, agriculture and food industry;
- Identify mechanisms to ensure coordination between different stakeholders in the fields of science and technology;
- Overseeing the definition of the national strategy for digital economy , approve and monitor its implementation, validate proposals for its updating and improvement, and ensure assessment of its performances and its impacts on the basis of quantified Key Performance Indicators;
- Reviewing public and private projects and initiatives to develop and promote the national strategy for the digital economy and provide useful support, guidelines and recommendations required to improve the methods of its successful implementation;
- The development of partnership with the developed countries and the Maghreb, African, Arab and Euro-Mediterranean countries, in science and technology;
- The establishment of a mixed network of national skills resident in Tunisia and abroad to support the promotion of high value scientific and technological activities;
- Give its opinion on all matters submitted to it by the Head of Government, especially in connection with the building of the knowledge society for all at the national level.

This new committee will be composed by 1/3 of academic members and 2/3 of members representing the socio-economic world.

The 5th committee, the National Committee for the Evaluation of Scientific Research, has to be transformed in an independent institution (agency) with more human and material resources.

The 6th committee, the Technical Committee for Scientific Research and Technology, will be in fact replaced by the secretariat of the new Knowledge Based Economy Advisory Committee to the Head of the Government.

In addition each ministry can create an internal sectorial or specialized committee for innovation; as needed after the approval of the Knowledge Based Economy Advisory Committee.

It is unfortunate that in many departments there are managers who are so afraid of the unknown that they adopt a behavior that impedes innovation. To resolve this issue of governance, we propose to:

1- Identify, within the administration, individuals with a successful track record in innovative activities, and prepare them to assume responsibility in research capabilities and innovation, particularly through training, and appropriate curriculum.

2- Create within ministries positions of scientific directors (Chief scientific advisers), with appropriate hierarchical status to contribute effectively to define the strategic objectives of departments and, in particular, to participate in the development of regulations and budgets for R & D & Innovation, as well as in the interdepartmental coordination.

With these new governance rules and since one of the important mission of the Knowledge Based Economy Advisory Committee is to “Identify mechanisms to ensure coordination between different stakeholders in the fields of science and technology”, the future NTTO will be a worthy working tool permitting to the Committee to fulfill its assignments.

In this connection, NTTO can usefully be attached to an operational transverse structure in charge of the promotion of knowledge, science and technology and we propose for that purpose that ANPR, the National Agency for Promotion of Research, will be the coordinator of the Tunisian NTTO.

Every stakeholder of the technology transfer process, who wishes it, may receive a label of NTTO-Partner, according to some precise criteria to be defined and announced, but necessarily after presenting to the Knowledge Based Economy Advisory Committee a multiannual strategy and an action program. This label will allow the access to certain financial and technical assistance and invaluable helps for the realization of transfer of technology programs, but the concerned stakeholder will keep the benefit of this label only if it presents annually a new program of action and a balance sheet over the past year about the previously adopted action program.

V -2 A readable STI strategy

With a better and more readable governance rules it becomes easier to define long term objectives assigned for the NIS, to examine different scenarios for the evolution of the scientific and technological national and international environment and to analyze and anticipate the market tendencies for a better positioning of the country especially for exportation of goods and services.

This permits to adopt a national STI strategy which has to be clearly formulated and communicated to all stakeholders, by a similar approach to that adopted in South Korea allowing the country to draw up in 2002 the National Technology Roadmap (NTRM) [12].

To drive this strategy we needed to set up a scoreboard consisting of key performance indicators, KPIs. To this end we propose to define a scoreboard inspired from the Innovation Scoreboard adopted by the European Union, which is classified as fourth in the world, according to this scoreboard, after the United States, Japan and South Korea, but with which we have more economic, scientific, technological and cultural exchanges.

The Innovation European Union Scoreboard [10] distinguishes between 3 main types of indicators – Enablers, Firm activities and Outputs – and 8 innovation dimensions, capturing in total 25 indicators as detailed in Figure 1 below:

We can also use the Arab Innovation Scoreboard to be adopted by ETC and Arab countries.

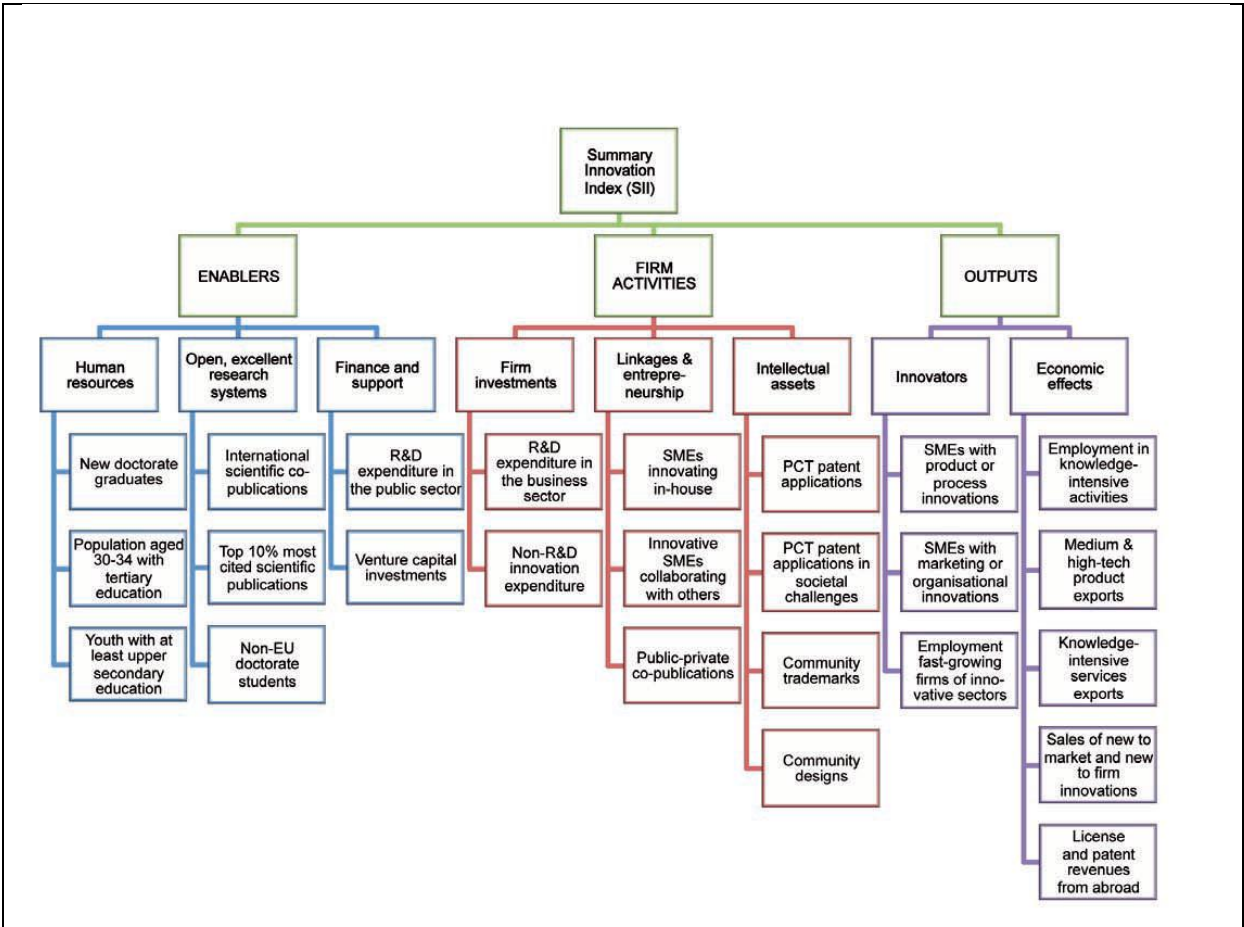


Figure 1: The 25 indicators of the Innovation European Union Scoreboard

But the Tunisian dashboard should be adapted to the Tunisian context, taking into account the specificities of the Tunisian NIS and data that are available and / or calculable within a reasonable time.

V -3 Adapting the regulatory for a more efficient and effective Governance

Adapting the regulatory is necessary if the new proposed rules are adopted. But independently, for a more efficient and effective Governance even within the actual general frame, we already have to adopt some improvements as mentioned below:

- 1- A higher education teacher who benefits from a granted leave to start a business has now the duty to ensure his teaching hours, and this do not leave him clear mind and full availability to succeed in his plan to create of a company. This should change and a beneficiary of leave for the creation of a business should be exempted from his teaching load, otherwise that's not a leave!
- 2- We have to create a clear legal framework for public and private incubators, for technology resource centers and platforms and for the Technology Transfer Offices within the Universities and Research Centers (BuTT, Bureau de Transfert de Technologie), so that these structures stop groping and fulfill their mission satisfactorily.
- 3- Increase the financial amount of the Grant for Investment in Research and Development allocated by the Ministry of Industry (PIRD, Prime d'Investissement à la Recherche et Développement) and improve its functioning by more easing of attribution. Currently this financial assistance is limited to 50% of the total cost of studies with a ceiling at 25,000 Dinars (12,500 USD) and 50% of the cost of experiments and prototypes achievements of technical tests as well as field experiments and acquisition of scientific laboratory equipment needed to conduct research and development projects with a ceiling at 100,000 Dinars (50,000 USD).
- 4- The rules for the creation of Research Laboratories and Units are now the same in the Universities and the Higher Institutes of Technological Studies, in terms of critical mass in human resources and scientific production; although teachers are not governed by the same status and socio-economic missions of the two kinds of institutions are not the same. In this context it is urgent to create a new breed of Laboratories and Research Units, which can be called Innovation Laboratories and Units, by adopting new criteria in which the IP and Technology Transfer have more importance when assessing the proposal for creation or renewal of such Innovation structures.
- 5- The special status of teachers of universities (Decree No. 93-1825 dated on 6th September 1993) lists a first training mission and a second mission of participation to scientific research and development activities and, as appropriate, to finalization of its results. To promote effective integration of relations with the economic sector in assessing public researchers and teachers, we have to mention explicitly in their statutes the valorization mission of research results and do not be limited to the finalization which generally means the publication of results in journals.

- 6- In the general status of the civil service, the highest degree enumerated in the rules of recruitment is the Master Degree or the National Engineer Degree and it is urgent to introduce at this level the PhD Degree in order to facilitate the recruitment of PhD's in Public Administrations.

V -4 Placing the IP Value Stream in the core process of the NIS

A readable STI strategy passes through a policy for IP with more incentives to researchers to claim and valorize their ideas and discoveries and more incentives to Business Angels to launch innovative startups.

A new policy in the domain of the intellectual property has to be more incentive and dynamic and will go through:

- 1- Improving the level of general awareness of intellectual property in Tunisia;
- 2- The establishment of a reference system for the disposal process and intellectual property acquisition;
- 3- The definition of a legal framework to develop commercial intermediaries to ensure IP protection services;
- 4- Introducing a rule of substantive investigation on novelty, to be done by the National Institute of Standardization and Industrial Property (INNORPI, Institut National de la Normalisation et de la Propriété Industrielle), before agreeing a patent of IP;
- 5- Granting of financial incentives to authors of patents and / or plant varieties.

In this connection we propose to take inspiration from the helping system managed by Innovate-UK, which is the British agency managing "Innovation Vouchers", and to put in place a system permitting to help Tunisian innovator startups, to find and choose an expert from one of the following:

- universities and further education institutions,
- research centers,
- technical centers,
- technology resource centers and platforms,
- intellectual property advisers.

These new technical and financial supports adapted to the Tunisian context can be managed by the Promotion Agency for Industry and Innovation of Tunisia (APII).

V -5 Nurturing the Technology Transfer as an Industry

In this connection, we propose to develop a greater use of compensation clauses in public contracts, which are to constrain the contracting foreign companies in certain markets, to increase the rate of local integration by including more products and intermediary services made in Tunisia among the goods and services to be supplied.

Similarly it is proposed to increase the use of technology transfer clause, as to require the contracting company to associate a local team which will thus be trained to support the future expansion of the project or similar projects and the maintenance of equipments supplied or built.

But today we must be more demanding and incorporate among the terms of reference of Public Calls for Tenders, depending on the nature of the markets, a clause of sub-contracting of Research and Development, through contracts with Tunisian Research and/or Innovation Laboratories, by setting a minimum value for the financial envelope of such outsourced R&D activities as a percentage of the contracted market.

In addition it is proposed to develop the activity of economic intelligence and technology watch.

Similarly it is urgent to develop the National Observatory of Science and Technology, which is currently limited to a project manager attached to the Office of the Minister of Higher Education and Scientific Research, to a more important structure radiant throughout the NIS in particular by the periodic publication of KPIs and by monitoring their development over time and in comparison with those of comparable countries and target countries.

V -6 Easing the access to R&D funds and Innovation financing

The Investment Companies in Risk Capital are supposed to facilitate access of startups to the necessary financing even if the developers do not have sufficient assets to mortgage for access to traditional bank loans.

But in reality things don't go in this direction and many innovative project promoters complain that they are often forced, from the beginning, to sign a pledge to buy the shares of the Investment Companies in Risk Capital (SICAR) in the corporate capital of the startups that they seek to launch. In fact SICARs do not play their role in risk-taking and they complain in their turn of the smallness of the stock market which makes the risk disproportionate to them. This fact calls for a thorough reform of the system of financial support to innovative companies and more generally SMEs.

Tunisian law does not recognize the status of Business Angel and leaves no room for the shareholder agreement. In France for example, the Business Angels benefit from a tax reduction on the Fortune invested and on the income generated by the equity investments in SMEs. But the good practices are to be found in English-speaking countries. Indeed, if

France has around 4,000 business angels, it is far behind its neighbors, including Britain which counts 50,000 and behind the US which counts between 300,000 and 400,000 business angels [11]. This difference is partly explained by cultural factors, including a high trend of French people to invest in real estate, rather than in productive activities. This behavior towards productive investment is a feature that we find in Tunisia and that we must work to change, notably by creating inciter status for equity investors in SMEs. It is urgent today to create a legal and tax environment dedicated to Business Angels and thus support their efforts towards innovative entrepreneurs.

By another way, some specific public financial and technical help have to be targeting Small and Medium Enterprises (SME) and we propose here to establish a mechanism of "Innovation Vouchers", similar to the one managed by Innovate UK. This will permit to Tunisian SMEs to consult a public research institution, to ask for advice on an innovative project and to pay these consultancies and advices by using the Tunisian Innovation Vouchers that can be managed by APII.

VI- Conclusion

In this study, we considered the diagnosis of the Tunisian NIS and the general recommendations to improve its capacities that were presented and discussed at the workshop organized by the ETC and ANPR in December 2015 in Tunis. We also presented the main 20 national public devices of assistance for Technology Transfer and Innovation.

Then we proposed a renovation of the Tunisian NIS, based on a SWOT analysis and by inspiring us from best practices in countries that achieve the best performances in the areas of innovation and technology transfer between academia and the economic production world.

Here, it is important to note that it is not by bringing together the best components from the "best" NISs in the world that we will succeed in building a renovated NIS that will lead the country to the best results. In fact in our approach we have ensured to secure two necessary conditions for this: the overall consistency and appropriateness to the national context.

The policies and guidelines proposed in this study will be presented at a workshop gathering stakeholders of the Tunisian NIS that will be organized in a near future by ESCWA Technology Center and ANPR in Tunis, with the aim of encouraging stakeholders to effectively build or rebuild a NIS, including civil society, private and public economic sector and academia, and aiming to permit to them to benefit collectively and each for his own account from the renewed NIS.

This workshop will be an opportunity to remobilize the actors involved and to adopt and add proposals by integrating the different points of view of the participants and we hope that the awareness will be so deep and large that the multiple opinions and orientations will be converging.

The exchanges that will take place on this occasion will validate the relevance of new policies proposed here and the necessary coherence and adequacy of the renovated NIS, permitting to lead the country to expected results in the fields of Technology Transfer and Innovation and allowing to establish the Knowledge Economy for All and a more sustainable and inclusive development for regions and populations.

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