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Outline Proposal for an African Master Program in Engineering and Technology Policy (ETP) at ENIT

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Background

Africa is being hailed as the 21st Century growth engine. Undeniably, Africa is witnessing rapid economic changes, unprecedented political stability and momentous reforms in many of its nations. Some of these African countries are achieving or expecting to achieve double-digit growth. However, much of this economic revival is fueled by commodities price hikes!

Promisingly, Africa's political leadership solemnly declared, during the celebration of the Golden Jubilee of the founding of OAU/AU, to rededicate itself to the continent's development and pledged to develop "the Continental Agenda 2063, through a people-driven process for the realization of the vision of the AU for an integrated, people-centered, prosperous Africa, at peace with itself."

Fittingly, and in order to leverage the might of STI in helping Africa achieve its Agenda 2063 objectives, the Assembly of African Union Heads of States and Government, adopted in June 2014 the Science, Technology and Innovation Strategy for Africa (STISA-2024). Indeed, its foreword attests that "(t)he strategy is part of the long-term people centered AU Agenda 2063 which is underpinned by science, technology and innovation as multi-function tools and enabler for achieving continental development goals."

Realistically, to accomplish this continental vision, while taking advantage of this favorable, yet limited, window of opportunities, Africa is called to swiftly and vigorously engage in country specific transformation trajectories where commodities and/or agriculture are efficiently leveraged towards progressive industrialization by adding value, adopting and devising appropriate technologies, as well as providing needed services.

Motivation

The implementation of the Continental Agenda 2063 vision, requires, *inter alia*, appropriate strategies, horizontal and vertical policies, along with planning, execution and governance capacities. Unfortunately, the latter skills and know how, especially those related to STI, e.g., industrial policy in general and Technology development and Innovation in particular, remain very scarce in Africa!

As a matter of fact, STISA-2024 recognizes, in its situational analysis section, that Africa has "inadequate expertise on STI policy development." "Many of the officials involved in or responsible for drafting policy documents do not have the necessary skills or training and have no experience in evidence based policy making. Moreover, in most countries institutions responsible for STI policy do not have appropriate libraries or easy access to sources of relevant

information for policy-making. Very limited evidence-based policy development takes place in Africa."

Likewise, OASTI[1] claims that "many African countries do not have organized processes and institutions for STI policy-making." In fact, "(t)he first major attempts at formulating explicit science and technology (S&T) policies in post-colonial Africa can be traced to the 1970s and 1980s. These were largely efforts by UNESCO to assist some sub-Saharan African countries to put in place S&T policies and related institutions for policy formulation and implementation."

Moreover, OASTI attests that "In their efforts to review reform or formulate STI policies, African governments are discovering that expertise for STI policy is in very short supply in Africa. Most of the countries do not have expertise and programs for STI policy research and related capacity-building programs."

Therefore, it is critical for African universities to recognize that their duty is not only to educate and train say scientists, engineers and lawyers, but also managers, entrepreneurs, investors, consultants and policy makers. The latter category is expected to play a central role in policy analysis and design.

This serious African state of affairs is the result of a frail higher education system in general, and, as stated above, a quasi-absent policy capacity chiefly in STI. To promptly convert this vicious circle into a virtuous one and build the needed continental critical mass of policy experts, African leading universities have to create and/or consolidate their STI policy training programs and respond to their national, regional and continental decision making needs. Moreover, they need to pool their know-how, capabilities and institution together in networks in order to accelerate the emergence of a viable STI policy continental capacity and dynamics.

Post revolution Tunisia is getting ready to embark in a systemic and long term reform of its eco-socio-economic development model and thus is in dire need for the required policy capacity in general and STI one in particular. Indeed, such capacities will empower Tunisia to collectively will, jointly devise and collaboratively build an equitable sustainable knowledge society where innovation leads sustainable growth, education provides educated and skilled manpower, and information and communication infrastructure facilitates the assimilation, creation and diffusion

[1] AOSTI (African Observatory of Science, Technology and Innovation) (2013), Science, Technology and Innovation Policy-making in Africa: An Assessment of Capacity Needs and Priorities, AOSTI Working Papers No. 2

of knowledge within a viable National Innovation System. This unprecedented challenge will succeed unless all people, institutions and partners commit to a common vision.

As the oldest and leading engineering institution in Tunisia, ENIT is jump starting the salutary process of training the next wave of decision makers and leaders capable of safely steering the country through this difficult transition phase and beyond.

ENIT has initiated similar programs, be it graduate or undergraduate ones, in response to the country's needs and challenges, and has always succeeded in its endeavors. Almost two thirds of Tunisia's engineers are ENIT's alumni, many of them occupied and still hold leading positions in the country, and several held and are presently holding ministerial duties.

With the present master program, ENIT is not only responding to the call of its mother land and its people, but it is also offering its experience, its expertise and its networks to the region and the continent in order to contribute, with other African and non-African institutions, in making of STI a lever of development, prosperity and peace.

Engineering and Technology Policy (ETP) Master Program

Thus, to help alleviate this enduring and serious continental handicap, tackle the societal challenges facing Tunisia, Africa and the planet as a whole, align its mission with international practices and secure the benefits of the African nations' investment in knowledge, the University of Tunis El Manar, through its engineering school ENIT, is launching an African Master Program titled "**Engineering and Technology Policy** (ETP)."

The EPT master program follows a clear rationale as to its continental capacity building mission objectives, its policy profession skills and knowledge framework, and its Bologna Process academic organization.

Indeed, ETP is designed in order to achieve three main objectives and thus responds adequately, and at the several scales, to the many and diverse challenges facing STI in Africa. These three main objectives are:

1. Leverage innovation, within a viable National Innovation System (NIS) through sound STI policies, good governance and efficient management, to achieve equitable and sustainable development,
2. Insure the coverage and understanding of the Demand-Pull and Technology-Push innovation models, while paying special attention to Pro-Poor one, and

3. Insist on the importance of the policy process cycle, and encourage students to learn from previous experiences inside and outside of Africa, while emphasizing the importance of learning by doing.

Program's Global Orientations

The program is interdisciplinary and at the intersection of Engineering and social Sciences. The students are expected to engage in complex problems where science, engineering, technology and innovation blend, entre autres, with economics, management, policy, law and regulations.

The core of the program will consist of policy analysis, complex systems modeling and simulation, and economics and management. In addition, the curriculum will be structured in three complementary pillars, besides the engineering sciences background of the candidates. The pedagogical triad is (i) decision making tools, (ii) social sciences modules, and (iii) experiential activities such as round table simulations.

The targeted research areas will gravitate mainly around (i) Innovation Systems and development, (ii) Industrial and technology policy, and (iii) Climate change and sustainable development.

It is important to note that the third research theme is of particular interest and is covered in a dual manner. Firstly, sustainability and climate change challenges will be among the key themes underlying the master program pedagogical foundation. In so doing, policies will always undergo a practical scrutiny as to their possible effects on these global issues. Secondly, and as part of the sectorial STI policy modules, the latter themes will be addressed as need be.

The following table gives further information about the structure and content of the master program. As seen below, the master program is built around five major teaching units. Each component is described in the table via a number of keywords.

N°	Teaching Unit (TU)	Keywords
1	**Innovation & Innovation Ecosystems**	Knowledge Management - Innovation Value Chain Analysis - NIS Governance (local & global) - African contextualization of NIS - Innovation & Industrial Policy - STI & economic changes.
2	**STI Policy Analysis and Assessment**	System Thinking - System Modeling - Advanced complex System Simulation - Indicators for STI policy - IPR & Competition Law - Foresight and Road mapping - Sectorial STI Policies - Decision processes - Uncertainty & Risk Management.
3	**International STI Policy**	Comparative STI Policy I (Leading Countries) - Comparative STI Policy II (emerging countries) – Science Diplomacy, Cooperation and Aid.
4	**Human, Social & Political Sciences**	Political Systems - Funding Innovation - K-based Development Policies - Entrepreneurship & Innovation - Change Management & Leadership Development - STI & Society.
5	**STI Expertise Projects**	Synthetic Project I - Synthetic Project II - Final Project Design & Planning - ETP Final Project & Expertise Report.

Targeted Candidates

The target students' population is mainly from Africa, and to some extent from the Middle East. Of course, the program remains open to all developing countries candidates as long as funding permits.

Moreover, the postgraduate program is built in conformity with the Bologna Process regulations and guidelines. Consequently, License degrees holders from the hard sciences are eligible, engineering degree holders and last year engineering students, enrolled in five years academic programs, are also qualified. Any other qualifications congruent with the latter academic profiles are also entitled to enroll.

Targeted Potential Employers

As stated earlier, Africa is in dire need for policy analysts in general and STI ones in particular. Similar needs are to be found in the Middle East and most developing countries.

More specifically, the graduates will certainly find ample opportunities in Ministries in charge of STI or part of it, public agencies in need for policy analysts, large public and private companies, Think Tanks and NGOs.

Moreover, international development institutions, universities and research and training centers are potential recruiters.

Policy Skills Framework

Skills, competences and qualifications needed by policy makers for policy making are many in nature and vary according to the levels of responsibility. Policy professionals are called to bring together evidence, politics and delivery to support decision makers achieve outcome and thus change.

The policy profession skills and knowledge framework adopted in this master program is the one developed by the UK Government. This framework is composed of four skills and four levels, where each skill is decomposed in three sub skills (see the matrix below.) The master program covers all four skills and levels 2 and 3.

The four skills are:

1. Understanding the context,
2. Developing the options,
3. Getting to a decision, and
4. Making it happen.

Partners and Potential Ones

Due to the novel interdisciplinary nature of the master program, as well as its regional dimension, the founding team has endeavored to build partnerships with universities and institutions capable of contributing to the design, delivery and hopefully the success of this master program. In addition, and in order to enhance positive spillovers, visibility and thus support for the program, a UNESCO Chair in STI policy proposal was submitted by the founding members of the master program.

Today, the University of Manouba (Tunisia), the University of Bremen (Germany), Georgia Tech (USA), and NISER (Nigeria) have been directly involved in the design of the master program, and their official implications will follow shortly.

Along the same line, the master program will benefit from the cooperation and/or partnerships with additional universities and institutions from and outside of Africa. As a matter of fact, the UNESCO Hammamet workshop is a great opportunity to initiate new partnerships with the participants' institutions and work together towards building Africa's STI policy capacit

Teaching Units (TU) & Semesters

N°	TU	SEM I	SEM II	SEM III	SEM IV
1	**Innovation & Innovation Ecosystem**	Knowledge management	NIS Governance (Local and Global)	Innovation & Industrial Policy	
		Innovation Value Chain Analysis	African/Pro Poor NIS	STI & macroeconomics Policies	
2	**STI Policy Analysis and Assessment**	System Thinking	System Modeling	Advanced Complex System Simulation	
		STI Policy Indicators	Foresight and Road mapping	Sectorial Systems of Innovation and Dynamic Technological Catch Up	
		IPR & Competition Law	Decision Processes	Uncertainty & Risk Management	
3	**International STI Policy**	Comparative STI Policy I (Leading Countries)	Comparative STI Policy II (Emerging countries)	Science Diplomacy, Cooperation and Aid	
4	**Human, Social & Political Sciences**	Political Systems	Funding Innovation	K-based Development Policies	
		STI & Society	Entrepreneurship & Innovation	Change Management & Leadership Development	
5	**STI Expertise Projects**	Synthetic Project I	Synthetic Project II	Final Project Design and Planning	ETP Final Project

Semester I

N°	Teaching Unit (TU)	Nature of TU (Fundamental/ Optional)	Course	Hours per Semester (14 weeks)	Credits	Coefficient		Exams		
				Hours	Course	TU	Course	TU	Conti.	Mixt
1	Innovation & Innovation Ecosystems	F	Knowledge Management	30	3	2	1	Innovation & Innovation Ecosystems		X
			Innovation Value Chain Analysis	30	3		1			X
2	STI Policy Analysis and Assessment	F	System Thinking	30	3	3	1	STI Policy Analysis and Assessment		X
			Indicators for STI policy	30	3		1			X
			IPR & Competition Law	30	3		1			X
3	International STI Policy	F	Comparative STI Policy I (Leading Countries)	30	3	1	1	International STI Policy		X
4	Human, Social & Political Sciences	F	Political Systems	30	3	2	1	Human, Social & Political Sciences		X
			STI & Society	30	3		1			X
5	STI Expertise Projects	F	Synthetic Project	60	6	2	2	Synthetic Project	X	
				Total SEM I	30	10				

Semester II

N°	Teaching Unit (TU)	Nature of TU (Fundamental/ Optional)	Course	Hours per Semester (14 weeks)	Credits	Coefficient		Exams		
				Hours	Course	TU	Course			
1	Innovation & Innovation Ecosystems	F	NIS Governance (local & global)	30	3	2	1	Innovation & Innovation Ecosystems		X
			African/Pro Poor NIS	30	3		1			X
2	STI Policy Analysis and Assessment	F	System Modeling	30	3	3	1	STI Policy Analysis and Assessment		X
			Foresight and Road mapping	30	3		1			X
			Decision Processes	30	3		1			X
3	International STI Policy	F	Comparative STI Policy II (emerging countries)	30	3	1	1	International STI Policy		X
4	Human, Social & Political Sciences	F	Funding Innovation	30	3	2	1	Human, Social & Political Sciences		X
			Entrepreneurship & Innovation	30	3		1			X
5	STI Expertise Projects	F	Synthetic Project II	60	6	2	2	Synthetic Project	X	
				Total SEM II	30	10				

Semesters III & IV

N°	Teaching Unit (TU)	Nature of TU (Fundamental/ Optional)	Course	Hours per Semester (14 weeks)	Credits	Coefficient		Exams		
				Hours	Course	TU	Course			
1	Innovation & Innovation Ecosystems	F	Innovation & Industrial Policy	30	3	2	1	Innovation & Innovation Ecosystems		X
			STI & macroeconomics Policies	30	3		1			X
2	STI Policy Analysis and Assessment	F	Advanced complex System Simulation	30	3	3	1	STI Policy Analysis and Assessment		X
			Sectorial STI Policy *(HR, Energy, Transport & Logistics, Health…)*	30	3		1			X
			Uncertainty & Risk Management	30	3		1			X
3	International STI Policy	F	Science Diplomacy, Cooperation and Aid	30	3	1	1	International STI Policy		X
4	Human, Social & Political Sciences	F	K-based Development Policy	30	3	2	1	Human, Social & Political Sciences		X
			Change Management & Leadership Development	30	3		1			X
5	STI Expertise Projects	F	Final Project Design & Planning	60	6	2	2	Synthetic Project	X	
				Total SEM III	30	10				
				Total SEM IV ETP Final Project	30	10				
				Total Programme Master ETP	120	40				

Teaching Units & Modules

This section presents tentative free style descriptions of the different courses submitted by the several potential lecturers and/or partners. They are shared mainly for discussion and possible enhancement purposes. Once the global structure of the master program agreed on, and the courses settled, all contents will be streamlined along the following structure:

1. Course title
2. A short introduction
3. Course objective
4. Course content, and
5. Learning objectives.

Teaching Unit: ETP_10: Innovation & Innovation Ecosystems

Module: ETP_11: Knowledge Management (KM)

Knowledge either codified or personal, is a great enabler for the decision we make and to the action we take. Thus, we need to:

- Recognize and understand the K processes in order to improve the quality of our decision and actions.
- Analyze the impacts of KM, K services and K Infrastructure on the organization and economy competitiveness.
- History and Definition of Concepts and arts of KM - Current state of the art of KM - Information Management & KM - Explicit Knowledge - tacit knowledge - K-Infrastructure – K-services - KM and Innovation process – Impacts on Competitiveness of the organization and the economy -
- KM Auditing – Strategic KM - KM and ethics.
- Case studies.

Module: ETP_12: Innovation Value Chain (IVC)

''The more value an organization creates, the more profitable it is likely to be. And when you provide more value to your customers, you build competitive advantage.'' Porter Michael. How Innovation encompasses such a paradigm?

Principles of Value Chain Analysis: Porter's Model- Value Chain vs Value System - Empirical analysis.
Innovation Value Chain (IVC): Innovation production - Innovation outputs- value added - impact of innovation on a firm's growth and productivity -

Innovation Value Chain Audit: IVC assessment - Critical indicators -
Case Studies

Module: ETP_13: NIS Governance

Investments in developing an NIS should give governance particular attention, especially the systems and practices for setting priorities and agendas, designing and implementing policies, and obtaining knowledge about their impacts. This Module helps the understanding of the related concepts, tools and practices. Governance played a major role in the development of innovation systems in many leading countries. Related policy issues, lessons, and recommendations emerging from case studies should be captured.
One of the key issues arising from the cases is that well-functioning innovation systems critically depends on how well governments can bring together and coordinate the activities of the various actors and stakeholders which is fundamental for advancing Science, Technology, and Innovation in various sectors of the economy.

Concepts and Models: Innovation processes, systems and Ecosystems – Local vs. Global Innovation Systems -
NIS Actors and Stakeholders : K&T Transfer Actors and Services – University, Industry and Government interactions in Triple Helix Framework - Synergy Engines (Clusters, Open Innovation Labs….) – First line beneficiaries – PPP players - Sectorial systems of innovation and the dynamics of technological catch-up.
Governance and Governability: Institutional Governance – Activities Governance - Priorities and STI Agendas – Governability and governance Impact on organization – Impact on governmental STI policy. - Impact of the evolution into regional innovation systems on fostering innovation activities – contextualization of Innovation Systems in Africa.
Case studies: Leading countries, African/Emerging countries - Related Policy issues, captured lessons and recommendations.

Module: ETP_14: NIS Contextualization in Africa

This course provides the origins and knowledge of the national system of innovation (NSI) framework and how it can be applied to the analysis of African economies.

Origins and definitions of the national system of innovation
Characterizing the NSI according to national development levels
Knowledge flows and innovation in the NSI framework
Agents' interaction and technological learning within the NSI framework
Contextualizing innovation in Africa's development
The national system of innovation and Africa's innovation challenge

Technological capability building and the NSI

Skills & outcomes
Adequate knowledge of the NSI framework and its application to the analysis of African economies
Knowledge of strategies for building technological capability through the application of the NSI framework

Module: ETP_15: Innovation & Industrial Policy

This course provides the understanding of how science, technology and innovation policy can promote the relationships between the knowledge industry, government and the private sector.

The triple helix framework and its applications in developing countries
Intellectual property, patenting regimes, and the role of government
Technology incubation as innovation policy
Industrial policy and the constraints on university-industry linkages

Skills & outcomes
Provide understanding on the scope and limits of interaction between universities, industry and government in the bid to promote technological learning and innovation.
Learn how to promote firm spin-off from economically useful knowledge.

Module: ETP_16: STI & Perspectives on Economic changes

To provide an overview of the economic thoughts underpinning the role of technological change in economic development.
Main stream neo-classical economics and its assumptions
Technology and growth
Technology and competitive market selection
Entrepreneurship and Neo-Schumpeterian economics
Skills & outcomes
Basic knowledge of economic thought in the analysis of science, technology and innovation policy
Capacity for understanding the interface between economic policy, industrial policy and innovation policy.

Teaching Unit: ETP_20: STI Policy Analysis & Assessment

Module: ETP_21: System Thinking

Today's socio-technical systems are growing more complex and thus defy simplistic analysis and linear decision making. The failures of many policies are due to the application of mechanistic approaches and reductionist thinking. To avoid the pitfalls of these traditional policy analysis practices, this course introduces system thinking as a holistic and systemic perspective for policy engineering.

System thinking promotes a more holistic understanding of reality by bringing together three activities. It apprehends complexity, uncertainty and change by focusing on interrelationships and structure. It engages with multiple and often contrasting perspectives among stakeholders. It encourages collective thinking to bring about viable improvements.

The course provides a framework for students to engage with real policy problems and allows them, through case studies, to value the potential of system thinking and complexity handling in general.

Module: ETP_22: STI Policy Indicators

For the STI indicators the standard approach is to follow the OECD 'Frascati' Manual guidelines, whereas for Innovation Surveys the methodology of Eurostat, based on the OECD 'Oslo' Manual is the de facto standard. These approaches are designed to permit construction of indicators that are broadly comparable across countries and are carried out within the framework of a broad methodology that ensures consistency.

An important application of this work is the use of indicators to identify gaps that may require government intervention. The analysis of indicators for science, technology and innovation can also identify areas for capacity building support by donor countries. The system of indicators would then provide the business case in support of donor involvement, and then provide a means of monitoring the change resulting from the aid.

Module: ETP_23: IPR & Competition Law

The objective of the module is to make Engineers learn about complex international legal environment in which multinational corporations and businesses operate. Through several case studies, the module introduces some practical legal concepts and compliances that are needed by today's businesses to comply with Competition Law, IPRs and their legal linkages. This module provides also, dual benefits of learning Competition Law & IPRs challenges faced by developing

countries when they expand into new innovative territories, markets and need to develop an efficient competitive policy.

Introduction of competition and competition law – introduction to intellectual property – Introduction to IPR and completion law – legal framework of competition in Tunisia – abusive anti-competitive practices – abuse of dominant position – anti competitive agreements – international perspectives (Europe, USA, Brazil, India…) – International Agreement of Trade related IPR aspects(TRIPS) - IP-competition relationship in developing countries - IP based competition policy approach in DC – Case studies.

Module: ETP_24: System Modeling

System modeling in general and system dynamics in particular, help the decision maker untangle complexity by providing a language and a set of tools to model the system under study and thus capture the cause-and-effect relationships among the different policy variables. The course is focused on modeling, simulation and experimental analysis of complex problems and the design of policy for change. Systems' structures, i.e., feedback loops, interconnectedness, and delays, encountered in the System Thinking course, and the dynamics of the individual components determine the overall dynamical behavior of the system under study.

Real case studies, computer modeling and simulation and in depth examination allow the students to build skills and learn how to anticipate potential problems, avoid possible pitfalls, and design viable policies to improve performance.

Module: ETP_25: Foresight & Road mapping

Forecasting, technology road mapping, future studies and other forms of foresight try to identify long term trends and thus to guide decision-making. Foresight that emerged in the recent years mostly in Europe aims at identifying today's research and innovation priorities on the basis of scenarios of future developments in science and technology, society and economy.

Foresight is a participative process involving different stakeholders. The latter may include public authorities, industry, research organizations, non-governmental organizations, etc. The process can be organized at different levels: cross-national, national, or regional.

Foresight aims at identifying possible futures, imagining desirable futures, and defining strategies. Results are generally fed into public decision-making (for example, which research

priorities deserve public funding), but they also help participants themselves to develop or adjust their strategy.

Thinking, debating and shaping the future is even more essential today because the complexity of science, technology and society interrelationships, the limitation of financial resources, the increasing rate of scientific and technological change impose on governments and the actors in the research and innovation system to make choices.

Module: ETP_26: Decision Processes

This Module covers the basics of decision-making and critical thinking. These skills are critical for all managers, since the majority of their tasks revolve around making decisions that impact their organization, its employees, and its customers.
A. Organizational Decision-Making:
-Theories of Managerial Decision-Making include the classical theory and the behavioral (or administrative) theory.
-Types of Decisions vary based on the type of decisions that have been made, those to be made, and the frequency of decisions.
-Personal vs. Business Decisions
-Business Decisions
B. Critical Thinking:
-The Scientific Method is used so knowledge is obtained in an unbiased manner.
-Logical Reasoning Using the Scientific Process
-Logical Thinking Patterns
C. Creative Thinking in Decision-Making
-Individual Creativity
-Using the Creative Process in Organizations

Module: ETP_27: Advanced Complex System Simulation

The traditional analysis and modeling tools, such as System thinking and System Dynamics, have been and remain extensively used in the realm of policy engineering. Nevertheless, there is a growing recognition of the limitations of these tools in capturing the complex realities inherent in public policy analysis and design.

This course introduces Agent-Based Modeling (ABM) as a methodological complement or enhancement to classical tools used in policy analysis. The course starts with an outline of the history of ABM as well as the similarities and differences with System Dynamics. An important outcome of this course is to provide the student with guidelines as to how to choose between

ABM or System Dynamics in a particular situation. The main goal of the course is to enhance the student's modeling skills and thus bring the students to build from scratch their ABM models.

As the course progresses, the students will be introduced to increasingly complicated problems and related ABM models helping them sharpen their policy analysis and design skills. Moreover, and all along the course, the students will be dealing with micro-macro levels dialectics, adaptation, evolving structures, emergence, and non ergodicity.

Module: ETP_28: Sectorial Systems of Innovation and Dynamic Technological Catch Up

This course teaches the dynamics of sectorial competition and innovation policy in a global technological race

What are sectorial systems of innovation?
Intersections between sectorial, regional and national innovation systems and their roles in technological catch up.

Factors responsible for technological laggards and learning to overcome them: examples from successful emerging economies
Sectorial specialization and the prospects for economic and technological catch up by African economies

Skills & outcomes
Provide knowledge of sectorial system of innovation and its relevance in innovation policy.
Help build capacity for strategic thinking in the formulation of engineering and technology policy.

Module: ETP_29: Uncertainty & Risk Management

Nearly all analyses of Policy problems are confronted with uncertainty. The implications of these uncertainties are particularly critical in the assessment and selection of regulatory options. Current practices within the regulatory community do not adequately deal with uncertainty. In contrast, a quantitative approach to uncertainty analysis is proposed as the most appropriate way to deal with uncertainties. The benefits of such an approach include more proper and explicit characterization of the state-of-knowledge about science and technology without the burden of simplifying, policy-motivated assumptions, concise communication of such information to decision-makers, and a capability to quantitatively identify modeling directions, data requirements, and research needs. General methodological issues of uncertainty analysis are discussed. These issues are illustrated based on a review of uncertainty analysis activities in exposure assessment.

Introduction to risk : General concepts and terminology - Risk management approach
Reliability according to design codes : Design principles and criteria using a probabilistic basis - Performance limit states - The semi-probabilistic and full probabilistic approaches - Simulation techniques and safety index.
Hazard identification : Checklists - Preliminary hazard analysis (PHA) - Hazard and operability analysis (HAZOP).
System analysis : Failure mode and effect analysis (FMEA) - Systematic identification of release points (SIRP) - Fault tree analysis (FTA) - Event tree analysis (ETA)
Risk analysis : Consequences analysis: loss of life and quantification of economic losses. - Risk assessment and robustness - Methods for the risk control. Cost-benefit analysis and cost-efficiency of control measures. - Tolerable and acceptable risk criteria. Risk perception, risk aversion and risk mitigation.
Examples of risk analysis applied to different fields of public policy.

Teaching Unit: ETP_30: International STI Policy

Module: ETP_31: Comparative STI Policy I (Leading Countries)

The aim of comparative policy studies is to compare and contrast policy making across national, regional and sectorial boundaries in order to avoid pitfalls in the design, implementation and evaluation of such policies.

Methods of comparative inquiry will be considered, a number of theoretical approaches used to make sense of policy processes and outcomes will be surveyed with special attention on variations and similarities between selected developed countries' STI policies.

The students will be encouraged, through the course, to identify the underlying policy, institutional and cultural determinants behind the countries performances and thus the added benefits of cross-country analysis.

Module: ETP_32: Comparative STI Policy II (Emerging countries)

This course builds on the Comparative STI I course and allows the students to apply their acquired knowledge to developing countries especially African ones. In doing so, the students are called to factor in and integrate the fact that STI are contextual processes whose impacts depend on the innovation systems and socio-economic environments they are embedded in.

The BRICS as a canonical emerging countries group will be used for inter- and cross-countries analysis with special attention to African countries. The explicit connection between STI and the

socio-economic development as a fundamental process of learning dependent and particular to its context is emphasized.

The students will make extensive use of macroeconomic, social and STI indicators. Moreover, they will confront their comparative analysis, entre autres, to the structures of the national innovation systems, the relevant STI policies, and the related governance and monitoring structures.

Module: ETP_33: STI Diplomacy, Cooperation & Aid

In today's globalized world, countries are as much affected by endogenous dynamics as much as they endure exogenous international disturbances. In addition to this concomitant national/international complication, a plethora of actors are involved. Consequently, policy analysis and design should take into consideration the possible effects of both spheres.

The international sphere is composed of three major interrelated subsystems, the foreign policy, the cooperation and aid subsystems. Within the context of this course, these subsystems are presented under the angle of STI policy design. Thus, Science Diplomacy, STI cooperation and eventually Aid that supports the latter activities make up the bulk of the course material.

Throughout the course, the students are presented with case studies made of known programs in order to give them a viable grasp of the international sphere and its different instruments.

Teaching Unit: ETP_40: Human, Social and Political Sciences

Module: ETP_41: Political Systems

This lecture is about the political life and therefore how the political systems operate. It broadens coverage of the range of contemporary international systems but looks primarily at the processes governing policy makers and scholars use to interpret the African political systems.
The important role of new media and social networks as tools for the exchange of information, awareness-raising and mobilization during the Arab uprisings has already been emphasized in academic and public debates in the African countries.

This course is useful and helpful for engineers whose future job requires them to have a working knowledge of political key concepts and terms. The target is to build up a 'bank' of useful concepts to assist those interested in politics and wishing to become more conversant in English within a political context designed to progressively enhance relevant and meaningful

communication skills.
The focus throughout the lectures will be also on the different narratives that students might be expected to understand and use on a day-to-day basis. The ongoing power struggles in African countries are reflected in competing narratives and in fierce struggles over representations, terminologies and "truth". What has been the role of politicians during the volatile transformation phase that the region is currently experiencing? The analyses will be throughout cross-country comparisons and exchange of experiences of African citizens.

Political participation is one of the key dimensions of citizenship. The ways and modes of participation are numerous, be it through so-called "formal" channels like elections, political parties or trade unions, or "informal" ones like demonstrations, social movements or online activism. In Egypt and Tunisia, the formation of new political parties and their participation in elections has been an important element of the ongoing transformations.

Around the World: The five most common political systems – The Greek History of democracy - pillars of modern democracy.

Tunisia: Review of political history - Post-revolution Transition overview - 2014 constitution – Stable democratic institutions – the place and the weight of civil society – The People Representatives Assembly (PRA) – Place of STI and development in the constitution - Political STI stakeholders – The Fourth power – Law Processing scheme and counterparts.
Case Studies.

Module: ETP_42: STI & Society

Society looks increasingly to experts to do more than conduct research and produce knowledge. Society looks to experts to play a central role in securing the benefits of the nation's investment in knowledge, while at the same time, helping to protect against the misuse or unintended consequences of science and technology. In short, society expects experts to contribute to decision making in public, private and civic settings. Understanding the roles of science and technology in broader societal context – as well as the influences of that context on the practices and uses of science and technology would thus seem to be a prerequisite to a successful career at the science-society interface.

This course seeks to contribute to such improved understandings by introducing learners to the area of research typically characterized as "science and technology studies."

Seminar Format:
The course is a seminar, which means that we each share responsibility for participation and leadership. There are a considerable amount of readings in the course and consequently the course has been structured in a way to allow for sharing responsibility for learning. The formal

requirements of the course include informal weekly one-pagers, frequent opportunities for student-led classes and presentations, attendance at several outside-class events and an individual term project.

Module: ETP_43: Funding Innovation

The best and most innovative ideas will never see the light of day unless they can obtain funding. This course will explore the major crucial points of financial issues in STI area mainly in Tunisia and comparatively in advanced countries.

Review of the Innovation process - investment risk in innovation - Most common Funds in innovation, Capital venturing – Business angels - Public R&D Funding – the Public Private Partnership –Innovation versus investment code – Financing research mobility between university and industry – Funding innovative entrepreneurship - Business models of spin off and startups -

Topics Include:

- Discounted Cash-Flow Analysis
- Weighted Average Cost of Capital
- Real Options and the Staging of Investment
- Valuation Multiples
- Pre and Post-Money Valuation

Module: ETP_44: Entrepreneurship & Innovation

Innovation is the specific tool of entrepreneurs. The means by which they take advantage of change and as an opportunity for a different business or a different activity. Entrepreneurs need to search for the sources of innovation, the changes and their symptoms that indicate the opportunities of a successful innovation. They need to know and to apply the principles of successful innovation**.**

Nature of creativity and innovation and their role in entrepreneurship
steps in the creative process – How entrepreneurs can enhance creativity - The four major types of innovation - Sources of innovation for entrepreneurs - The major myths and principles of innovation – Innovative entrepreneurship as one of the pillars of NIS – guide lines for a successful entrepreneurship policy?

Module: ETP_45: K-Based Development Policies

Many countries, city-regions around the world started to view knowledge and creativity as keys to development and economic prosperity, and adjusted their endogenous development strategies increasingly by visioning the ultimate goal of knowledge-based development. In this context, knowledge-based urban development, a strategic management approach applicable to human settlements, has gained popularity as a powerful strategy for sustainable economic, social and urban growth, and for the post-industrial development of city-regions.
In the knowledge-based development process of city-regions, knowledge-based assets play a critical role by both securing a competitive advantage in the knowledge-based economy, and also engineering the formation of creative urban regions. Knowledge-based strategic planning, the planning and implementation instrument of knowledge-based urban development, is a mechanism to (re)organize critical knowledge assets, both tangible and intangible, of city-regions in order to prepare a base for their knowledge-based development.

Overview of evolutionary perspectives on economic change - characteristics of K-based economy – critical weight of Human capital – sustainability as the engine of K-based development – strategic planning -developing smart city-regions with smart technologies : distance services, GIS, Transport, friendly public service… – Global NIS getting local (Territorial Economic watch, clustering Innovation value chains…) – New Research open labs and tools : Territorial development policy – Place Marketing - city open labs - Mass Creative games and Mass involvement.

Module: ETP_46: Change Management & Leadership Development

Change management as a discipline has grown tremendously over the last five years. Below are several reasons change management has become so important to organizations in recent years.

1. More and frequent changes - Change is occurring at an incredible pace in organizations today. The sheer quantity of changes is increasing, and changes are happening more frequently and faster than ever before. With such large amounts of change happening, organizations need a better and more structured way to manage the individuals in the organization impacted by all of these changes.
2. Value system of empowerment - Over the last fifty years, value systems have shifted in many organizations. Old values of control and predictability have been replaced by new values to push decision making, authority and responsibility down into the organization. While this shift has delivered many benefits, it has also made top-down changes more difficult and increased the resistance they face. Organizations with empowered workforces need to manage the human side of change more effectively than they did in the very hierarchical structure of the past.

Competitive advantage - Many sources of competitive advantage have eroded as information moves more quickly and across the globe in seconds. In upcoming years, speed and agility will be a central differentiator in the market place. And organizations that do not use change management cannot build their internal competency to quickly and effectively implement change. Strong change management competencies within an organization are a key source of competitive advantage in coming years.

This module will allow learners to:

1. Witness how the values of a society and an organization impact the approach to managing change and how organizational value systems impact the way change happens.
2. Learn through interactive discussions the universal principles of change management and how to contextualize them with respect to the Tunisian organization
3. Discover the values of change
4. Uncover a value system and learn how to implement change.

Teaching Unit: ETP_50: STI Expertise Projects

Module: ETP_51: Synthetic Project I

Module: ETP_52: Synthetic Project II

Module: ETP_53: Design & Planning of Master Project

Module: ETP_54: Master Project

Policy Skills Framework

	Level 1	Level 2	Level 3	Level 4	
Understanding the Context	Identifies and uses relevant evidence sources	Uses evidence to support or challenge change	Identifies the required outcomes and supports them with detailed evidence	Identifies required outcomes and sources of evidence across the policy programme	Evidence
	Understands the political context of policy work	Demonstrates awareness of the political and constitutional implications of policy change	Articulates the political and constitut-ional drivers for and against change	Understands the political and constit-utional context & anticipates future direction	Politics
	Includes experiences of the policy in practice in the evidence base	Demonstrates an understanding of front-line delivery	Analyses the delivery system	Understands the full range of delivery options and investigates innovative approaches	Delivery
Developing the Options	Gathers evidence to develop policy options	Develops innovative, evidence-based policy options	Leads the development of innovative, evidence-based policy options	Oversees the development of innovative, evidence-based policy options	Evidence
	Makes connections between options and the wider political context	Investigates the political implications of options	Develops options that acknowledge the political context	Manages the political implications of options	Politics
	Incorporates evidence of front-line delivery in options development	Investigates the practical implications of options	Provides full analysis of how options would work in practice	Ensures implications for the policy in practice have been fully assessed	Delivery
Getting to a Decision	Articulates the rationale for selection of the preferred option	Proposes a preferred option based on evidence	Recommends a preferred option, supported by evidence	Ensures that Ministers have reliable evidence to inform decisions	Evidence
	Supports the decision-making process	Builds support for the preferred option	Secures political buy-in	Builds support for the decision	Politics
	Understands how the selected option will work in practice	Adapts proposals to ensure the selected option will work in practice	Ensures the selected option will work in practice	Structures the delivery system	Delivery
Making it Happen	Gathers evidence of policy effectiveness	Monitors the performance of policy	Leads the monitoring of policy performance	Ensures effective monitoring and evaluation of policy performance	Evidence
	Deals with ministers and decision-makers confidently and diplomatically	Identifies and anticipates changes to political buy-in	Ensures ongoing political buy-in and effective communications	Maintains political legitimacy	Politics
	Understands how working with delivery partners improves policy in practice	Works with delivery partners to improve the policy in practice	Anticipates and resolves potential delivery problems	Seeks policy improvements across the programme	Delivery