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Identification of the Smart Specialisation priority domains of Tunisia

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Abstract

Mapping exercise represents the cornerstone of the Smart Specialisation process for two main reasons: 1) it provides the evidence-based ground for identifying the preliminary priority areas for Smart Specialisation, and 2) it represents the stage where the first in-depth feedback from the key stakeholders in the proposed priority areas is received. The results of the mapping exercise are the essential input for the upcoming stakeholder dialogue stage. Tunisia has completed the mapping exercise and is about to embark on the Entrepreneurial Discovery Process journey, where the final list of priority domains and related policy actions would be proposed. This report presents the main findings on the economic, innovation and scientific potential of Tunisia, discusses the justification of the selection of preliminary priority areas for Smart Specialisation and outlines the preparatory steps to be taken for launching the stakeholder dialogue.

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Executive summary

Smart Specialisation represents a unique approach to reinforce economic transformation by supporting targeted actions for further development of the most promising areas, aiming at improving competitiveness, innovativeness and responding to societal challenges. Tunisia expressed interest in unlocking its innovation potential for sustainable economic competitiveness by applying the Smart Specialisation approach with the support of the Joint Research Centre. The support to the development of the evidence-based and participatory innovation policy based on Smart Specialisation is aligned within the EU priority 'A stronger Europe in the world'. Cooperation with the neighbouring countries, including Tunisia, is a key to strengthening the EU's role as a global leader while ensuring the highest standards in tackling modern day challenges.

The report documents the findings of the analytical phase of development of the Smart Specialisation Strategy for Tunisia, implemented with the methodological support of the Joint Research Centre of the European Commission (JRC). The analysis follows the Smart Specialisation Framework for the EU Enlargement and Neighbourhood Region (Matusiak and Kleibrink, 2018) and has three complementary parts: quantitative mapping aims to identify the potential Smart Specialisation priority areas based on the set of indicators, showing critical mass, specialisation, and growth rates in the subsectors of economic activity and specialisation in science, technology and innovation outputs. Such an exercise is based on the thorough analysis of various data sources related to economic, innovation and scientific potential, with the ultimate goal of identifying potential promising areas for investment. The mapping exercise was conducted based entirely on the Smart Specialisation Framework for the EU Enlargement and Neighbourhood Region, which has been developed by the Joint Research Centre to provide guidance and assist economies in enhancing policy-making through the joint participation of businesses, academia, civil society and public administration, in a process based on transparency and evidence.

The results of this analysis are verified in a second step through qualitative mapping, based on structured interviews. It further allowed qualitative validation through the engagement of stakeholders, aiming at determining the existence of critical mass in each proposed priority area as well as at understanding both current and potential future trends. Through this cumulative sequence of analytical steps, the mapping exercise succeeded in consolidating the list of preliminary priority areas.

Customised interviews of stakeholders in the qualitative mapping phase represented the first thorough involvement of stakeholders in the Smart Specialisation process and helped in the design of the upcoming Entrepreneurial Discovery Process in the country.

Both analyses provide a sound base for the following part, which are the recommendations and guidelines for the upcoming stakeholder dialogue under the Entrepreneurial Discovery Process (EDP). It should be noted that this exercise represents the first and successful application of the Smart Specialisation methodology performed under the guidance of the Joint Research Centre in the EU Southern Neighbourhood Region, which can be set as a leading example for the economies in the area.

The Smart Specialisation team of Tunisia needs to discuss the findings of the mapping exercise with key stakeholders in order to decide on the final steps in justifying priority domains which surfaced from the exercise, taking into account the transformational and sustainability perspectives as well as tackling main challenges of the economy. By defining directionalities in the domains, the team will look into possible issues of ecological and social sustainability, which will provide important information and findings for cross-policy dialogue in the country. These tasks will facilitate the efficient preparation for the stakeholder dialogue, as it entails continuous engagement of stakeholders that will be crucial in designing policy actions in priority areas and sub-areas in the upcoming phase.

The upcoming Entrepreneurial Discovery Process will build on the achievements in the mapping stage, especially from the analysis of preliminary priorities and data on stakeholders, but the possibility to attract new interested businesses, academia and civil organisations in the designated areas has to be kept open. This is especially important for innovative businesses that have the capacity to undertake innovation activities in these areas. In preparing for the Entrepreneurial Discovery Process stage, the capacity of the S3 team and the local experts that will organise and coordinate the workshops should be in focus and the efforts for increasing this capacity needs to be invested. Having in mind the continuous nature of the stakeholder dialogue, it is essential to maintain capabilities of these professionals. Development of capabilities should take into account various concepts, e.g. from communication expertise to the principles of socio-technical transition and system-level changes.

When preparing for the Entrepreneurial Discovery Process, certain rules should be followed. This means that the kick-off workshop needs to be organised to officially announce the stakeholder dialogue and attract and motivate stakeholders for an ongoing exercise of profiling priority areas and related policy actions. The initial cycle of workshops will identify or confirm the 'process ambassadors' that should positively impact the motivation and engagement of stakeholders, which will be essential also in the strategy implementation stage. Communication of right and timely messages towards and between the stakeholders as well as towards the public is crucial and the Smart Specialisation team needs to pay attention to this early on.

Resources matter very much in this stage - human, technical and financial. They are required for organising different events, communication purposes, engaging key stakeholders, setting up the knowledge base and maintaining the relevant IT system, among other actions. Many existing tools can be used to facilitate smooth workshops and production of deliverables and the experiences from the EU Enlargement and Neighbourhood Region should be consulted in order to build on previous success stories. All these aspects need to be considered by the relevant authorities for properly justifying the priority areas and devising policy actions in transparent and sustainable manner for the efficient exploitation of the economic and innovation potential in these areas.

1 Introduction

The Directorate B - Growth and Innovation of the Joint Research Centre (JRC) of the European Commission, is based mainly in Seville (Spain). Its mission is to provide techno-economic analysis in support of the EU policy-making process. Its prime objectives are to monitor and to analyse science and technology developments, their cross-sectorial impact, their inter-relationship with the socio-economic context, and their implications for future policy development.

The Urban and Territorial Development Unit (B.3) supports the urban and territorial articulation of the EU policy agenda, its external investment and global outreach. The aim is to deliver world-class science for policy support to bring Europe closer to citizens and places, turning territorial diversity into value. The Unit aims at strengthening the EU global role in putting forward place-based solutions for recovery and sustainability and at localizing global agendas, bringing back to Europe what we learn from outside.

In 2017, the JRC launched a pilot project on "Smart specialisation and organisational development in enlargement and H2020 associated countries" (under the Enlargement & Integration Action, E&IA), that is continued since. The overall objective of the project is to support the design and implementation of Smart Specialisation Strategies in EU Enlargement and Neighbourhood Region. To achieve this objective, it is necessary to adapt the existing approaches and develop new guidance that takes into account the context of non-EU countries.

Tunisia has shown a great interest to adopt a Smart Specialisation Strategy. Through its operational agency, the National Agency for the Promotion of Scientific Research (ANPR), the Ministry of Higher Education and Scientific Research (MHESR) introduced this concept to R&I ecosystem stakeholders in 2016 with a first seminar for senior decision-makers from different ministries, regional leaders, representatives of the private sector, and civil society organized with the support of the EC TAIEX instrument.

Tunisia has undertaken preparatory actions mobilising smart specialisation team and exploring opportunities in launching S3 in three pilot regions, namely Bizerte in the north, Sfax in the center, and Medenine in the south. During the first half of 2021, an assessment of the state of the art of Smart Specialisation in the three pilot regions has been carried out, along with a quantitative mapping. The assessment has stressed the opportunity for Tunisia to start the smart specialisation process at national level while continuing it at regional level in Sfax, which has showed a good degree of preparedness. Hence, further expert support was required to follow the JRC framework and to apply quantitative and qualitative analyses methodology for mapping economic, scientific, and innovative potentials at national level to identify smart specialisation domains and provide recommendations to national agencies and authorities.

The quantitative analysis part uses a dedicated methodology developed by the authors in answering the needs of a smart specialisation process, and based on that, conducts an analysis of the economic, the innovation and the scientific potential, using relevant data for Tunisia as a country and benchmarking the results with other Mediterranean countries / Southern European countries. The overarching aim of the analysis is to understand which economic sectors can be considered as Tunisia's strengths or competitive niches when compared to the aforementioned countries. The second part of the mapping exercise, qualitative analysis, aim to support the national authorities in the follow-up stages and in the definition of the priority areas of the Tunisian S3, through an identification of the possible areas of specialisation.

Beyond this introductory section, the report starts with the presentation of the methodology, by introducing the key concepts used throughout the analysis and the specifics for identifying the economic, the scientific and the innovation potential. Then, it presents the results from each perspective and concludes with the joint interpretation of the results and the identification of the NACE sectors that, based on the evidence provided, can be considered as priority sectors for smart specialisation at the national level in Tunisia, before entering into the qualitative analysis phase. The starting point of the qualitative analysis corresponds to the findings of the quantitative phase, which identified areas with a high economic, innovative and scientific potential in Tunisia. The qualitative analysis completes the mapping phase and aims to better define the activities that will be selected as priorities by the national authorities in the future S3. This analysis represents one of the crucial parts of the

S3 framework of the Enlargement and Associated Countries and will prepare the next phase of the Entrepreneurial Discovery Process ([1]).

([1]) Footnote text (please always insert <tab> at the beginning). When the text is longer than one line, it is indented for a more reader-friendly layout.

2 Quantitative analysis of economic, innovation and scientific potential

Quantitative analysis represents the crucial analytical stage of the Smart Specialisation process. The Smart Specialisation framework for the EU Enlargement and Neighbourhood Region defines is as the mapping of main strengths and specialisations by statistical data in order to reveal economic, innovation and scientific potential of a region or a country. Its objective is to indicate preliminary areas of Smart Specialisation based on expert assessment of matches between the three types of potential. Hence, its results are to be used for grouping the relevant findings for defining preliminary priority areas to be further examined in the qualitative analysis stage.

2.1 Methodology

2.1.1 Specialisation analysis

2.1.1.1 Location quotients

Irrespective of the dataset used to perform specialisation analysis, all the relevant data are categorised in accordance with a native taxonomy, such as the NACE Rev. 2 sectors for employment, International Patent Classification scheme for patents, or Subject Areas for scientific publications, or the Nice Classes for trademarks. Therefore, the Location Quotients (LQ) will be computed in terms of the data original taxonomies. The location quotients measure, for a certain entity of interest (in our case, Tunisia) the degree of specialisation in a given category against a given baseline (in our case a set of EU Member States in Southern Europe / Mediterranean). The LQ is equal to the ratio of two proportions: the proportion of the output produced by the entity in the category with respect to the entity's total, divided by the proportion of the output produced by the baseline in the category with respect to the baseline total, being calculated as follows:

LQi = (ei / e) / (Ei / E)

where

LQi = location quotient for category i in Tunisia;

ei = the output for category i in Tunisia;

e = the output for all categories in Tunisia;

Ei = the output for category i in benchmark countries;

E = the output for all categories in benchmark countries.

Therefore, a LQ greater than 1 implies the entity of interest, i.e., Tunisia, is specialised in the category at hand with respect to baseline, whereas a LQ below 1 means the opposite. Moreover, to maintain consistency with similar JRC-initiated mapping efforts in the past, we use LQ=1.25 as the specialisation threshold. This means 25% stronger concentration with respect to the baseline. Depending on the domain of specialisation analysis, this can be relaxed to anything in the range from 1.25 to 1.5.

2.1.1.2 Critical mass

The category of location quotients, as defined in the previous section, can be misleading by indicating strong concentration where the output is very low in the entity of interest. Therefore, we need to introduce another criterion to distinguish categories that are more relevant for developing and implementing policy action. The absolute size of categories matters and categories' size or 'critical mass' is measured by their relative share as follows:

cmi = ei / e

where

cmi = critical mass or relative size of category i in Tunisia

ei = output in category i in Tunisia

e = aggregate output in all categories in Tunisia

As already discussed in the previous section, there are no set rules for determining the threshold values. The most common practice is to start with threshold values which are also used in other studies and then to either use these if the number of selected industries matches policy needs, or to decrease a threshold if the number of selected industries is too small or to increase a threshold if the number of selected industries is too high.

2.1.1.3 Baseline selection

The economic and scientific profiles of the south European, Mediterranean countries is very diverse; thus, it was shown impossible to select a good group of peer economies for all attributes. Therefore, we had to rely on a heuristic, starting the specialisation analysis using some Mediterranean EU Member States that heavily rely on tourism and on the primary sector, such as Cyprus, Greece, Croatia, Malta and Portugal. Using these and Tunisia as the baseline would provide a good understanding of Tunisia's specialisation versus 'peer' EU economies. Then we extended our analysis by gradually including larger EU Member States in the Mediterranean, such as Italy and Spain. Finally, we performed a specialisation analysis of Tunisia versus all the Mediterranean countries and Portugal in terms of scientific publications, patents and trademarks. In principle, domains of strong specialisation in most, or all four baselines, should be considered as Tunisia's specialisations. We have found that the set of EU Member States comprising Croatia, Cyprus, Greece, Italy, Malta and Portugal effectively captures the strong specialisations of Tunisia across most of the four baselines we examined, and thus we use it as the baseline for all types of analyses included in this report.

2.2 Economic potential

2.2.1 Industries with current economic potential

For determining the degree of specialisation, the economic performance of industries in Tunisia needs to be compared to the performance of the same industries in a set of benchmark countries (baseline). For mapping studies at the country level usually the European Union (EU27) has been used as the baseline. However, the EU is composed of 27 Member States of different economic size and different economic structures. For the mapping of Tunisia, a more focused approach has been adopted (see section 'Baseline Selection' above) as differences in economic structures and differences in the size of the economies are smaller.

The identification of industries with an economic potential is based on economic data on employment and wages received for Tunisia and the benchmark countries. For Tunisia, the following economic data, for NACE Rev. 2 3-digit industries, have been made available by the National Institute of Statistics (Institut National de la Statistique: INS): Number of enterprises for 2012-2019, Employment for 2012-2019, and Total nominal wages in Tunisian Dinar for 2012-2019. Data on employment, total nominal wages, and Purchasing Power Parities[2] have been used to calculate Average wages in PPP Dollars for 2012-2019 for all 3-digit NACE Rev. 2 industries, assuming the same PPP for all industries.

Economic data for 2012-2019 for NACE Rev. 2 4-digit industries for the business sector for EU Member States and other European countries are available from Eurostat from the *Annual detailed enterprise statistics*. Data for Agriculture, forestry, and fishing (NACE A) and public services (NACE O-U) are not available. Data on the business sector covers the following industries:

- NACE Rev. 2: B Mining and quarrying
- NACE Rev. 2: C Manufacturing
- NACE Rev. 2: D Electricity, gas, steam, and air conditioning supply
- NACE Rev. 2: E Water supply; sewerage, waste management and remediation activities
- NACE Rev. 2: F Construction
- NACE Rev. 2: G Wholesale and retail trade; repair of motor vehicles and motorcycles
- NACE Rev. 2: H Transportation and storage
- NACE Rev. 2: I Accommodation and food service activities

[2] PPPs extracted from the World Bank's World Development Indicators database (https://datatopics.worldbank.org/world-development-indicators/).

- NACE Rev. 2: J Information and communication
- NACE Rev. 2: K65 Insurance, reinsurance, and pension funding, except compulsory social security
- NACE Rev. 2: L Real estate activities
- NACE Rev. 2: M Professional, scientific, and technical activities
- NACE Rev. 2: N Administrative and support service activities
- NACE Rev. 2: S95 Repair of computers and personal and household goods

Data on number of employees and average wages are used in the mapping exercise to identify industries as having a current economic potential. For each of the following criteria, **an industry should pass all thresholds** for at least 6 out of 8 years (2012 to 2019) and for the average of the 2012-2019 period:

- Size is sufficiently high, i.e., above a pre-defined threshold value:
  - $cm_i > 0.10\%$

Industries should account for at least 0.10% of total number of employees or turnover in Tunisia.

- Specialisation (LQ) is sufficiently high, i.e., above a pre-defined threshold value:
  - $LQ_i > 1.25$

Industries with a degree of specialisation, for both number of employees and turnover, above 1.25 are defined as specialised.

- Average wages are sufficiently high compared to average wages for all industries in Tunisia:
  - $aw_i > 100\% * aw$

Industries with wages higher than 1.0 times the level of average wages in Tunisia perform close to or above the country's average.

- Average wages, in PPP Dollars, are sufficiently high compared to average wages, in PPP Dollars, in the same industry in the benchmark countries:
  - $aw_i > 40\% * AW_i$

Industries with average wages higher than 0.4 times the level of average wages in the same industry in the selected benchmark countries perform close to or above the industry average in the selected benchmark countries.

As initial results based on the above methodology exclude industries which do not pass all criteria, but which do perform very strongly on some of these criteria, industries also have a current economic potential if they **pass 3 criteria and perform very strongly in at least 2 of these**. An industry performs very strongly for a particular criterion if:

- Size is above 2% for at least 6 years and the average for the 2012-2019 period;
- Specialisation (LQ) is above 2 for at least 6 years and the average for the 2012-2019 period;
- Average wages are at least 50% higher than those of Tunisia for at least 6 years and the average for the 2012-2019 period;
- Average wages in PPP dollars are at least 60% of those in the same industry in the benchmark countries for at least 6 years and the average for the 2012-2019 period.

2.2.2 Industries with emerging economic potential

For Employment, Specialisation, Averages wages, Average wages relative to those of Tunisia, and Average wages relative to the same industry in the benchmark countries, the following changes, including 7 annual changes and 1 period change, are calculated:

- Annual change between 2012 and 2013: the score in 2013 minus that in 2012;
- Annual change between 2013 and 2014: the score in 2014 minus that in 2013;

- Annual change between 2014 and 2015: the score in 2015 minus that in 2014;
- Annual change between 2015 and 2016: the score in 2016 minus that in 2015;
- Annual change between 2016 and 2017: the score in 2017 minus that in 2016;
- Annual change between 2017 and 2018: the score in 2018 minus that in 2017;
- Annual change between 2018 and 2019: the score in 2019 minus that in 2018;
- Period change between 2012 and 2019: the score in 2019 minus that in 2012.

The following criteria are used to identify industries with emerging economic strength:

- Employment: Annual changes should be positive for at least 5 (out of 7) years and the change for the 2012-2019 period should be positive;
- Specialisation: Annual changes should be positive for at least 5 (out of 7) years and the change for the 2012-2019 period should be positive;
- Average wages relative to those of Tunisia: Annual changes should be positive for at least 5 (out of 7) years and the change for the 2012-2019 period should be positive.

An industry is defined as having an emerging economic potential if it passes the Employment, Specialisation, and Average wages relative to Tunisia criteria. The results for Average wages relative to those of the same industry in the benchmark countries have not been used as this would result in a too small number of industries.[3]

2.3 Scientific potential

To perform the specialisation analysis of Tunisia versus the baseline in terms of scientific publications, we used Scopus' internal analysis tools to calculate the number of publications classified in the Subject Areas, the internal taxonomy of scientific disciplines used by Scopus. The query to retrieve the records for Set 4, i.e., all Med countries and Portugal, returned more than 1.6 million records, of which 70.466 from Tunisia:

AFFILCOUNTRY (Croatia OR Cyprus OR Greece OR Italy OR Malta OR Portugal OR Tunisia) AND PUBYEAR > 2009 AND PUBYEAR < 2020

We computed the LQs for two 5-year intervals, i.e., 2010-2014 and 2015-2019, by aggregating the annual outputs per interval for both the reference (Tunisia) and the baseline (all countries in the query above).

The mapping exercise identifies Subject Areas as having a static or current scientific potential for which:

- Size is sufficiently high, i.e., above a pre-defined threshold value:
    - cmi > 2.5 %

Subject Areas should account for at least 2.5% of total number of publications co-authored by at least one author in Tunisia between 2010 and 2019;

- Specialisation (LQ) is sufficiently high, i.e., above a pre-defined threshold value:
    - LQi > 1.25

Subject Areas with a degree of specialisation, for both 5-year periods, above 1.25 are defined as continuously specialised. Moreover, areas with a degree of specialisation above 1.25 in the second 5-year interval and below 1.25 in the first 5-year interval are considered as emerging specialisations.

[3] If an industry would be required to pass all 4 criteria, this would result in a very low number of only 3 industries with an emerging economic potential. If instead of Average wages relative to Tunisia, Average wages relative to those of the same industry in the benchmark countries would be used, this would result in 6 industries with an emerging economic potential.

2.4 Innovation potential

For mapping the innovation potential, ideally national innovation survey data should be used, as these provide the required data on number of enterprises that innovate and different types of innovations. Unfortunately, such data are not available for Tunisia as there is neither a recent innovation survey nor a R&D survey[4].

Instead, this chapter combines results from different data sources including data from international data sources including data on innovation activities, product exports, patents and trademarks.

2.4.1 Innovation data

Data on innovation activities are available from the World Bank Enterprise Survey. Firm-level data are available for Tunisia from the 2013 and 2020 edition of the Enterprise Survey and include identifiers for different industries. Data from the 2020 edition were analysed and compared with those of the following benchmark countries: 2018 data for Greece, and 2019 data for Croatia, Cyprus, Italy, Malta and Portugal. Enterprise Survey data are classified to different industries using the ISIC Rev. 3.1 classification which corresponds perfectly to NACE Rev. 1.1.

The Enterprise Survey includes two questions on innovation:

- During the last three years, has this establishment introduced new or improved products or services?
- During the last three years, has this establishment introduced any new or improved process? (These include methods of manufacturing products or offering services; logistics, delivery, or distribution methods for inputs, products, or services; or supporting activities for processes)

A new variable has been constructed by combining both questions to identify enterprises having introduced a product and/or process innovation. This variable is used to calculate the location quotients.

The mapping exercise identifies industries as having a static or current innovation potential for which:

- Specialisation (LQ) is sufficiently high, i.e., above a pre-defined threshold value:
    - $LQi > 1.25$

Industries with a LQ above 1.25 are defined as specialised in terms of their innovation potential.

2.4.2 Product export data

Product export data can be used to assess the competitiveness of Tunisian industries. Detailed product export data for 2012-2019 are available from UN Comtrade for exports of goods. SITC Rev. 4 is the most recent version of the Standard International Trade Classification (SITC). For older versions of the SITC, correspondence tables exist allowing to recalculate export data by products to export data by industry. For SITC Rev. 4 such a correspondence table does not exist. For the older SITC Rev. 3 correspondence tables are available to both NACE Rev. 1 and International Standard Industrial Classification of All Economic Activities (ISIC) Rev. 3. In this report, export data by industry were analysed using SITC Rev. 3 export data from UN Comtrade which have been recalculated to NACE Rev. 1 industries using the correspondence table[5] that is available from the product correspondence tables from the World Integrated Trade Solution (WITS)[6]. NACE Rev. 1 is closely linked to the more recent NACE Rev. 1.1. The correspondence table between NACE Rev. 1.1 and NACE Rev. 2, which is the industrial classification scheme used for the mapping of the economic potential, does not allow a straightforward recalculation of results by industries as many 4-digit individual NACE Rev 1.1 industries have reclassified into multiple 4-digit NACE Rev. 2 industries[7]. Results, therefore, cannot be directly compared to the results on economic potential.

[4] The 2005 innovation survey covering the years 2002-2004 seems to be the most recent survey but results would be too old and not detailed enough to be useful for this report.
[5] http://wits.worldbank.org/data/public/concordance/Concordance_S3_to_NC.zip
[6] https://wits.worldbank.org/product_concordance.html
[7]https://ec.europa.eu/eurostat/ramon/relations/index.cfm?TargetUrl=LST_LINK&StrNomRelCode=NACE%20REV.%201.1%20-%20NACE%20REV.%202&StrLanguageCode=EN

The product export shares and degrees of specialisation are shown in Annex B. Export shares should be higher than 0.1% of total product exports and these industries are highlighted in green. Degrees of specialisation should be higher than 1.25 and these industries are highlighted in green. An industry is selected as having an innovation potential if it passes both criteria for at least 7 years. These industries are highly competitive on the international market, and it is assumed that this high degree of competitiveness is due to being innovative, having introduced new products or having introduced efficiency improvements resulting from process innovations.

For the above categories (NACE Rev. 1.1 industrial sectors), we used the value of product exports to calculate critical mass and the location quotients. The mapping exercise identifies industries as having a static or current innovation potential for which:

- Size is sufficiently high, i.e., above a pre-defined threshold value:
    - cmi > 0.10%

The share of the industry i value of exports should be higher than 0.1% of total product exports by all Tunisian industries.

- Specialisation (LQ) is sufficiently high, i.e., above a pre-defined threshold value:
    - LQi > 1.25

Industries with a degree of specialisation above 1.25 in terms of value of product exports for at least 7 out of 8 years are defined as specialised.

The industries that pass the above criteria are highly competitive on the international market, and it is assumed that this high degree of competitiveness is due to being innovative, having introduced new products or having introduced efficiency improvements resulting from process innovations.

2.4.3 Patents

Patents can be considered as a proxy for technological innovation. The World Intellectual Property Organisation (WIPO) provides country specific datasets that vary in terms of detail and coverage. In our analysis, we used:

- Patent grants to residents[8] by field of technology. The internal taxonomy of this dataset comprises 35 fields of technology. Data is available for all countries in our baseline, but coverage is restricted to major patent offices. This means that the data cannot capture the entire patent activity in Tunisia and the countries in the baseline, especially patents granted only by the respective national offices.
- PCT publications originated in Tunisia (or the baseline countries) by IPC class. The internal taxonomy of this dataset comprises all the 4-digit International Patent Classification Codes.

We computed the LQs for two 5-year intervals, i.e., 2010-2014 and 2015-2019, by aggregating the annual outputs per interval for both the reference (Tunisia) and the baseline (all countries in the query above).

The mapping exercise identifies Fields of Technology / IPC classes as having a static or current scientific potential for which:

- Size is sufficiently high, i.e., above a pre-defined threshold value:
    - cmi > 2.5 %

Fields of Technology / IPC classes should account for at least 2.5% of total number of the aggregate count between 2010 and 2019;

- Specialisation (LQ) is sufficiently high, i.e., above a pre-defined threshold value:
    - LQi > 1.25

Fields of Technology / IPC classes with a degree of specialisation above 1.25, for both 5-year periods, are defined as continuously specialised. Moreover, Fields of Technology / IPC classes with a degree of specialisation above

[8] A resident filing refers to an application filed in the country by its own resident; whereas a non-resident filing refers to the one filed by a foreign applicant.

1.25 in the second 5-year interval and below 1.25 in the first 5-year interval are considered as emerging specialisations.

The analysis of the PCT dataset was further associated with NACE Rev. 2 industrial sectors by using a Eurostat-provided correspondence table[9] that matches 4-digit International Patent Classification Codes (IPC V8) to 2-digit NACE Rev. 2 codes (i.e., IPC A47B is matched to NACE Rev. 2 31-Manufacture of Furniture) and in some cases, to 3-digit NACE Rev. 2 codes.

2.4.4 Trademarks

Trademarks are a proxy for innovation activity[10], being able to describe non-technological innovation. By considering trademarks granted by the European Intellectual Property Office (EUIPO) to Tunisian applicants, we can infer the propensity of Tunisian economic sectors to enter EU markets.

WIPO Trademark data is very spotty. WIPO's Total trademark registrations (direct and via the Madrid system) lacks information on residents for, among others, Greece (2010-2019), and Tunisia (2010-12 and 2018-19). To have a common dataset for all countries in our chosen baseline, we chose to limit our search to EUIPO-registered trademarks for which there is full data availability. Thus, we used indicator 4 (total registrations by class-direct and via the Madrid system), counting by filing office (EUIPO) and applicant's origin (Tunisia and the baseline countries) to perform our specialisation analysis.

We computed the LQs for two 5-year intervals, i.e., 2010-2014 and 2015-2019, by aggregating the annual class counts per interval for both the reference (Tunisia) and the baseline (all countries in the query above).

The mapping exercise identifies Nice classes as having a static or current scientific potential for which:

- Size is sufficiently high, i.e., above a pre-defined threshold value:
    - cmi > 2.5 %

Nice classes should account for at least 2.5% of total number of the aggregate class count between 2010 and 2019;

- Specialisation (LQ) is sufficiently high, i.e., above a pre-defined threshold value:
    - LQi > 1.25

Nice classes with a degree of specialisation above 1.25, for both 5-year periods, are defined as continuously specialised. Moreover, Nice classes with a degree of specialisation above 1.25 in the second 5-year interval and below 1.25 in the first 5-year interval are considered as emerging specialisations.

The NICE Classification scheme categorises the entire business spectrum into 45 distinct classes: 1 to 34 for products and 35 to 45 for services. However, there is no formal correspondence table to match NICE classes to economic activities. Therefore, NICE classes will be used to qualitatively discuss linkages to economic activities. A correspondence table issued by the Spanish Patent and Trademark office[11] was also consulted to inform our analysis.

2.5 Results

2.5.1 Economic potential

Table 6 in the Data Annex presents the data for identifying industries with a current and emerging economic potential. If industries pass a threshold on an individual criterion the value in the respective table cell is 1, otherwise it is 0. Industries for which comparable data for the selected benchmark countries are not available are highlighted in red in the first column.

[9] See https://ec.europa.eu/eurostat/ramon/documents/IPC_NACE2_Version2_0_20150630.pdf

[10] Mendonça S., Pereira, T.S. and Godinho, M.M. (2004). Trademarks as an indicator of innovation and industrial change. Research Policy, 33, pp. 1385-1404.

[11] http://www.oepm.es/export/sites/oepm/comun/documentos_relacionados/varios_todas_modalidades/Concordancia_CNAE_NIZA.pdf

Columns 2-6 show the results for mapping industries with a current economic potential. The 2nd column shows if and how many industries (130) passed the size criterion for employment, the 3rd column shows if and how many industries (58) passed the specialisation criterion for employment, the 4th column shows if and how many industries (92) passed the criterion for average wages relative to those in Tunisia, and the 5th column shows if and how many industries (149) passed the criterion for average wages relative to those in the same industry in the benchmark countries. The 6th column shows if and how many industries passed all criteria (22).

Columns 7-11 show the results for mapping industries with an emerging economic potential. The 7th column shows if and how many industries (110) passed the size criterion for employment, the 8th column shows if and how many industries (59) passed the specialisation criterion for employment, and the 9th column shows if and how many industries (41) passed the criterion for average wages relative to those in Tunisia. The 10th column shows if and how many industries (23) would have passed the criterion for average wages relative to those in the same industry in the benchmark countries. The 11th column shows if and how many industries passed the size, specialisation and average wages relative to Tunisia criteria (11).

In total 40 industries were shown to have a current economic potential. Of these, 22 industries have passed all 4 selection criteria:

- NACE Rev. 2: 061 Extraction of crude petroleum;
- NACE Rev. 2: 105 Manufacture of dairy products;
- NACE Rev. 2: 106 Manufacture of grain mill products, starches and starch products;
- NACE Rev. 2: 109 Manufacture of prepared animal feeds;
- NACE Rev. 2: 110 Manufacture of beverages;
- NACE Rev. 2: 172 Manufacture of articles of paper and paperboard;
- NACE Rev. 2: 201 Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms;
- NACE Rev. 2: 203 Manufacture of paints, varnishes and similar coatings, printing ink and mastics;
- NACE Rev. 2: 204 Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations;
- NACE Rev. 2: 205 Manufacture of other chemical products;
- NACE Rev. 2: 221 Manufacture of rubber products;
- NACE Rev. 2: 235 Manufacture of cement, lime and plaster;
- NACE Rev. 2: 241 Manufacture of basic iron and steel and of ferro-alloys;
- NACE Rev. 2: 259 Manufacture of other fabricated metal products;
- NACE Rev. 2: 275 Manufacture of domestic appliances;
- NACE Rev. 2: 281 Manufacture of general-purpose machinery;
- NACE Rev. 2: 291 Manufacture of motor vehicles;
- NACE Rev. 2: 303 Manufacture of air and spacecraft and related machinery;
- NACE Rev. 2: 411 Development of building projects;
- NACE Rev. 2: 422 Construction of utility projects;
- NACE Rev. 2: 612 Wireless telecommunications activities;
- NACE Rev. 2: 822 Activities of call centres.

In addition, 18 industries have passed 3 selection criteria and perform very strongly on at least 2 of these (shown in brackets (size, specialisation, average wages, average wages PPP)):

- NACE Rev. 2: 089 Mining and quarrying n.e.c. (specialisation, average wages, average wages PPP);

- NACE Rev. 2: 091 Support activities for petroleum and natural gas extraction (specialisation, average wages, average wages PPP);
- NACE Rev. 2: 139 Manufacture of other textiles (size, specialisation);
- NACE Rev. 2: 141 Manufacture of wearing apparel, except fur apparel (size, specialisation);
- NACE Rev. 2: 211 Manufacture of basic pharmaceutical products (specialisation, average wages);
- NACE Rev. 2: 234 Manufacture of other porcelain and ceramic products brackets (specialisation, average wages PPP);
- NACE Rev. 2: 293 Manufacture of parts and accessories for motor vehicles (size, specialisation);
- NACE Rev. 2: 451 Sale of motor vehicles (average wages, average wages PPP);
- NACE Rev. 2: 465 Wholesale of information and communication equipment (average wages, average wages PPP);
- NACE Rev. 2: 619 Other telecommunications activities (average wages, average wages PPP);
- NACE Rev. 2: 620 Computer programming, consultancy and related activities (average wages, average wages PPP);
- NACE Rev. 2: 631 Data processing, hosting and related activities; web portals (average wages, average wages PPP);
- NACE Rev. 2: 651 Insurance (average wages, average wages PPP);
- NACE Rev. 2: 711 Architectural and engineering activities and related technical consultancy (average wages, average wages PPP);
- NACE Rev. 2: 731 Advertising (average wages, average wages PPP);
- NACE Rev. 2: 732 Market research and public opinion polling (average wages, average wages PPP);
- NACE Rev. 2: 813 Landscape service activities (specialisation, average wages PPP);
- NACE Rev. 2: 829 Business support service activities n.e.c. (average wages, average wages PPP).

In total, 11 industries pass all criteria for having an emerging economic potential, but 6 industries have already been identified as having a current economic potential[12] and these industries are excluded from the list of industries with an emerging economic potential. In total, 5 industries have an emerging economic potential:

- NACE Rev. 2: 242 Manufacture of tubes, pipes, hollow profiles and related fittings, of steel;
- NACE Rev. 2: 256 Treatment and coating of metals; machining;
- NACE Rev. 2: 257 Manufacture of cutlery, tools and general hardware;
- NACE Rev. 2: 282 Manufacture of other general-purpose machinery;
- NACE Rev. 2: 476 Retail sale of cultural and recreation goods in specialised stores.

2.5.2 Scientific potential

Table 7 in the Data Annex presents the results of specialisation analysis on Scopus subject areas. Areas with strong specialisation (i.e., LQ ≥ 1.25) are highlighted with green background. Moreover, areas of weak specialisation, i.e., having LQ in [1.00, 1.25) are highlighted with yellow background. Finally, areas that pass the critical mass criterion (2.5% of the total output) are indicated in bold in the second column of the table (TN output).

[12] The following industries have been identified as having a current economic potential: NACE 139 Manufacture of other textiles, NACE 281 Manufacture of general-purpose machinery, NACE 303 Manufacture of air and spacecraft and related machinery NACE 451 Sale of motor vehicles, NACE 813 Landscape service activities and NACE 822 Activities of call centres.

From the evidence, we can assert that Tunisia, when compared to the baseline, exhibits:

- Strong and continuous specialisation (i.e., LQ ≥ 1.25 for both H1 and H2) in Computer Science, Decision Sciences, Engineering, Materials Science and Mathematics.
- Emerging specialisation (LQ < 1.25 in H1 and LQ ≥ 1.25 in H2) in Business, Management and Accounting, Chemical Engineering and Energy.
- Declining specialisation (LQ ≥ 1.25 in H1 and LQ < 1.25 in H2) in Agricultural and Biological Sciences, Immunology and Microbiology.

2.5.3 Innovation potential

2.5.3.1 Innovation Data

Results are shown in table 8. The second column show the share of enterprises having introduced a product and/or process innovation in the different industries for which the World Bank Enterprise Survey firm-level data provide results. Columns 7-11 show the comparable shares for each of the benchmark countries. In Food e.g., 19% of Tunisian enterprises have introduced such an innovation, which is lower than in any of the benchmark countries, where shares range from 23% in Italy to 70% in Cyprus. Average shares for the benchmark countries are shown in columns 4 and 5. The weighted average in column 4 takes into account differences in the size of benchmark countries' economies, with higher (lower) weights for larger (smaller) countries. The average weighted share of enterprises having introduced a product and/or process innovation in the benchmark countries is 18.5%. The unweighted average in column 5 takes the arithmetic average of the percentage shares of the benchmark countries, giving equal weights to small and large countries. The average unweighted share of enterprises having introduced a product and/or process innovation in the benchmark countries is 33.4%, which is much higher than the weighted average as in Cyprus and Malta, the two smallest countries, close to 50% of the enterprises have introduced a product and/or process innovation, which is much higher than in the other and larger benchmark countries.

Columns 2 and 3 show the degree of specialisation by dividing the share of enterprises having introduced a product and/or process innovation in Tunisia with the average share in the benchmark countries. Industries where the degree of specialisation is above 1.25 have an innovation potential and are highlighted in green. These industries include:

- NACE Rev 1.1: 17 Textiles;
- NACE Rev 1.1: 19 Leather;
- NACE Rev 1.1: 21 Paper;
- NACE Rev 1.1: 26 Non-metallic mineral products;
- NACE Rev 1.1: 28 Fabricated metal products;
- NACE Rev 1.1: 31-32 Electronics;
- NACE Rev 1.1: 51 Wholesale.

2.5.3.2 Product exports

The export shares and degrees of specialisation are shown in Table 7 of the Data Annex. Export shares should be higher than 0.1% of total product exports and these industries are highlighted in green. Degrees of specialisation should be higher than 1.25 and these industries are highlighted in green. An industry is selected as having an innovation potential if it passes both criteria for at least 7 years. These industries are highly competitive on the international market, and it is assumed that this high degree of competitiveness is due to being innovative, having introduced new products or having introduced efficiency improvements resulting from process innovations. The following 23 industries have an innovation potential based on product exports[13]:

- NACE Rev. 1: 111 Extraction of crude petroleum and natural gas;
- NACE Rev. 1: 144 Production of salt;
- NACE Rev. 1: 154 Vegetable and animal oils and fats;
- NACE Rev. 1: 171 Textile fibres;
- NACE Rev. 1: 172 Textile weaving;
- NACE Rev. 1: 174 Made-up textile articles;
- NACE Rev. 1: 177 Knitted and crocheted articles;
- NACE Rev. 1: 182 Other wearing apparel and accessories;
- NACE Rev. 1: 193 Footwear;
- NACE Rev. 1: 212 Articles of paper and paperboard;
- NACE Rev. 1: 241 Basic chemicals;
- NACE Rev. 1: 311 Electric motors, generators and transformers;
- NACE Rev. 1: 312 Electricity distribution and control apparatus;
- NACE Rev. 1: 313 Isolated wire and cable;
- NACE Rev. 1: 316 Electrical equipment n. e. c.;
- NACE Rev. 1: 323 TV, radio and recording apparatus;
- NACE Rev. 1: 331 Medical equipment;
- NACE Rev. 1: 332 Instruments for measuring, checking, testing, navigating;
- NACE Rev. 1: 342 Bodies for motor vehicles, trailers;
- NACE Rev. 1: 343 Parts and accessories for motor vehicles;
- NACE Rev. 1: 354 Motorcycles and bicycles;
- NACE Rev. 1: 364 Sports goods;
- NACE Rev. 1: 366 Miscellaneous manufacturing n. e. c.

2.5.3.3 Patents

Table 7 in the Data Annex presents the results of the specialisation analysis on WIPO's fields of Technology. Overall, the number of Tunisian patents in the data is very low, therefore specialisation is very high in the fields of technology where activity is reported for Tunisia. The critical mass threshold would reject fields of technology with less than 3 patents. Therefore, we can assert that Tunisia exhibits:

- Strong and continuous specialisation (i.e., LQ ≥ 1.25 for both H1 and H2) in Pharmaceuticals, Computer technology, Food chemistry and Telecommunications.
- Emerging specialisation (LQ < 1.25 in H1 and LQ ≥ 1.25 in H2) in Medical technology, in Textile and paper machines and in Digital Communication.

[13] Focusing on the most recent 4 years (2016-2019), 24 industries would be identified having an innovation potential based on product exports. Of these 21 industries are the same as for the 2012-2019 period and 3 industries are new: NACE 265 Cement, lime and plaster, NACE 287 Other fabricated metal products, and NACE 353 Aircraft and spacecraft. Of the 23 industries identified using data for 2012-2019, 2 industries would not be included: NACE 177 Knitted and crocheted articles and NACE 354 Motorcycles and bicycles.

- Declining specialisation (LQ ≥ 1.25 in H1 and LQ < 1.25 in H2) in Organic fine chemistry, and in Other consumer goods.

Moreover, Table 8 in the Data Annex presents the results of the specialisation analysis on IPC four-digit classes that belong to granted patents through the Patent Cooperation Treaty (PCT). Although the number of Tunisian patents in this dataset is lower than the previous dataset, these patents are of higher value since they reflect technological innovation at the global level.

From this analysis, we can assert that Tunisia exhibits:

- Strong and continuous specialisation (i.e., LQ ≥ 1.25 for both H1 and H2) in three IPC classes, namely A01G, F03B and G06Q;
- Emerging specialisation (LQ < 1.25 in H1 and LQ ≥ 1.25 in H2) in two IPC classes, namely A61B and C05B;
- Declining specialisation (LQ ≥ 1.25 in H1 and LQ < 1.25 in H2) in three IPC classes, namely A61K, A23L and A61P.

Using the Eurostat-provided correspondence map, we find that the NACE Rev. 2 industries that are associated with the IPC classes that were characterised as continuous or emerging specialisations are:

- NACE Rev. 2: 20.1 Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms (C05B);
- NACE Rev. 2: 28.1 Manufacture of general-purpose machinery (F03B);
- NACE Rev. 2: 28.3 Manufacture of agricultural and forestry machinery (A01G);
- NACE Rev. 2: 32.5 Manufacture of medical and dental instruments and supplies (A61B);
- NACE Rev. 2: 62 Computer programming, consultancy and related activities (G06Q).

2.5.3.4 Trademarks

Table 9 in the Data Annex presents the results of specialisation analysis on Nice Classes for trademarks registered at EUIPO. Overall, the number of Tunisian EUIPO trademarks in the data is low, therefore specialisation is very high in the Nice classes where considerable activity is reported for Tunisia. The critical mass threshold rejects Nice classes with less than 13 trademarks associated with them.

On the basis of the data reported in Table 9, we can assert that Tunisia exhibits:

- Strong and continuous specialisation (i.e., LQ ≥ 1.25 for both H1 and H2) in Classes 29 (Delicatessen articles, namely olives with herbs and pickled in brine, sheep's cheese in brine and in herbal oil, cream cheese being filling for fruit, fruit filled with cream cheese, goats' milk cheese; pickled vegetables with various fillings and fruits; pulp concentrates; piccalilli; pickles; soups; vegetable pies; mince meat in pastry and in flat bread, included in class 29; edible oils and fats), 30 (Bread, flat bread, pastries; vinegar, relishes; chutneys (condiments); spices; dips; ketchup, mustard; pastes), 03 (Bleaching preparations and other substances for laundry use; Cleaning-, polishing, scouring- and abrasive preparations; soaps; perfumery) and 32 (Non-alcoholic drinks; essences for making beverages; non-alcoholic fruit extracts; non-alcoholic fruit drinks; non-alcoholic fruit nectars; non-alcoholic fruit juices; beverage preparations; liqueur preparations; lemonades; syrups for lemonade; fruit nectars; syrups for beverages; sorbets).
- Declining specialisation (LQ ≥ 1.25 in H1 and LQ < 1.25 in H2) in Class 33 (Alcoholic beverages, except beers; alcoholic preparations for making beverages), 24 (Textiles and substitutes for textiles; household linen; curtains of textile or plastic) 26 (Lace, braid and embroidery, and haberdashery ribbons and bows; buttons, hooks and eyes, pins and needles; artificial flowers; hair decorations; false hair) and 38 (Telecommunications services).

The NACE Rev. 2 sectors that correspond to the stongly specialised Nice classes identified above are:

- NACE Rev. 2: 011 Growing of non-perennial crops (Class 29 & 30);
- NACE Rev. 2: 101 Processing and preserving of meat and production of meat products (Class 29);
- NACE Rev. 2: 102 Processing and preserving of fish, crustaceans and molluscs (Class 30);

- NACE Rev. 2: 103 Processing and preserving of fruit and vegetables (Class 29 & 32);
- NACE Rev. 2: 104 Manufacture of vegetable and animal oils and fats (Class 29);
- NACE Rev. 2: 105 Manufacture of dairy products (Class 29);
- NACE Rev. 2: 106 Manufacture of grain mill products, starches and starch products (Class 30);
- NACE Rev. 2: 107 Manufacture of bakery and farinaceous products (Class 30);
- NACE Rev. 2: 108 Manufacture of other food products (Class 29 & 30);
- NACE Rev. 2: 110 Manufacture of beverages (Class 32);
- NACE Rev. 2: 204 Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations (Class 03);
- NACE Rev. 2: 239 Manufacture of abrasive products and non-metallic mineral products n.e.c. (Class 03);
- NACE Rev. 2: 61 Telecommunications (Class 38);
- NACE Rev. 2: 639 Other information service activities (Class 38);

2.6 Discussion

The Table 5 in the Annex summarizes the results of the different analyses. The industries with an identified economic potential in the second column (highlighted in green) are mapped to having a scientific (highlighted in green in the last column) or innovation potential (highlighted in green in the third column) where between brackets the particular innovation potential is mentioned (product exports, innovation activities, patents or trademarks). Industries with a scientific potential and at least one innovation potential, where are 3 columns are highlighted in green, are potential candidates to be selected as priority areas in the country's smart specialisation strategy. Industries which have a current economic potential by passing only 3 selection criteria but performing very strongly on at least 2 of these are highlighted in italics in the second column. In the list of industries some industries are also included which have no identified economic potential, but which have both a strong scientific and innovation potential. These industries could also be considered as potential priority areas.

The combined results show the following 12 potential priority areas for Tunisia's smart specialisation strategy, where industries have been combined in higher level aggregates[14] where possible where an additional selection has been made by excluding too small industries:

- Extraction of crude petroleum (NACE 061 & 091). This is a relatively small industry accounting for about of 0.4% of total employment and would best be excluded as it is a non-sustainable industry in the longer run with the decarbonisation of the world economy;
- Manufacture of Food products and beverages (NACE 10 & 11). This is a large industry accounting for more than 6% of total employment and includes several highly specialised food industries;
- Manufacture of Textiles, apparel, leather and related products (NACE 13 & 14 & 152). This is a large industry accounting for more than 15% of total employment and is a key industry. The focus for smart specialisation however should not be on the whole industry but on the identified NACE 3-digit industries (NACE 131, 132, 139, 141, 143, 152);
- Manufacture of Chemicals and chemical products (NACE 20). This industry accounts for about 1% of total employment and almost 6% of total product exports[15];
- Manufacture of Other non-metallic mineral products (NACE 234 & 235). This is a relatively small industry accounting for about of 0.5% of total employment;

[14] Where possible we use the higher-level aggregates from the Intermediate SNA/ISIC aggregation A*38 (cf. the table on page 44 in the Eurostat publication "NACE Rev. 2 – Statistical classification of economic activities" - https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/ks-ra-07-015).

[15] https://wits.worldbank.org/CountryProfile/en/Country/TUN/Year/2019/Summary.

- Manufacture of Fabricated metal products (NACE 256 & 257 & 259). This industry accounts for about 1% of total employment with high average wages;
- Manufacture of Electrical equipment (NACE 27). This is a large industry accounting for more than 4% of total employment. The industry lacks the support of relevant patents and trademarks;
- Manufacture of General-purpose machinery (NACE 281 & 282). This is a relatively small industry accounting for about of 0.55% of total employment. The industry lacks the support of relevant patents and trademarks;
- Manufacture of Transport equipment, in particular Motor vehicles and related service activities (NACE 291 & 293 & 303 & 451). The industry account sor more than 3% of total employment and combines high average wages with high shares of firms with innovation activities;
- Manufacture of Medical and dental instruments and supplies (NACE 325). This is a relatively small industry accounting for about 0.2% of total employment and the industry has not been identified as having an economic potential. But the presence of both a scientific and innovation potential makes this a potentially interesting industry for future developments;
- Construction of buildings and utility projects (NACE 411 & 422). The narrowly defined industry accounts for less than 1% of total employment but the broader Construction industry (NACE 41-32) accounts for more than 5% of total employment. The industry could be relevant for further domestic development but its growth potential may be limited if activities are limited to the domestic market. The industry might be excluded from the list of potential priority areas;
- Telecommunications (NACE 61). This is a relatively small industry accounting for about 0.5% of total employment but it has a high potential as average wages are very high and there is a strong support from both relevant technologies and scientific developments.

This should be seen as a preliminary list of priority industrial areas for strengthening the future development of Tunisia. Further analyses are needed to explore these industries in more detail including recent policy development, global market developments and the expected developments in Tunisia's technological and science base.

3 Qualitative Analysis of economic, innovation and scientific potential

The starting point of the qualitative analysis corresponds to the results of the quantitative analysis as explained in the previous chapter, which identified the areas with significant economic, innovative and scientific potential in Tunisia.

This qualitative analysis part intends to complete the mapping phase and aims to better define the future activities and measures to be taken within the Smart Specialisation efforts in Tunisia. This analysis also aims at identifying promising priority areas to be further explored in the upcoming Entrepreneurial Discovery Process.

3.1 Methodology

3.1.1 Interview with the stakeholders

Based on the list of stakeholders disaggregated by priority area and by category (business, academia, public sector, civil society), the experts conducted in-depth interviews per selected area.

The interviews were conducted online due to the constraints of the COVID-19 pandemic measures. The experts were responsible for organising the interviews, taking notes and collecting the results.

The experts identified relevant information on, among other things: the main strengths and challenges of the proposed preliminary priority areas, the sub-sectors/parts of the value chain of the identified sectors, the regions most present in these sub-sectors/parts, the most innovative companies in each identified sector, lessons to be learned, the potential for cross-sectoral innovation, the role of start-ups, future trends, reactions to the recent crisis.

3.1.2 Online survey

It was not considered necessary to carry out an additional online survey, as the main purpose of the interviews was to collect qualitative data in order to identify any gaps in the results of the quantitative analysis. However, the online questionnaire was made available to 2 stakeholders, who wished to respond in writing. Therefore, the two data collection instruments (questionnaire and survey) were merged.

During the discussions, the experts asked the participants for a possible ranking of priority areas for smart specialisation in Tunisia, as well as their suggestion to adapt the suggested smart specialisation areas with the inclusion of global trends (digitalisation, renewable energies, etc.) and technological foresight.

3.1.3 Description of the data collection phase

After an internal time of definition of a short list of priority areas (May – July 2022) between the JRC and local partners, the experts were able to start collecting qualitative data by mid-July 2022 and conducted interviews with key stakeholders between mid-July and the end of September 2022, according to the following table:

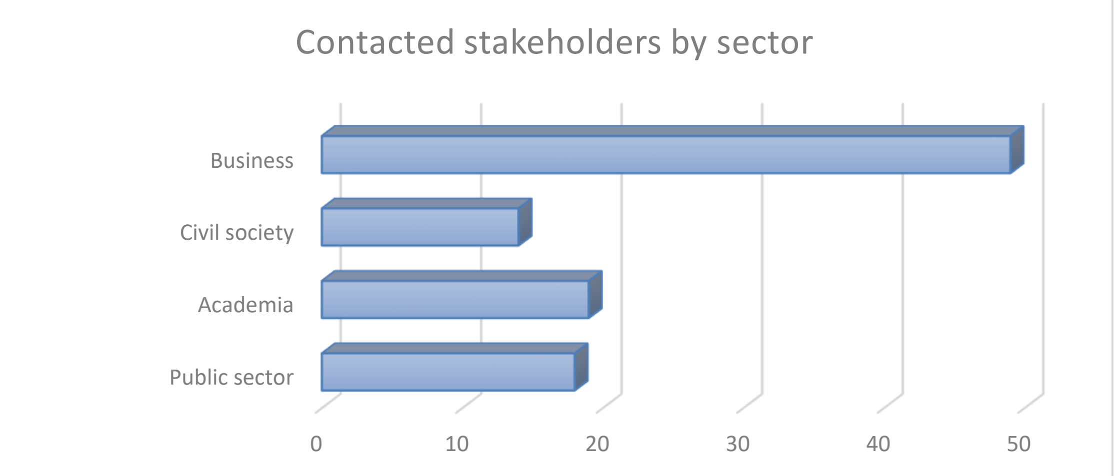
Table 1. Number of interviews planned and conducted

	Invitations sent	Interviews conducted	Response rate
Public sector actors	18	7	50%
Academic actors	19	2	10,5%
Civil society actors	14	4	28,6%
Business actors	49	13	26,5%
Total	100	26	26%

Source: authors

While the response rate from public actors (50%) is considered satisfactory, the response rate from civil society and business actors was 28.6% and 26.5%, respectively. The response rate of the academic actors contacted was low (10.5%).

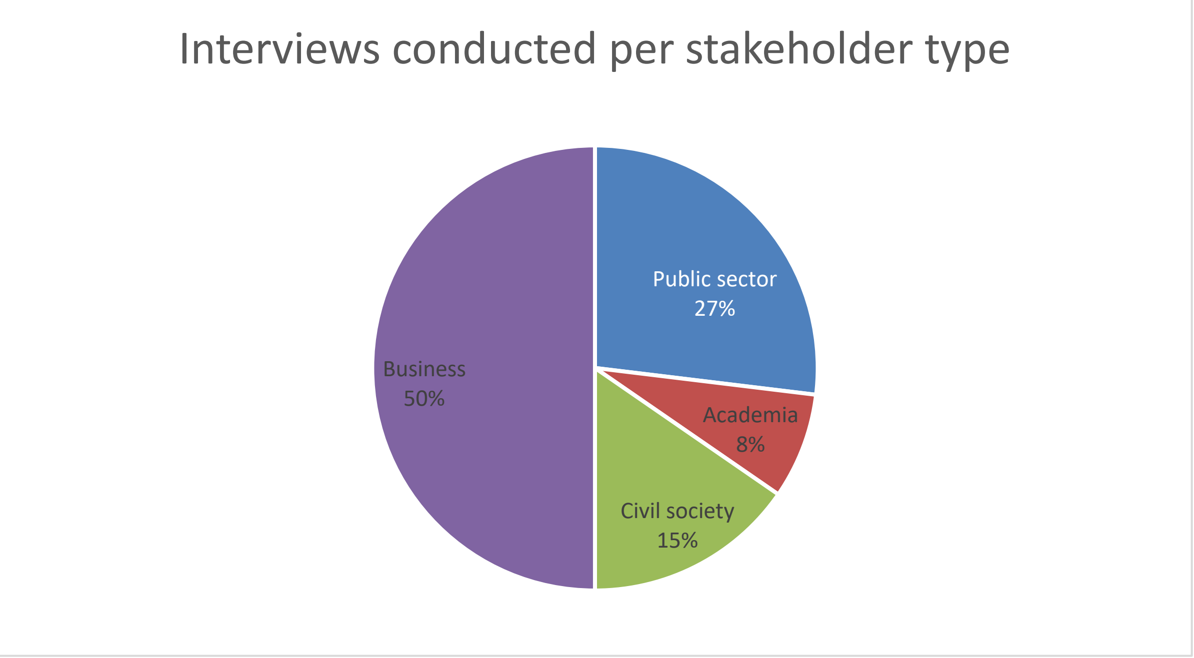
Figure 1. Contacted stakeholders by sector



	Public sector	Academia	Civil society	Business
Contacted stakeholders	18	19	14	49

Source: authors

Figure 2. Interviews conducted by type of stakeholder



Source: authors

The total of 100 interview requests were sent to the main stakeholders of the quadruple helix (public sector, academia, civil society, private sector).

The total of 26 interviews have been carried out in the following manner:

- 7 with public sector actors, representing 27% of the interviewees;

- 2 with academic actors (N.B.: 3 interviews were conducted but one university professor was counted as a civil society actor because of his active role), representing 8% of the interviewees;
- 4 with civil society actors, representing 15% of the interviewees;
- 13 with business actors, representing 50% of the interviewees.

The experts acknowledge the relatively low level of representativeness of the results due to the difficulty in reaching stakeholders, in particular academic actors. Stakeholder participation should be further developed in the next steps (EDP).

3.2 Strengths and limitations concerning Smart Specialisation in Tunisia

3.2.1 Perception of the main benefits of the S3 concept for the Tunisian economy

Although the level of knowledge and prior experience of S3 varies among the actors interviewed, they agree on a definition of S3 adapted to the Tunisian framework. They consider that "*S3 is a collaborative process of regional development through research and innovation*". The purpose of S3, for all the actors interviewed, corresponds to socio-economic development and regional growth.

When asked about their perception of the main advantages of the S3 concept to support the Tunisian economy, the public sector actors mention the identification of transforming activities, the strengthening of the regional ecosystem, the search for specialisation around comparative advantages - not only in terms of cost but also in terms of quality, the ascent into international value chains (many of them cite the example of the valorisation of olive oil) thanks to the acquisition of productive knowledge and the transfer of technology in well-defined regions.

The S3 approach, through the identification of areas of Smart Specialisation, also makes it possible to contribute to a certain international reputation of the latter, as well as the identification of European and international partners. The public sector actors willingly highlighted the advantages of adopting an S3 approach in Tunisia: collaborative work centred on the common interest, development of co-creation processes, search for synergy between actors, development of international cooperation, intra- and inter-sectoral mutual aid, cohesion of socio-economic development actors, collaboration between research infrastructures and the regional innovation ecosystem.

The public actors consider that the S3 concept can be adapted to the Tunisian context by mobilising the Higher education institutions (HEIs), the structures linked to innovation and the productive entities, while finding the necessary links between the actors, in each determined territory.

There is a perception of this potential among public sector actors to transform scientific output into product or process innovations. According to the Global Innovation Index 2021[16], Tunisia is ranked 71st in the world overall, 18th in terms of scientific and technical production per capita (at purchasing power parity) and 35th in terms of human resources and research. Its spending on education, especially on public funding of secondary education, and its share of tertiary graduates in science and technology (43.4%) were mentioned as strengths in the 2021 report.

For the civil society actors interviewed, the advantages of adopting an S3 approach are as follows: federating actors from different backgrounds, focusing on a reduced set of sectors, building on the strengths of each region and trying to reduce the brain drain, particularly in the IT and telecommunications sectors. The adoption of an S3 is seen as very positive for Tunisia's social and solidarity economy and the engagement of young people in collaborative approaches is seen as strong.

Among the advantages of an S3 at national level, the academic actors who took part in this qualitative study underline the support for an effective increase in the skills of the active population in order to boost the entrepreneurial ecosystem, which is dependent on economic conditions and investments, the consolidation of

[16] The Global Innovation Index (GII) is published by the World Intellectual Property Organization (WIPO), a specialized agency of the United Nations. https://www.globalinnovationindex.org/home

value chains and the capacity of the S3 to mobilise all the actors, starting with civil society, around the common interest.

The S3 would thus make it possible to take advantage of the assets of the Tunisian economy: quality of scientific research, training of its human resources, proximity of the Maghreb and European Union neighbours, multilingualism, geographical location, etc. Finally, the adoption of an S3 in Tunisia would have the advantage of reversing the current paradigm of collaboration between academia and business: it is now industry that comes to the world of research to help it meet the needs of the territory.

Despite their limited prior knowledge of the S3 concept, business actors were quickly able to identify the main benefits of smart specialisation. First of all, an S3 approach allows to focus the efforts of all actors around the potential and strengths of each region, after having formally identified them. The business actors interviewed also emphasise the virtues of a cross-sectoral collaborative approach. The private actors also highlight a better opening to the European market, as well as an exchange of know-how between European and Tunisian economic actors. This would lead to better results for Tunisia in terms of investment and production or export of innovative products and services.

Finally, business stakeholders consider that S3 could retain talent in the country, especially in the digital, IT and robotics sectors, which also offer huge opportunities, but also the effects of the inclusion of information and communication technologies (ICT) and artificial intelligence (AI) in many industries, such as textiles.

3.2.2 Limitations to the application of Smart Specialisation in the country

Despite the many advantages of adopting an S3 approach in Tunisia, there are some limitations to the application of the Smart Specialisation in the country.

The mentioned limitations are of several kinds:

- **Governance limitations**

The public sector and civil society players primarily mention the difficulties linked to the operationalisation of S3 governance, particularly with regard to arbitration and delays in steering, leading to more delicate decision-making. They consider that a national coordination structure for the S3 would be useful and that it would be useful to reactivate the interministerial committee to ensure better coordination between the various players. The actors from the academic world thus underlined a lack of global information on the S3 despite the strategy's broad orientation towards socio-economic and environmental challenges.

S3 requires by its very nature a multidisciplinary approach and implies that all stakeholders work in the spirit of S3 and it is essential that the governance structure is the foundation of S3 in Tunisia in order to embed the approach over time (see temporal limits, below).

- **Infrastructure limitations**

Public sector and private sector actors also highlighted the limitations of the physical, logistical, telecom and transport infrastructure as potential obstacles to the implementation of S3 throughout Tunisia.

- **Limitations on means**

The public sector and civil society actors interviewed stressed the importance of equipping themselves with the financial, technical, software, intangible and material means to meet the ambitions of the S3. It is therefore essential to attract long-term productive investment in high value-added sectors, such as the construction of high-tech parts for the automotive, aeronautics and aerospace industries.

The academic actors who participated in this study consider that Tunisian universities have the capacity to train high-level managers and engineers, but that Tunisian companies do not provide them with an attractive working environment, which partly explains the Tunisian brain drain (according to the INS, 2016-2022: 32,000 engineers left to work abroad between 2016 and 2022).

In terms of financial means, the scattering of financial aid and foreign donors was also mentioned during this study. This is all the more important as Law 72 (Law No. 72-40 of 1 June 1972) does not subject international or off-shore companies to conventional regulations, which has the indirect consequence of making access to finance more difficult for national companies, particularly SMEs.

- **Temporal limits**

It was pointed out by public sector and academic stakeholders that companies generally take a short-term approach, whereas S3 is a process that needs time. This can lead to a loss of momentum during the design and implementation phase of S3 if companies do not see its potential quickly. It is therefore essential to anchor the S3 approach in time and to convince stakeholders, particularly those from the business world, that the results will come with time. This work involves the dissemination of good practices and the collection of experiences from other regions in order to describe their approach and activities related to the implementation of smart specialisation[17].

This short-term approach is compounded by a series of rigidities in the legal and structural framework and a bureaucracy considered to be significant by academic, civil society and business actors. For example, the long time frame for public procurement and the slow response to private sector funding needs were highlighted.

The latter is not free of rigidities, as it faces a lack of collaboration with HEIs to adapt curricula to market needs, a low degree of labour mobility in the face of emerging challenges, and a strategic vision that is still not very forward-looking with regard to emerging techno-economic developments (internet of things, big data, quantum computing, etc.).

- **Limitations related to knowledge and technology transfer**

The public actors interviewed insisted on the important limits relating to the absorption of knowledge and innovation by Tunisian companies. Even though Tunisia is performing better than expected for its level of development according to the Global Innovation Index report for the year 2021[18] and ranks 7th among the 34 lower-middle income economies, 9th among the 19 economies of North Africa and West Asia, 38th out of 130 countries in terms of knowledge generation, the country still suffers from a significant difficulty in knowledge absorption (Tunisia is ranked 113th out of 130 countries).

- **Limitations related to the mobilisation of actors**

The public sector actors interviewed expressed their concern about finding a sufficient level of representativeness of the actors, particularly companies, about mastering the information disseminated at national level and about mobilising the actors of the quadruple helix. The launch of a national S3 approach represents a strong awareness-raising action for the actors and must invite all the stakeholders, demonstrate the interest of the approach through examples of pilot initiatives at national level, or even good practices in the framework of the Western Mediterranean Forum for Research, Innovation and Higher Education (5+5 dialogue)[19], in which Tunisia participates, for example.

The academic actors who participated in this qualitative study are aware that Tunisian universities need to participate more in the dialogue with the other actors of the quadruple helix. They stress that regions lack autonomy to respond to the challenges of the territory by taking into account an S3 approach. As an example, they mention that university programmes are uniform and not adapted to the needs of the regional economy.

- **Limitations related to centralisation and regional specificities**

Many actors, particularly from civil society, have expressed limitations related to the strong centralisation of the decision-making process in Tunisia. It is de facto easier to undertake, meet key actors and collaborate in Tunis than in some Tunisian governorates.

There are also great disparities between the various Tunisian governorates, which should be reflected in the S3 at regional level (level of unemployment, access to higher education, etc.). For example, the region of Sfax is better off than many regions: there is a greater sense of entrepreneurship, civil society is well structured and the regional economic potential has been clearly identified. Similarly, the Junior Enterprises in Bizerte or Gabes show great disparities in the level of entrepreneurial spirit of regional actors.

These limitations also raise the need to align the S3s with the country's needs, particularly in terms of health, transport or education infrastructure and the contribution of future S3 strategies to the Sustainable Development Goals (SDGs).

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[17] See for example the collection of "smart stories" by the JRC S3 platform: https://s3platform.jrc.ec.europa.eu/smart-stories
[18] Source: Global Innovation Index (GII). Calculated from the ratio of GII score to GDP per capita [logarithmic scale in PPP].
[19] https://www.fiveplusfiverihe.org/fr

- **Limitations related to the choice of the smart specialisation areas**

A number of stakeholders interviewed, particularly from the business community, point out that there is a risk, not of the S3 process itself, but of misidentifying areas of specialisation by concentrating investment in sectors with low transformational potential.

3.2.3 Main challenges for the implementation of the S3 strategy in Tunisia

According to the public sector actors interviewed, the main challenges for the implementation of the S3 strategy in Tunisia are the quality of governance, i.e. the mechanisms of collaboration between actors, the participation of enterprises, the definition of specialisation axes that allow insertion into global value chains, and the establishment of a legal framework to facilitate the development of investments.

For their part, civil society actors consider themselves ready and underline the interest of actors in organising themselves to contribute to a multi-actor innovation system, proposing local solutions to retain talent while gaining a national dimension through the development of clusters. Nevertheless, the civil society actors interviewed mentioned the possibility of blockages and monopoly situations that could slow down the spread of S3. They consider that the public sector still has a sectoral approach, different from the cross-cutting S3 approach.

Academic stakeholders pointed to a certain loss of momentum within HEIs, a lack of commitment of stakeholders within the commissions and a lack of autonomy of regions as the main challenges for the implementation of the S3.

Business actors consider that there is significant uncertainty in Tunisia. According to a projection made by Bloomberg, CMA, and the International Monetary Fund (IMF)[20] on the vulnerability of sovereign debt, the country is ranked third internationally after El Salvador and Ghana in the countries that could default in 2022. They also mentioned a high level of resistance to change on the part of public actors, which can lead to a blockage of decisions and a lack of a shared vision for investments. They consider that it is necessary to work with trade unions to convince the whole civil society. Finally, business actors stress the importance of strengthening the digital infrastructure and, in general, the physical infrastructure to improve connections between cities.

The public sector actors interviewed consider that the COVID-19 pandemic has blocked progress in the design stages of S3, apart from the online meetings organised by the JRC. COVID-19 also seized up the coordination mechanisms and limited contacts to develop the process.Nevertheless, they underline the positive effect for some sectors (see for example the experience of the pharmaceutical sector) which were able to launch innovations and stand out. In the adversity of the health crisis, Tunisia was able to federate actors around concrete projects (e.g. the implementation of respirators) to encourage collaboration between actors. Other sectors (e.g. the automotive sector) have been negatively impacted by the drop in demand and the difficulty associated with the supply of raw materials.

The civil society actors who participated in this qualitative study confirm that the COVID-19 pandemic led to a partial loss of exchanges after a sustained rhythm of work with Professor Dominique Foray and Ms Amani Charrad in 2019-2020.

The private sector has suffered greatly, especially in certain sectors (those directly exposed to the public or dependent on exports). For example, tourism has been severely affected, although domestic tourism has been strong, as has the building construction sector and projects financed largely by public revenues.

Food and beverage manufacturing has experienced an increase in the price of goods and a decrease in consumer purchasing power. In comparison, the telecommunications, IT and digitisation sector have suffered relatively less than the others. The increase in demand for energy has led to an increase in the cost of energy, which has benefited the energy sector, but has had a negative impact on most other sectors, particularly the transport and agri-food sectors.

[20] https://www.bloomberg.com/news/articles/2022-07-07/why-developing-countries-are-facing-a-debt-default-crisis

3.3 Analysis of the relevance of the suggested areas of specialisation

The discussion on understanding which priority and potential areas resulting from the quantitative analysis reflect the current situation and which could be further explored in the qualitative analysis included various stakeholders from Tunisia and experts from this area.

The following priority areas were suggested: Information technology; Manufacture of medical and dental instruments and supplies; Manufacture of electrical equipment; Telecommunications; Manufacture of transport equipment including motor vehicles and related service activities; Food and beverage manufacturing (mainly olive oil); Manufacture of textiles, clothing, leather, and related products; Manufacture of medical and dental instruments and supplies.

3.3.1 Objectives

The qualitative analysis seeks to verify whether the results reflect the reality of the Tunisian context from the point of view of the main actors of the quadruple helix. Having in mind the characteristics of the Tunisian economy, specificities of the Smart Specialisation approach and the regional context, it was suggested to abandon the sectoral approach and to reduce the number of specialisation areas. In this regard, the following list was proposed:

- Energy (crude oil extraction, new energies);
- Telecommunications, IT and digitisation;
- Food and beverage manufacturing;
- Textiles, clothing, leather and related products; chemicals and chemical products; other non-metallic mineral products;
- Manufacture of transport vehicles (electrical equipment; general-purpose machinery; transport equipment, in particular motor vehicles and related service activities, aircraft components);
- Construction of public service buildings and projects;
- Tourism (including medical tourism).

The S3 approach was to be applied by not only identifying priorities in areas where Tunisia has a competitive advantage, but also by considering the potential to generate knowledge-based growth and to achieve the economic transformation necessary to address the major and most pressing challenges to society and the environment.

In the Tunisian socio-economic context, social innovation and practice-based innovation play an equally important role in the S3 as technological innovation based on scientific research. S3 involves not only radical innovation, but also the exploitation of niches by innovating in traditional areas, developing and applying new business or organisational models, and adapting/exploiting innovations derived from tacit knowledge and experience in these areas.

In-depth interviews with key S3 actors in Tunisia allowed the experts to identify additional suggestions for areas of specialisation to complement the pre-existing list. It should be stressed that the areas of specialisation suggested in this document are the result of numerous exchanges with the stakeholders interviewed, but the final decision on the priorities should be taken by the S3 team and the Tunisian smart specialisation stakeholders.

This document should therefore be used as an additional insight to feed the debate on current and future S3 priorities in Tunisia. Although an initial set of priorities should be identified when designing the S3, they can also be changed or modified when new information or recent developments make it desirable.

3.3.2 Methodological precautions regarding private sector actors

Methodological precautions were necessary in terms of the selection of key players in the business world and the representativeness of the sample.

The business stakeholders interviewed were specialists working or with recent experience in one or more of these specialised areas or with a cross-sectoral view (e.g. consultancy, banking, investment companies, etc.).

They were also chosen because of their role in their company (managers of large companies or SMEs, or consultants).

It is important to note that not all private actors interviewed have their sector represented in the areas of specialisation (e.g. actors from the investment sector, market research or banking), which increases the objectivity of their opinion.

3.3.3 Level of knowledge and ownership of the S3 concept

The public sector actors interviewed during this qualitative study were familiar with the S3 concept through first experiences, such as the realisation of events to attract local and regional actors around S3, the participation in the programme "Regional Initiative to Support Sustainable Economic Development" - IRADA[21] through the creation of regional platforms for public-private dialogue in 8 pilot governorates to develop collaboration around value chains. The IRADA project has thus put the S3 at the centre as a planning tool in three regions with important economic weight in Tunisia (Sfax, Medenine and Bizerte) and introduced an element of innovation.

Other public sector actors who responded to this qualitative study were working on projects that aim to support the innovation ecosystem at the level of a Tunisian governorate based on two priority sectors in the region (Nabeul), close to the S3 concept.

The civil society actors have also a good level of appropriation of the S3 concept, notably through their participation in the IRADA programme. For example, one of them is the founder of the Sfax Technopole in the digital field and the president of a think tank (Beit Elkhibra) on the future of the Sfax region. The civil society actors who participated in this study have an entrepreneurial spirit and are aware of the potential of a strategy based on the search for collaborations between actors of the innovation ecosystem in Tunisia to better position themselves in the international value chain (for example for olive oil, mechanics, and health technologies - health tech).

Other actors have significant associative experience at the border of the university and entrepreneurship, through their participation in the junior enterprise of the Faculty of Sciences of Tunis and then in the confederation of junior enterprises of Tunisia. They are well versed in the subjects of professional integration of students and youth entrepreneurship and have already taken an interest in the S3.

The academic actors interviewed for this analysis also had a good knowledge of the concept of smart specialisation. They are vice-presidents in charge of the valorisation of research, particularly with technopoles and training structures. They are aware of the catalytic role of higher education institutions (HEIs) for S3 through its horizontal positioning, its openness to business and its capacity to train human resources as a support for future areas of specialization.

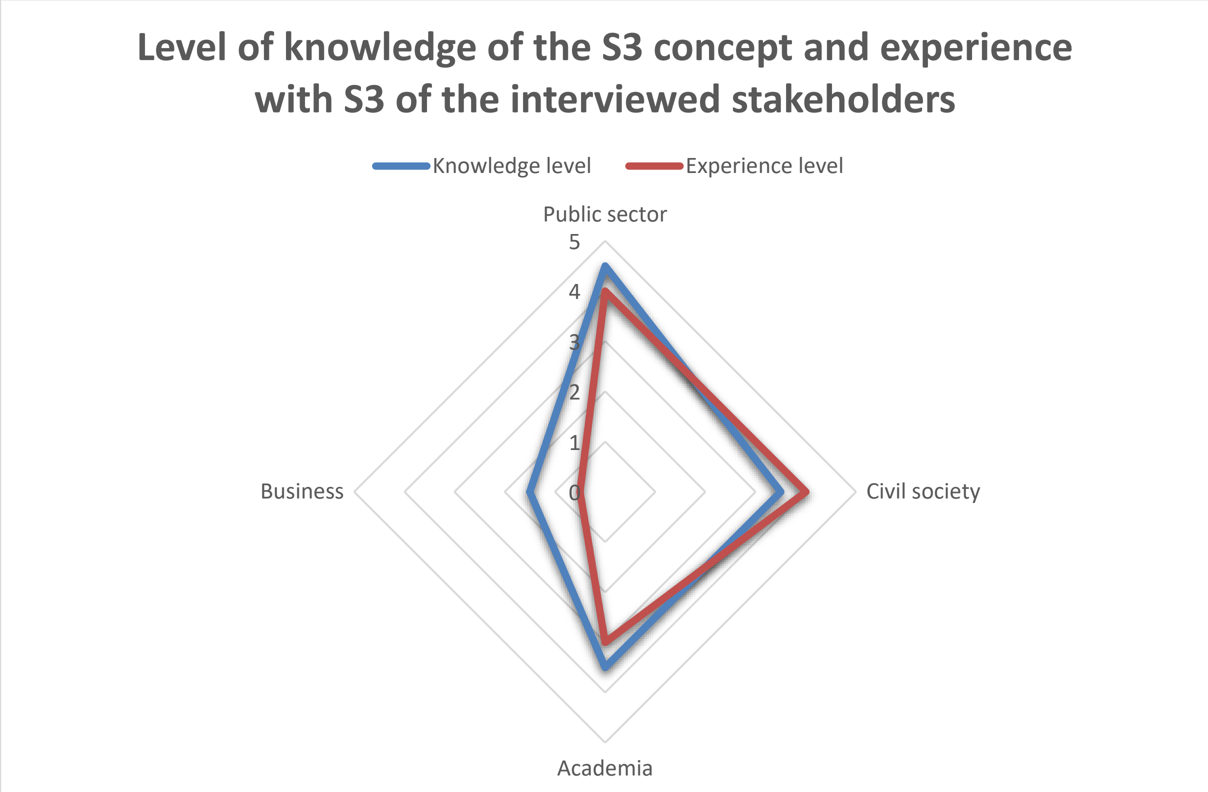
In contrast to the other players in the quadruple helix, business players were not fully familiar with the S3 concept. Some of them were familiar with the European Union's major programmes.

The figure below summarises the relative levels of knowledge of the S3 concept and experience of the stakeholders interviewed during this qualitative study[22].

[21] The IRADA programme is financed by the European Union for an amount of €32 million and aims to contribute to sustainable and inclusive economic development and to improve the employability of women and men in 8 pilot governorates (Gabès, Médenine, Gafsa, Kasserine, Sfax, Sidi Bouzid, Bizerte and Jendouba). https://irada.com.tn/

[22] This is not an extrapolation to all quadruple helix players in Tunisia.

Figure 3. Level of knowledge of the S3 concept and experience with S3 of the interviewed stakeholders by sector



Source: authors

3.3.4 Potential for addressing societal challenges in Tunisia through suggested areas of specialisation

Public sector actors consider that the pre-identified areas of specialisation are sufficiently ambitious to meet the societal challenges facing Tunisia, but it is necessary to facilitate the environment for their development, notably through the evolution of the legal framework.

They consider that the political orientations are associated with economic priority areas such as water, energy and food security, digital transition, and the circular economy. Tunisia has private investments that allow it to work on these issues (see Ministry of Industry, Mines and Energy, March 2022. Industrial and Innovation Strategy 2035).[23]

For the actors of the civil society, the specialisation on solar energy meets the environmental challenges, and the potential fields of specialisation around medical technologies (health tech) and niche tourism are turned towards the future and exhibit the potential of innovation at the regional level. It was noted that there is a potential in youth entrepreneurship and health ecosystem in the region of Sfax, but lacking sustainable partnerships.

The academic actors also consider that the associative fabric has prepared a favourable ground through the identification of major societal challenges, the launch of citizen initiatives and the mobilisation of actors on the ground which are necessary for an innovative approach (mobilisation of young entrepreneurs, inclusion of women in business and science, etc.).

While the stakeholders were also convinced by the level of ambition of the suggested areas of specialisation to address the societal challenges facing Tunisia in theory, the business actors were more reserved about the implementation of the strategies in the regions. They stress the need for good institutional governance to ensure a proper management, regional leadership and stable resources and mechanisms to facilitate implementation. A possible specialisation in the field of renewable energy seems particularly ambitious to address the challenges

[23] http://www.tunisieindustrie.gov.tn/si2035/Livrable_7_Rapport_final.pdf

of energy and water access. Sustainable tourism is also seen very positively by private sector actors, as it can have a significant knock-on effect on other sectors (construction, transport, etc.).

3.3.5 Degree of relevance to the aspirations of Tunisian civil society

The actors interviewed confirmed the strong demand for regional economic development on the part of citizens - to create more wealth but also to enable social needs to be met.

The pre-identified areas of specialisation correspond to the aspirations of civil society, particularly in relation to health technology, ICT, energy (with a focus on renewable energy), textiles and clothing. The S3 approach can also build on the resilience and entrepreneurial strength of the Tunisian economy.

However, beyond the choice of areas of specialisation, it is essential that civil society players are closely involved in the definition and implementation of the S3. The imperative of social justice and civil society's aspiration for a fair distribution of the wealth created reinforces the need to involve the fabric of associations and SMEs, and to show the benefits of the adoption of the S3 for civil society. Since the Tunisian revolution of 2011, the state has simplified the creation of associations, which are more active than before and are looking for collaborative projects.

For the civil society and academic actors interviewed, the identification of S3 priorities is less important than the incorporation of social and environmental concerns to better "rethink" economic activity and the capacity to create added value.

Other interviewed stakeholders mention that it is possible that the adoption of an S3 approach will positively affect the whole of civil society in an indirect way, but it will require a major dissemination effort. It will also be necessary to reverse the talent drain by communicating S3 successes at regional level.

3.3.6 Capacity of the S3 to support smart and sustainable economic development in Tunisia

The public sector actors consider that the objectives of economic growth and social development constitute the core of the future S3 in the Tunisian context, while leaving an important part to the energy transition, the needs of smart and sustainable economic development, as well as culture. Given the great diversity of Tunisia's territory (urban areas, mountains, coastline, islands, mines, desert; plant and animal diversity), they consider it essential to find the "right balance" between economic development and the environment, by activating research structures to enhance the value of research results geared towards sustainable development (for example, technology transfers on wastewater treatment, renewable energies, biotech, etc.).

They also consider it essential to develop S3 strategies that respect the environment and allow local populations to remain in their territory, if they so wish, by allowing projects to emerge that correspond to the specificities of each region.

The civil society actors who were interviewed stressed the importance of putting in place social and environmental constraints and insist on the role of start-ups in helping companies to become more environmentally and socially conscious, while maintaining manufacturing in Tunisia by taking advantage of the still relatively low cost of labour, in order to move up the value chains while incorporating the social and environmental criteria that were at the heart of the demands of the 2011 revolution (fight against unemployment, more dignity, etc.).

It was recalled that this approach of including social and environmental criteria can be applied to all the pre-identified areas of specialisation, as the following examples show:

- It is possible to reorient tourism away from mass, seasonal tourism, which destroys the coastline and consumes water and energy resources, and towards "green" tourism, capable of attracting visitors to the whole of Tunisia and operating all year round by exploiting Tunisia's natural, historical and cultural assets;
- Similarly, it is possible to reorient traditional energy specialisation towards the production of renewable energy, to incorporate the results of RDI in the textile industry or the automotive industry in order to provide more decent and qualified jobs;
- The construction sector can benefit from advances in 3D construction or eco-construction;

- In the field of telecommunications, IT and digitisation, there is a major constraint linked to the cost of energy because the technologies use clouds, which are very energy-intensive. There is also an environmental constraint to cool the physical infrastructure in a hot country;
- In the agri-food sector, where more than 70% of farms are smaller than 5 hectares and suffer from a lack of water supply, it is possible to take into account the imperative of sustainability and environmental concerns by favouring short circuits, targeting local products, niche products and products of excellence (e.g. olive oil), and by favouring organic farming. Tunisia has unique ecotypes, used for example for the extraction of essential oils for the perfume industry.) This approach would increase the economic and social value of the farm, while respecting environmental constraints;
- As far as the manufacture of green transport vehicles is concerned, Tunisia could become a laboratory of smart transportation for the transformation of the urban landscape, facilitated by the continuous urbanisation along the side but also on the main transport axes.

It is also possible to take advantage of possible synergies so that innovation can spill over to the whole economy, for example by considering the potential of eco-construction combined with the use of solar energy to promote eco-tourism in Tunisia.

The academic actors interviewed were also able to mention initiatives that make it possible to consider the capacity of the S3 to support the smart and sustainable economic development of Tunisia. For example, the Carthage University think tank focuses its activities on three key areas: the energy transition (through an alliance with a German university to set up a green hydrogen plant[24]) and the promotion of an energy mix between hydrogen, wind and solar energy and the creation of storage devices), the use of ICT to avoid wasting water for the exploitation of shale gas, and the intensification of links between the agri-food industry and the sustainable use of water resources.

The business actors are in line with the vision of the other actors as to the capacity of the S3 to support the smart and sustainable economic development of Tunisia. They consider the potential of smart products combined with the know-how, sometimes traditional, and the quality of manufacturing in Tunisia, which is recognised beyond the borders and which has attracted many multinational companies. It was also mentioned that the existence of start-ups in the ecosystem allows to "force" the collaboration between actors, accelerating the inclusion of technological advances to create high value-added products or services.

3.3.7 Proposed specialisation areas and international perspectives

For the public sector and civil society actors participating in this study, the national priorities are in line with those of the partner countries, including the European Union. The assets of the Tunisian innovation ecosystem and the country's know-how will allow for a better integration into the global value chains through the S3. In fact, Tunisia is already positioned on a very competitive world market. Some international companies have already chosen Tunisia to develop their products. It is now involved in the manufacture of high quality automotive and aeronautical parts for demanding international customers. The country aims to attract 5,000 to 10,000 engineers by 2030.

The link with the major world trends is therefore already established and Tunisia has committed itself very voluntarily to strengthening links with European and also African countries.

Business actors also consider that the areas of specialisation are in line with recent and future market developments, both globally and regionally (in terms of the importance of the development of renewable energies, the growth potential that digitalisation and IT telecommunications seem to offer, the challenges of food security, sustainable tourism, etc.).

It was also pointed out by some business actors that some sectors are being automated, such as in the textile industry. It is therefore necessary to be cautious in terms of investments. They consider that it is preferable to

[24] On December 15, 2020, the Tunisian and German governments signed a memorandum of understanding to confirm their willingness to cooperate in the field of hydrogen through the "Tunisian-German Alliance for Green Hydrogen". The amount of 31 million Euros, allocated to Tunisia by the German Government, will be used to carry out a pilot project for the production of green hydrogen in Tunisia and to develop national skills in this field.

focus on the human experience (for example in tourism), in line with Tunisia's tradition of openness and its wealth of human capital and education.

The privileged geographical situation of Tunisia was also mentioned as an undeniable asset in the search for internationalisation of its industry. With the current economic situation and the increase in transport costs, Tunisia can take advantage of its situation to develop towards the outside world, in particular the European Union market, to improve the balance of trade and to increase its exports.

3.3.8 Link between the future S3 strategy and the current national R&I strategies in Tunisia

The public sector actors confirmed that S3 is included in the three-year strategic development plan 2023-2025, under the supervision of the Ministry of Economy.

As such, the sectoral sub-committee for research and innovation has an entire chapter on the S3, aligned with the three-year strategy. The key role of the Ministry of Higher Education and Scientific Research (MESRS) and its efforts to enhance the links between the future S3 strategy and the current national R&I strategies in Tunisia were highlighted.

Public sector actors consider that the S3 priorities presented are well aligned with the country's R&I strategy, although adjustments will need to be made in order to refine the areas of specialisation. It was stressed by academic stakeholders that the strategic development plan thus allows for the orientation of training and funds to support future S3 themes.

In particular, this allows the research community not to be compartmentalised in the face of the strategic orientations of smart specialisation, to be able to redeploy sectors and to direct researchers towards new areas of specialisation.

The vast majority of the business actors interviewed are not aware of the current R&I strategies at national level in Tunisia. Nevertheless, they expressed the need for research to be more open to certain fields in order to meet the new needs of the textile industry or tourism, for example. They would like, for example, the launch of national initiatives to help researchers put their ideas into practice and obtain funding. Business actors also emphasise their need for stability in the R&I funding framework to be able to work in the long term.

3.3.9 National priority challenges and suggested priority areas

The six national priority challenges defined in 2017 by the Tunisian Ministry of Higher Education and Scientific Research in its scoping document "Scientific Research: priorities, future orientations and key initiatives 2017-2022"[25] constitute a first priority-setting exercise, around the following axes:

- Energy, water and food security.
- Societal project: education, culture and youth.
- Citizen's health.
- Digital and industrial transition.
- Governance and decentralisation.
- Circular economy.

For the public actors interviewed, as commendable as it is, this exercise is still too broad to be assimilated to an S3 approach, but its framework is compatible with an S3 approach. Most of these challenges are perfectly integrated with the pre-identified areas of specialisation. The application of the S3 definition process will allow the application of a methodology to focus on less broad priorities, considering the potential for cross-fertilisation and the specificities of these challenges at the regional level.

Moreover, academic actors consider that in 2022 the 6 priorities should be reviewed due to the international context (notably the COVID-19 pandemic, the war in Ukraine and its consequences on energy supplies, and the importance of climate change).

[25] https://www.esen.tn/portail/medias/documents/actualites/p1brgh9e9u1vn41eem1d5bqv015v4.pdf

It is worth mentioning here the lack of knowledge of the scope of this document for civil society and business actors.

3.3.10 Revision of the areas of specialisation identified in the quantitative analysis

The qualitative analysis incorporates the suggestions to review some of these areas of specialisation and/or to reformulate some of the suggested priorities. The areas suggested following the qualitative analysis - carried out based on statistics on the Tunisian economy and the identification of its comparative advantages - are still quite in line with a sectoral approach (energy, ICT, construction, tourism, etc.).

In this section, we intend to bring the perspective of S3 actors in Tunisia towards a formulation of S3 priorities in line with a place-based approach, taking into account the transformational potential of the economy.

In general, the public sector actors found the identified areas too broad and emphasised the importance of exploring the cross-cutting potential of the areas for identifying priorities. Furthermore, they mentioned the lack of foresight in the areas presented, as they '*sketch the present from a statistical reality*'.

The civil society considered type of approach and integrating or not the imperative of sustainability and response to socio-environmental issues, being more important than the final choice of smart specialisation priorities. For them, the future S3 must be aligned with the objectives of sustainable development.

As for the actors of the academic world, they underlined that the macro fields are correctly aligned at the international level (e.g. energy, ICT, agri-food, circular economy). They advised that the future priorities that will emerge would be specific to a region (e.g. around smart textiles or green vehicles) and be adapted to the needs identified by the regional economic actors (e.g. STIA in Sousse, Damartex in Zaghouan).

Business actors point out that Tunisia is marked by a disparity in access to resources in regard to regions and geographical and urban/rural divide. There are important regional differences in capacities and needs. They consider the pre-identified areas to be relevant, well aligned globally and regionally and in line with international trends. However, business actors insist that regions need to identify added value to be interested and to compete for exports.

They also pointed out that in Tunisia, being a small country, monopolies or quasi-monopolies have been formed in certain sectors, which may be detrimental to regional collaboration, even though the success of the S3 makes it necessary to involve a large number of actors. Finally, the business actors deplore the unequal distribution of wealth in Tunisia, which reinforces the shortage of professionals in some regions. They insist that the S3 must focus on priorities that allow the retention of talent in the country.

The revision of the specialisation areas is given below.

1. **Energy (crude oil extraction, new energies)**

For all the actors interviewed, fossil fuels are reaching their limits and the specialisation area should be oriented towards renewable energies in order to align this priority with carbon emission reduction objectives and climate issues. In 2022, crude oil extraction is no longer a forward-looking activity that can be included in the smart specialisation priorities.

Stakeholders interviewed highlighted Tunisia's significant potential in renewable energy (solar/photovoltaic, wind), as well as in biofuels and hydrogen production, storage and transport to improve the country's energy mix. Due to the climate crisis, some European partners have expressed their willingness to invest in renewable energy outside their borders. The proximity of some EU countries, notably Italy, France and Malta, to facilitate the transport of hydrogen was highlighted.

This priority has a strong potential impact on other sectors, by reducing the cost of energy and by sparking research projects with the transport industry in general, and the automotive industry in particular. This orientation is also in line with one of the three specialisations of the Carthage University think tank on energy and energy transition, and the collaboration with a German university to set up a green hydrogen plant.

- Identified strengths:
    - Climate.
    - Geographical proximity to countries that buy new energy.
- Identified limitations:

    - Access to finance.
- Cross-sectoral potential:
    - Manufacturing of automotive parts, transport, building construction, ICT (clouds) green tourism.
- Recommendation:
    - Maintain the area of specialisation, removing the reference to crude oil extraction and focusing RDI efforts on renewable energy.
- Proposed new name:
    - Energy sources of the future (production, storage and transport of renewable energy: solar, wind and hydrogen)

2. Telecommunications, Computing and Digitisation

Information and communication technologies (ICT) have a strong potential for cross-fertilisation in all sectors. With digitisation, ICT form a promising sector that allows to act globally by freeing oneself from physical constraints and by pushing back the limits of artificial intelligence (Internet of Things). Tunisia is on the right path because of its human capital, the excellent level of training of students in scientific and computer science fields, but is particularly exposed to the brain drain. It therefore needs to attract leading international companies in the ICT sector.

The ICT sector is a major contributor to international value chains as it allows the export of digital services. Moreover, it is a less vulnerable sector than others (during the crisis it even grew).

The potential of this field and its applications are almost limitless, e-Education and MOOCs, internet of things (IoT), 3D construction, health tech and telemedicine, fintech, industry 4.0, smart cities, dematerialisation of public services, etc. Nevertheless, physical infrastructures (servers, clouds) are energy intensive and increase the energy bill, especially in the Tunisian climate.

Furthermore, there is a need to create a framework for start-ups, as Law 72 (Law No. 72-40 of 1 June 1972) does not subject international or offshore companies to treaty regulation.

- Identified strengths:
    - Quality of Tunisian engineers.
    - Positive experiences (e.g. health tech).
- Identified limitations:
    - Access to finance for start-ups.
    - Legal framework for start-ups.
    - Energy consumption.
    - Talent drain.
- Cross-sectoral potential:
    - All sectors.
- Recommendation:
    - Maintain the area of specialisation, but in a horizontal way (key enabling technology).
- Proposed new name:
    - KET: Smart technologies, digital applications and artificial intelligence.

3. Food and Beverage Manufacturing

This pre-identified area of specialisation was the subject of some debate among the stakeholders interviewed. A recurring comment was the lack of explicit inclusion of agri-food.

As regards the production and manufacture of food and beverages, there is a great potential due to the variety of raw materials in Tunisia. Nevertheless, the distribution channel is very informal. There are also administrative rigidities for start-ups in this field. Furthermore, the actors interviewed insist on the importance of including in this area of specialisation food security (particularly important in the North-West of Tunisia) by guaranteeing the level of production, quality and quantity of agricultural production in Tunisia (one of the granaries of the Mediterranean).

This area of specialisation is aligned with many national initiatives, such as the "food and water" think tank at the University of Carthage, linked to the energy sector.

When S3 actors are asked about the sustainability of this field of specialization, they associate food and beverage manufacturing with organic and sustainable agriculture, and readily imagine the potential of cultivating healthy products (olive oil, cereals, dates, oranges) and its applications to develop industrial biotechnologies (cosmetics, food and pharmaceuticals), once again based on olive oil. It was thus proposed to target the agricultural transition towards terroir, niche and excellence products, and to direct RDI efforts towards the exploitation of Tunisia's unique ecotypes, to make it a destination like Grasse (France).

- Identified strengths:
  - Diversity of agricultural production.
  - Presence of unique ecotypes.
  - Participation of Tunisia in European projects (e.g. PRIMA Med[26]).
- Identified limitations:
  - More than 70% of farms are smaller than 5 ha.
  - Water deficit.
- Potential for cross-fertilisation:
  - Industrial biotechnology, pharmaceutical production, cosmetics, sustainable tourism, ICT.
- Recommendation:
  - Maintain the area of specialisation, making explicit the reference to food safety and biotechnology.
- Proposed new name:
  - Sustainable food, food safety and biotechnology.

4. Textiles, clothing, leather and related products; chemicals and chemical products; other non-metallic mineral products

Tunisia is one of the leading countries in textile production (particularly for denim). This industry is particularly developed in the Tunisian Sahel region (Monastir).

Since the mid-1990s, the garment industry and related products have grown significantly, but the growth of Chinese production has greatly affected this highly competitive industry. Labour costs are still low today, but it is becoming necessary to put in place social and environmental constraints.

Moreover, the Tunisian textile sector suffers from Moroccan and Turkish competition in terms of costs. There is an opportunity in the incorporation of handicrafts which are difficult to compete with in terms of quality. Tunisia

[26] https://prima-med.org/

could see this as an interesting development opportunity, supported by a new wave of entrepreneurs in this sector.

There is another opportunity linked to the creation of a Textile Technical Centre in Tunisia (CETEX) which supports the operators of the textile sector in Tunisia in their innovation and Research and Development efforts, as well as through the research efforts of the Textile Engineering Laboratory of the ISET of Kasr Hellal (LGTEX) of the University of Monsastir. The LGTEX is the only research laboratory in this specialty in Tunisia and in the network of ISETs to ensure the link between the industrialists of the trade and the Tunisian university and to ensure the transfer of technology and know-how.

These research structures, together with more than 12 international textile companies, could further orient the specialisation area towards smart textiles or the exploitation of the potential of local natural fibres.

Chemicals and other non-metallic mineral products were not mentioned by the interviewees.

- Identified strengths:
  - Incorporation of handicrafts in textiles and leather (niche);
  - Advanced research structures.
- Identified limitations:
  - Very strong cost competition.
- Potential for cross-fertilisation:
  - Textile coatings for the automotive industry, textile crafts and tourism, ICT.
- Recommendation:
  - Maintain the area of specialisation, looking for high value-added market niches.
- Proposed new name:
  - Leather, textiles for technical purposes, clothing comfort of textile and para-textile fabrics, natural fibrous materials made of cellulose and protein.

5. Manufacture of transport vehicles (electrical equipment; general-purpose machinery; transport equipment, in particular motor vehicles and related service activities, aeronautical components)

The experience in the field of automobile assembly (through leading companies such as STEA) now allows Tunisia, and particularly the region of Sousse, to be positioned in the conception and design of spare parts, and not only in the assembly of automobile parts. This is a success in terms of moving up the industrial value chain, particularly around automotive wiring, made possible by an excellent level of training for young Tunisians.

Its objective today is to free itself from subcontracting and move towards the design of high added value parts by incorporating ICTs. Moreover, Tunisia already has a certain level of integration in this sector. If several companies have moved to Morocco, Tunisian technicality is recognised for electromechanics.

Some of the actors interviewed consider that Tunisia could be a laboratory for smart transportation for the transformation of the urban landscape through the manufacture of green vehicles.

The Tunisian aeronautical industry enjoys today an important credibility, through collaborations with Airbus and the European Space Agency (switch mode power supply).

- Identified strengths:
  - Level of sectoral integration.
  - Positioning in the value chain.
  - Technicality.
- Identified limitations:
  - Subcontracting.

- Potential for cross-fertilisation:
  - Energy, transport, tourism, ICT.
- Recommendation:
  - Maintain the area of specialisation.
- Proposed new name:
  - Smart transport vehicles, high-tech components for aeronautics and aerospace.

6. Construction of buildings and utility projects

Tunisia benefits from a skilled workforce in the construction sector, but the sector, although indispensable to the Tunisian economy, has a low added value.

The challenge of this area of specialisation is to promote sustainable ecological construction (eco-construction), in connection with renewable energies (water harvesting, solar energy). A potential cross-fertilisation can be identified with the construction of buildings for sustainable tourism.

This area of specialisation also raises the question of spatial planning and urban construction.

- Identified strengths:
  - Skilled labour.
- Identified limitations:
  - Low internationalisation.
  - Low added value.
- Potential for cross-fertilisation:
  - Green tourism, Renewable energies.
- Recommendation:
  - Maintain the area of specialisation on an experimental basis.
- Proposed new name:
  - Smart and sustainable buildings.

7. Tourism (including medical tourism)

A judicious choice in the 1970s to quickly occupy a poorly qualified workforce, "classic" tourism, highly industrialised and standardised, is oriented towards mass tourism. Tunisia, a country known for its welcoming tradition, remains competitive in this area, but it seems urgent to develop domestic tourism and to depend less on the tour operators.

The COVID-19 pandemic illustrated the limits of this mass tourism strategy and its fragility.

The stakeholders insisted on the importance of investing in a more ecological and responsible tourism, to share the culture of the country, especially in rural areas. This awareness will only be possible when stakeholders stop considering tourism as a sector of activity. It must be one of the forms of valorisation of the activities developed on the territory.

The successful experience of the health tech cluster in Sfax could contribute to the field of medical tourism by creating platforms for the care of patients, their logistics, their transport, and the establishment of relations with the establishments offering care (grouped charter, raw materials). The quality of the medical corps and care personnel in Tunisia makes it possible to attract international clients and to develop a type of tourism with high added value contributing to the fight against the flight of talents and turned towards the knowledge economy. Digitalisation could help certain regions to develop medical tourism.

In addition, some regions are also very attractive for eco-tourism. This would alleviate pressure on the coast (ecological problems) and bring tourists seeking a real experience (discovery of crafts, discovery of the natural wealth of the interior, eco-tourism) closer to the local population and a sustainable form of accommodation.

- Identified strengths:
  - Positive experience of the health tech cluster.
  - International trend towards eco-tourism.
  - Quality of the medical profession.
- Identified limitations:
  - Inertia of mass tourism.
- Potential for cross-fertilisation:
  - Transport, building construction, renewable energy.
- Recommendation:
  - Maintain the area of specialisation.
- Proposed new name:
  - New forms of tourism (medical tourism, eco-tourism).

3.3.11 New potential areas of specialisation

The interviewed stakeholders argued the potential of other emerging areas of specialisation, based on other factors not fully investigated in the mapping exercise. These were:

- Smart and green logistics

Due to its geographical location, Tunisia should strategically invest into its logistics potential. The positioning of Tunisia on the crossroads between Europe, the Maghreb and Sub-Saharan Africa, and at the heart of the Mediterranean, would enable the country to be positioned as an international hub with the developed logistics sector.

- Blue economy

The sea economy sector should focus more on exploiting its 1300 km of coastline through the sustainable exploitation of fisheries resources and seaweed farming, but also by the manufacture, maintenance and supply of the fleet at sea. Bizerte and Sfax are regions with great tradition in sea economy, while Sfax also has experience in water desalination.

However, due to insufficient data proving the critical mass for integrating these areas into the list of preliminary priority areas of the country, these areas should be further investigated for their potential inclusion in this regard.

3.3.12 Suggested Smart Specialisation preliminary areas

The list is given taking into account the quantitative analysis, findings from the qualitative survey and additional analyses, as explained in this report.

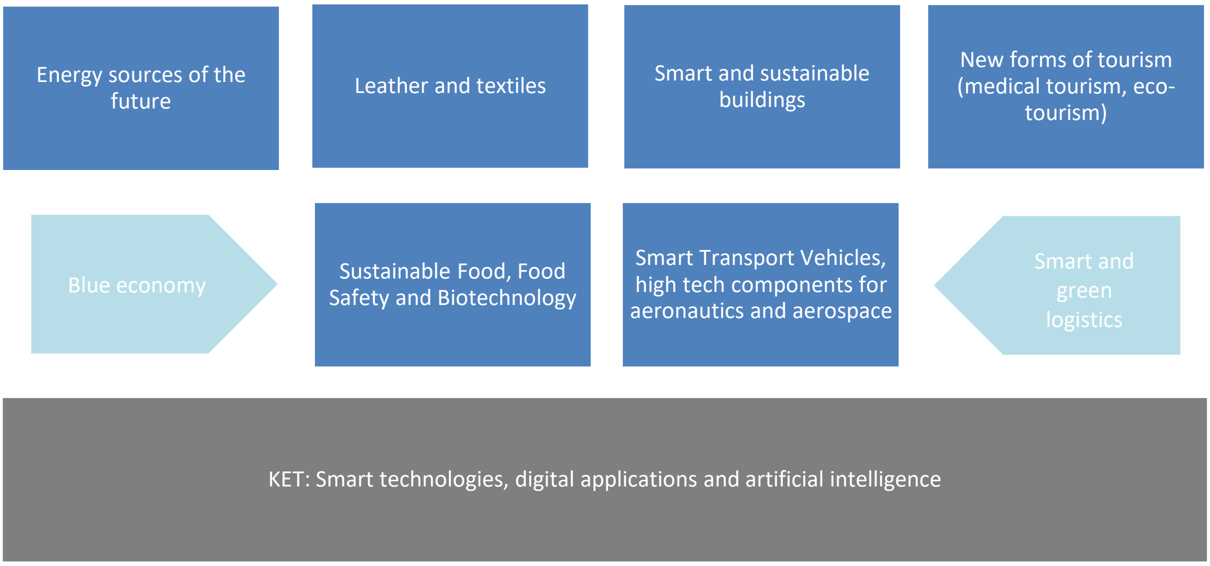
The suggested preliminary priority areas include:

- Energy sources of the future (production, storage and transport of renewable energy: solar, wind and hydrogen);
- Leather, textiles for technical purposes, clothing comfort of textile and para-textile fabrics, natural fibrous materials made of cellulose and protein;
- Sustainable food, food safety and biotechnology;
- Smart transport vehicles, high-tech components for aeronautics and aerospace;
- Smart and sustainable buildings;

- New forms of tourism (medical tourism, eco-tourism).

The additional areas with significant potential explained in the previous chapter, **Smart and green logistics** and **Blue economy**, should be further investigated for their potential integration with the area Smart transport vehicles, high tech components for aeronautics and aerospace in case of Smart and green logistics, as well as with the area Sustainable food, food safety and biotechnology in case of Blue economy. Also, the S3 team should further explore the cross-cutting potential of Key Enabling Technologies horizontally across the proposed priority areas for possible innovation potential. This can be done in the upcoming Entrepreneurial Discovery Process workshops, under the coordination of the S3 team of Tunisia.

Figure 4. Proposed S3 preliminary priority areas in Tunisia



Source: authors

3.4 Further recommendations for the Smart Specialisation process in Tunisia

3.4.1 Roles of the S3 stakeholders

The public sector actors emphasised their role in establishing governance mechanisms that coordinate with horizontal and sectoral ministries.

The question arises as to the level of granularity of the space constituting the territory of the future S3 at regional level, insofar as the governorates are quite small. It is recommended to divide the territory into 5 to 6 large regions, with a certain socio-economic unity. As an example, it could be interesting to analyse the advantages of the following division: Greater Tunis, North-West (El Kef, Jendouba, Bizerte), Cap Bon (Hammamet, Nabeul, etc.), Centre East and Islands (Sousse, Monastir, Djerba, Zarzis, Kerkennah), Centre West (Kerouan), and South (from Gabes to the South).

It is further recommended to foster interaction between research structures, civil society, companies and innovation centres and to provide incentives to the actors (e.g. through mobility of young researchers – e.g. MobiDoc - in companies, tax incentives, etc.). The role of civil society is threefold: it plays a role of information (relaying to citizens), consultation, and participation in the implementation of the S3.

It is essential that academic actors take up their "third mission", i.e. to support regional actors in meeting societal challenges. The QS world university Ranking ranks three Tunisian universities: the University of Sousse, the University of Tunis and the University of Tunis El Manar. It is recommended to set up a system of university observatories to facilitate the dissemination of research between numerous structures: the centres for the certification of skills and careers (4C), the PMOs, the technology transfer offices (BUT), and the thematic networks (RTN) currently being set up.

The role of HEIs also involves adapting curricula, carrying out research projects adapted to the business world, and creating spaces for innovation. In addition, it is recommended that the status of innovation promoter within universities be institutionalised, as a new figure for disseminating good practice and decompartmentalising S3-related initiatives.

It could also be interesting to explore opportunities for university credits for certification or degree programmes based on modules adapted to the S3 orientations, and globally to co-define a strategy to align programmes and curricula to meet the needs of industry and entrepreneurs.

To better understand the role of business in the design and implementation of S3, it is first necessary to recall the importance of the entrepreneurial discovery process (EDP), which is at the heart of the concept of smart specialisation. The EDP aims at identifying priority areas for investment in an inclusive and evidence-based manner, driven by stakeholder engagement and attention to market dynamics. The business community is, therefore, in a privileged position to ensure multi-sectoral collaboration, with the participation of large and small companies, but also of the start-up ecosystem. Collaboration with businesses and engineering schools should be strengthened to promote entrepreneurship and business participation in regional development through the dissemination of entrepreneurship support programmes addressing societal challenges. The business actors also stressed the importance of access to finance, both public (including tax credits for innovative companies and participation in public procurement) and private (through banks and investment funds).

3.4.2 Governance of the S3 process

The public sector actors insisted on the importance of good governance ensuring coordination with horizontal ministries (economy, employment, research and environment) and sectoral ministries (industry, agriculture). The Ministry of Higher Education and Scientific Research and the Ministry of Economy and Planning are candidates for governing the S3 process (coordination of governance between the two might be complicated in practice), while the National Agency for the Promotion of Research (ANPR) could represent this operational management level institution.

The governance should include a strategic committee and a more operational implementation committee. It seems essential that the S3 approach is to be steered by an actor with a cross-cutting vision and a capacity for action, for creating spaces for innovation, for steering and supporting the actors.

For the public actors involved, it is essential to disseminate S3 success stories to create inspiration and demonstrate that S3 works in other regions. It is also essential to ensure the institutionalisation of the S3 at national level by giving a legal framework to the S3 monitoring and coordination structure.

Civil society actors also consider that a governance structure is currently lacking. They recommend the establishment of a smaller steering committee (taskforce) at the level of the presidency of the government (with leadership capacity and a transversal vision) working on a consultation plan with all stakeholders. Ideally, the cluster should have an appropriate legal framework.

The academic actors insisted that universities and regional officials (through governors or representatives of the governorate) must be represented in the decision-making bodies of the S3, alongside industrialists and representatives of the Tunisian Union of Industry, Commerce and Handicrafts (UTICA) and the competent ministries (MESRS, Ministry of Economy and Planning, Ministry of Industry, Ministry of Health, Ministry of Social Affairs, Ministry of Agriculture).

Business actors also consider that the MESRS should play a key role in the S3 with the trade union representing the private sector in Tunisia. They advocated for a strong partnership between the national government, private actors (SMEs, entrepreneurs and chambers of commerce), Tunisian workers' unions, universities and civil society, to advance the S3, around Tunisia's intellectual wealth, in the face of the risks that too great a wait-and-see attitude towards the private sector can create.

It is recommended that the governance should not be hierarchical (top-down approach) but collaborative and respectful of regional interests. The Ministry of Economy is coordinating activities in the regions through the IRADA funding. IRADA supports decentralisation for the regions to move towards inclusive development. It will be important to involve the regional technopoles in the exercise of defining the future S3, and to build on the vision expressed by each region.

In order to succeed in the next step, i.e. the realisation of focus groups around the Entrepreneurial Discovery Process (EDP), it is also necessary to create a favourable framework for the mobilisation of actors, particularly with regard to the private sector. Beyond this, it is recommended to develop strategies to increase the level of confidence of the private sector in collaborating with other regional development actors, and to unleash access to investment.

3.4.3 Collaboration between the S3 actors

Civil society actors play an important role in the S3 discussions. Due to their neutral nature, associations and other civil society actors can play a role in accelerating the implementation of the S3, as shown by the work carried out in Sfax by the think tank Beit Elkhibra. It seems that civil society is already mobilised, particularly in the field of social entrepreneurship and the social and solidarity economy. It is able to accompany public policies, but also to be a credible partner during the phases of consultation and dialogue with other partners.

The role of the academic world is evolving, from an initial position of transmitting knowledge to a current function of interlocutor of companies to meet the needs expressed by the latter to meet societal challenges, rapidly develop added value to the entrepreneurial ecosystem and bring impact to the territories. There are currently collaborations and research networks with other universities that should be utilised for this purpose, such as collaboration with the University of Hamburg and the Tunisian Order of Engineers to train future managers in Bizerte.

However, the links between the academic world and the business sector are still weak. On the academic side, it is still necessary to gain the trust of private companies (although it should be noted that ICT companies seem to be taking a more open stance). Only the universities of Carthage and Sfax have created a centre for student entrepreneurs. The Virtual University of Tunis (UVT)[27], created in 2002, supports and accompanies digital transition for scientific research through three mechanisms: 1) distance learning[28] integrated with the so-called "classic" training (MOOC, transversal modules or specific modules); 2) integral distance learning (non-regular university public, lifelong learning, inclusion of social categories on the fringe of the conventional system); and 3) Techno-pedagogical monitoring and training of actors. The UVT has developed a new strategy 2022-2026, with one of its specific objectives being the strengthening of the S3 and it is the first university to include the S3 in its objectives. UVT can play a catalytic role for the S3 through its horizontal positioning, its openness to business, and the central role of human resources training as a pillar of the S3. UVT aims at encouraging public-private collaboration for economic development through the establishment of a sustainable partnership, positioned around the targets of the SDGs.

The business stakeholders interviewed consider that there is now a certain openness of HEIs towards entrepreneurs in the university world, especially through end-of-study projects and internships in engineering and computer science, etc. One of the examples of interesting collaborations between HEIs and business sector is the Innovation Centre of the University of Tunis El Manar (UTM)[29], which supports the creation of spin-offs and offers a coworking space for representatives of academia. In this framework, collaboration with companies to hire students has improved and industries are starting to hire young graduates in their R&D departments.

Having the central role in the S3, businesses need to pursue closer collaboration with higher education and research, whilst recognising the benefits of the S3 process. The private sector actors argued that the ecosystem is not favourable to entrepreneurship, as there is an insufficient public support for business creation.

It is recommended to apply a diversified approach through a participatory process, with strata of information, consultation, decision (and co-decision) defined between the central level and the regional actors.

[27] https://www.uvt.rnu.tn/
[28] https://mooc.uvt.tn/
[29] http://www.utm.rnu.tn/utm/fr/actualite-4058-le-centre-d-innovation-de-l-universite-de-tunis-el-manar-utm-soutient-ses-spinoffs

4 Guidelines for the Entrepreneurial Discovery Process in Tunisia

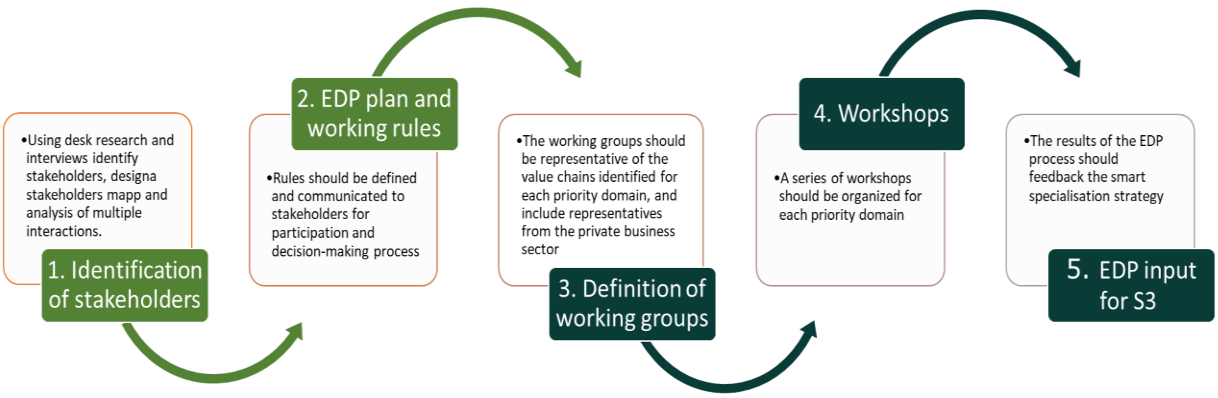
Tunisia has shown a great interest to adopt a Smart Specialisation strategy. Through its operational agency, the National Agency for the Promotion of Scientific Research (ANPR), the Ministry of Higher Education and Scientific Research (MHESR) introduced this concept to the local Science and Innovation stakeholders in 2016. After that, Tunisia has undertaken preparatory actions mobilising smart specialisation team and exploring opportunities for launching S3 in three pilot regions, namely Bizerte in the north, Sfax in the centre, and Medenine in the south. Tunisia is now about to enter the “Stakeholder Dialogue” stage. The “Diagnosis” stage (mapping exercise) was already reported in a series of important documents that illustrate the local context.

The first part of this report (quantitative analysis) crosses available economic data at industry level with innovation and scientific potential of each sector and provides an objective selection of 12 industrial sectors as the base for the selection of priority domains for a national level S3. This assessment suggested a number of sectors at the national level that have the highest potential for being priority domains, while encouraging Tunisia to continue also with the S3 initiatives at the regional level, particularly in Sfax, which has showed a good degree of preparedness.

In addition, the second part (qualitative analysis) builds a qualitative in-depth analysis of possible key priority domains as a preparatory stage for the stakeholder dialogue. Considering the complexity of the process and other factors (i.e. availability of dats), it would be advisable that priority domain are based on stronger justification in relation to their potential contribution to the Tunisian economy and transition towards an eco- and socially-sustainable Economy.

Hence, in accordance to what is specified in the methodological guide for Smart Specialisation Framework for the EU Enlargement and Neighbourhood Region (Matusiak M. and Kleibrink A., 2018), Tunisia needs to prepare the stakeholder dialogue that will support the Entrepreneurial Discovery Process. This involves the following steps (see Figure 5): Identification of stakeholders; EDP plan and working rules; definition of working groups; workshops; and EDP input for S3.

Figure 5. Implementation of stakeholder dialogue in Tunisia



Source: authors

In this section, we aim to provide further guidance for the justification of the priority domains proposed in the qualitative report and on how to initiate and sustain the stakeholder’s dialogue needed to support, facilitate and stimulate Entrepreneurial Discovery Processes.

The objectives of this section therefore are:

- To provide comments/suggestions for improvements/suitability of the qualitative report to the EDP and map the areas to be improved in detail.

- To prepare the guidelines for the EDP for the S3 in Tunisia taking into account the local context and potentials.

While this section reflects the work undertaken in Tunisia, its recommendations could be useful for other countries in Northern Africa as well as to other Mediterranean countries interested in new industrial innovation policies based on Smart Specialisations Strategies and Entreprepeneurial Discovery Processes.

4.1 Limitations of the mapping exercise

4.1.1 Summary of the Quantitative and Qualitative analysis

The qualitative report takes as input the result of the quantitative report which proposed a long list of 12 sectors, namely:

1. Extraction of crude petroleum (NACE 061 & 091).
2. Manufacture of Food products and beverages (NACE 10 & 11).
3. Manufacture of Textiles, apparel, leather and related products (NACE 13 & 14 & 152).
4. Manufacture of Chemicals and chemical products (NACE 20).
5. Manufacture of Other non-metallic mineral products (NACE 234 & 235).
6. Manufacture of Fabricated metal products (NACE 256 & 257 & 259).
7. Manufacture of Electrical equipment (NACE 27).
8. Manufacture of General-purpose machinery (NACE 281 & 282).
9. Manufacture of Transport equipment, in particular Motor vehicles and related service activities (NACE 291 & 293 & 303 & 451).
10. Manufacture of Medical and dental instruments and supplies (NACE 325).
11. Construction of buildings and utility projects (NACE 411 & 422).
12. Telecommunications (NACE 61).

These sectors of the Tunisian economy were selected because of their relatively higher economic, scientific and innovation potential relatively to a base line of other Southern European Mediterranean countries. However, the quantitative methodology followed overlooks important aspects that may introduce significant bias, namely:

First, the “informal economic activities”. The informal economy in Tunisia is probably an important phenomenon. International value chains in less developed countries often involve a substantial informal work force associated to micro and SME companies which are not accounted i.e. not registered in official statistics. This may explain, for example why agriculture is missing.

Second, the use of indicators of scientific potential based on scientific publications is a particular particularly harsh indicator for Tunisia that is in a process of establishing the right conditions for enabling effective R&D (see EU DG for Research and Innovation (2019). Likewise with regards indicators of human capital formation, education and patents.

Third, too many sectors are identified (12 sectors) in the quantitative report.

Given the limitations of the quantitative report the task of the qualitative report would have then to concentrate on complementing and supplementing the quantitative analysis.

In the period between mid-July 2022 and the end of September 2022 and with the support of the Tunisian S3 team local, interviews with local actors were conducted. These direct interviews were the main data input for the qualitative analysis of the promising priority domains which were identified in the quantitative mapping exercise. The Qualitative analysis, aimed to provide evidences for justification of selected preliminary priority domains and also to provide essential inputs for the future stakeholder dialogue within the Entrepreneurial Discovery Process.

However, the qualitative analysis team faced great difficulties in motivating the local actors for interviews around “smart specialisation strategies”. The total number of interviews was only 26 out of the 100 planned. This may be because it is a relatively unknown policy topic for local Tunisian actors. However, for such a large number of promising sectors to form priority domains the interviews failed to provide sufficient information to justify a choice of priority-domains. In addition the Quantitative report does not explain a correspondence between the actors and the potential or promising priority domains. What is reported is a classification of the organisations interviewed by type of organisation (public sector, academic, civil society or business).

Nevertheless, the Qualitative analysis experts recommend the following 7 promising domains:

1. Energy (crude oil extraction, new energies);
2. Telecommunications, IT and digitisation;
3. Food and beverage manufacturing;
4. Textiles, clothing, leather and related products; chemicals and chemical products; other non-metallic mineral products;
5. Manufacture of transport vehicles (electrical equipment; general-purpose machinery; transport equipment, in particular motor vehicles and related service activities, aircraft components);
6. Construction of public service buildings and projects;
7. Tourism (including medical tourism).

Overall from the Qualitative report one can conclude that the most serious limitations to implementation of Smart Specialisation Strategies, appear to be:

- Low mobilisation of stakeholders, in particular of academia but also private sector stakeholders which have a low perception about the value of R&D and Innovation.
- Difficulties in governance and public coordination, across policy domains an in particular in engaging private business sector in innovation.

4.1.2 Further justification and definition of the proposed priority domains

The quantitative and qualitative analyses provide insufficient evidence to support the proposal of the 7 priority domains referred earlier. In particular, the qualitative analysis would need more input from stakeholders and, if possible, triangulation of the data collected with secondary sources. Hence a better justification and definition of the promising priority domains needs to be done. In our view the main gaps are the following:

- A more detailed justification of the domains chosen in terms of their R&D and Innovation strengths, for example using share of researchers, international projects and innovation cases.
- A preliminary lower granularity exploration of subspecialisations in each domain (illustrated with examples), including considerations around which products and services in these domains that are competitive in international markets.
- The definition of priority domains needs to be associated the concept of value chains and therefore identification of where the largest value is being created and what is the position of national/regional players in global value chains is missing.
- While identification of sectoral specialisation and subspecialisations is important for knowing which old and new sectors/clusters are currently stronger in international markets, final definition of priority domains also needs to go beyond a choice of sectors/clusters. Priorities are agglomeration of sectors associated to a direction of transformation. A clear definition of a direction for transformation appears to be missing from the final proposal of 7 domains of specialisation in the qualitative report - for example, as defined by existing the UN SDGs. A transformative approach to S3 requires to choose socio-technical systems and a directionality (change pathway) for their change i.e. it is not just choosing sectors/clusters (for a definition and examples of socio-technical systems see Geels, 2020). The unit of specialisation focus therefore needs to be further specified. In addition, socio-technical change at the system level is not just about science and technology or R&D-based innovation. Other types of innovation such as organisational and system-change innovation need to be taken into account.

- Following from the association of priorities to value chains and to system level changes it is also necessary to have some analysis of comparative strengths and weaknesses in terms of skills needed for the transition processes.
- There is the need to identify the key actors and stakeholders involved in each priority domain transition. In particular which actors from the private business sector are habilitated for innovation? Similarly, with identification of key actors and stakeholders in each priority domain from the academic sector, government agencies and civic sector actors.

4.2 Guidelines for EDP supporting S3 in Tunisia

4.2.1 Recent changes in Smart Specialisation Strategies

Research and Innovation Strategies for Smart Specialization – S3 were originally defined in 2012 as "integrated, place-based economic transformation agendas" (EC 2012, p.8). These agendas, called for regional economic specialisation based on research and innovation priority-domains where regions possess strengths and on leveraging those capabilities through "diversified specialisation".

However, instead of the traditional top-down/bottom-up planning followed by monitoring and control of funding, the definition of priority domains was to be a process of joint discovery. According to Foray et al (2011, p.11) defining and exploring priority domains is the outcome of "Entrepreneurial Discovery Processes" involving all relevant regional stakeholders. While initially EDP was seen by the EC (2012) as a participated process, required for implementation of S3 after R&D and innovation domains have been selected, the concept evolved from being only carried out during the S3 implementation phase, into a process that supports initial definition and exploration of priority domains and keeps going throughout S3 implementation (Gianelle et al., 2016, p.15; Marinelly and Perianez-Forte, 2017; Guzzo and Perianez-Forte, 2019), maintaining stakeholders engaged in a refinement and review of the initially defined priority-investment domains, to jointly carve out smart specialisation fields.

Relative to the initial definition in 2012 and given the urgency of counteracting the accelerating climate change (IPCC, 2022), loss of biodiversity, resource depletion and unsustainable social and human consumption actions (UNEP, 2019) Smart Specialisation Strategies must now change to accommodate a more ecologic and inclusive socio-economic development.

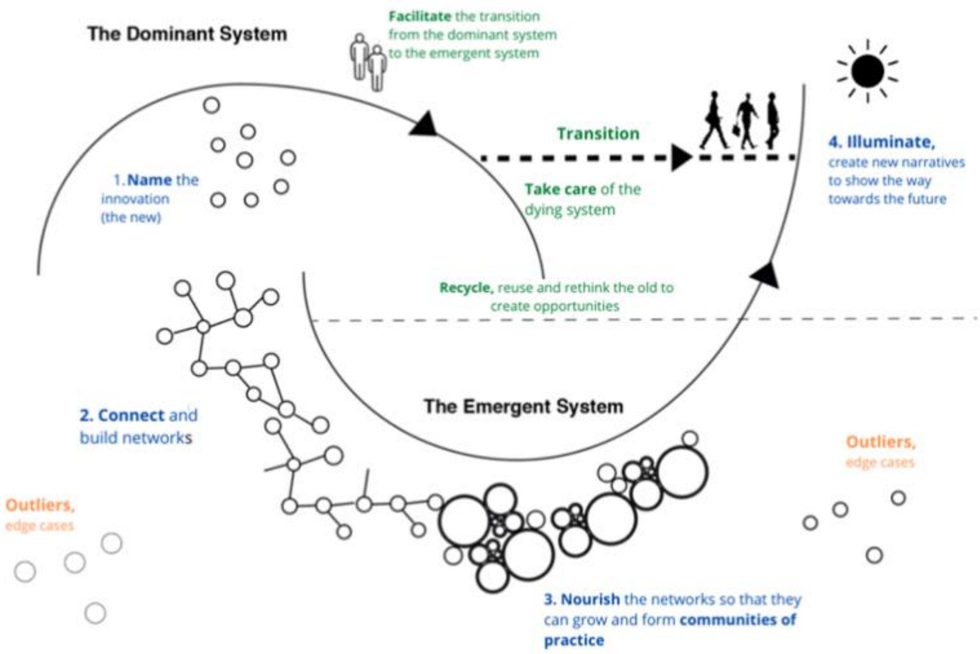
Comparing with the initial definition S3 are not just about streamlining R&I investment for moving up along international value chains towards international markets; or about improving coordination and evidence-based policy. Smart specialisation strategies (S3) should now:

- be aligned with the Green and Digital transitions;
- include a perspective of system level transformation geared towards the current broad ecological, social and human challenges – increase directionality;
- use shared vision, policy agendas for transition towards SDGs;
- be based on evidence about placed-based problems and challenges;
- be not just plans but living experiments able to iterate, "fail fast", "learn faster";
- adopt a Governance model, that goes beyond the usual R&I stakeholders, users.

Moving to a new S3 is not, however, just an exercise of re-alignment or adding extra-objectives. The new S3 brings fundamental changes, namely the need to consider a completely new innovation policy frame where Innovation Policies are to become "Transformative Innovation Policies" (Shot and Steinmuller, 2018) or Mission Oriented Innovation Policies (Mazzucato et al., 2020).

Usually in all territories the dominant system needs to give way to a new economic models based on the circular economy, the collaborative economy or the regenerative economy. The transition from the old to the new is not linear and is a path full of unknowns and uncertainties (see Figure 6).

Figure 6. Berkana Two Loops model

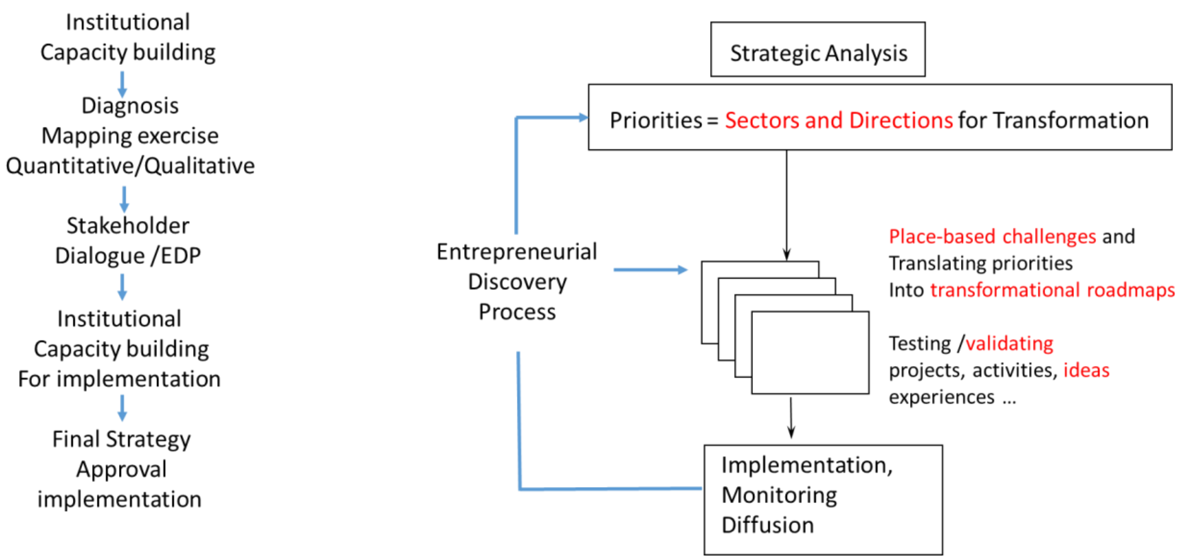


Source: adapted from Berkana institute

4.2.2 Design and implementation of S3 through Entrepreneurial Discovery Processes

In figure 3, we compare the methodology used by the JRC to build capacity in neighbouring countries in the design and implementation of Smart Specialisation policies with the strategic design/implement process associated with the whole S3 policy cycle which includes entrepreneurial discovery processes.

Figure 7. The S3 policy process



Source: own elaboration

Essentially the design and implementation process of S3 can be divided in a simple 3 stages model (see Laranja et al, 2020):

> i - After the mapping exercises (quantitative, qualitative) identify and explore priority domains through stakeholder dialogue

This stage corresponds to the creation of shared-agendas i.e. common understanding of what the challenges are within each priority domain defined. It includes the co-creation, of lower granularity place-based specific challenges. In other words includes the translation of wider national domains in to regional/sector specific domains. It is important, however to remember that priority domains are not just Economic sectors nor Science and Technology areas. They must correspond to a clear identification of directions for transformative change. For example, the transition of energy sector towards the SDGs.

> ii - Translating priority areas into a roadmap of project

This stage corresponds to conversion of each priority domain into a concrete transformational roadmap of experimental projects and activities that are committed to follow the same direction of change. These projects and actions must promise transformative changes through the generation of local spill-overs and wide diffusion. At this stage participating stakeholders use ideation and roadmap techniques to convert each priority into an initial set of projects and corresponding actors.

Events may be used to gather stakeholders, foster collaboration and promote innovation “pull” (i.e. searching for innovation ideas that originate from market opportunities) rather than just technology or science-push based innovation. Examples of events for fostering ideation and translation of priority areas into roadmaps are “EDP focus Group” and “Project Development Labs” events which have been used by JRC in European regions, during the first S3 policy cycle (2014-2020). “EDP focus Group” are stakeholder events with a sectoral focus, aimed at generating innovative ideas through interactions between business, public and research actors. “Project Development Labs” are follow-on events aimed at processing the EDP ideas and moving them towards implementation, identifying funding opportunities and concrete action plans (Boden, dos Santos, Haegeman, Marinelly and Valero, 2016).

Another particularly useful type of event at this second stage, might also be one focused on co-design of roadmapping exercises per priority domain. Ideation and Roamapping is a well-known methodology used for strategy and foresight studies. In the context of EDP one must bear in mind that roadmapping is a process to identify which projects and activities to experiment in each priority domain i.e. to identify and define which projects may lead to discoveries with place-based transformative potential. Romania and Lithuania have successfully used Roadmapping for the design and implementation of their country level Smart Specialisation Strategies (Gheorghiu et al., 2016; Paliokaite et al., 2015, 2016).

> iii - Implementation, follow up and monitoring

This stage corresponds to implementation of transformative activities in the roadmap. The stage requires mobilisation and coordinating financial instruments, which often have different objectives (R&D, training, infrastructure). Experimental projects and activities must however be evaluated regarding their promised results in order to decide further funding beyond initial experimentation. Discoveries along the way are made through learning and experimentation and therefore instruments that promote learning by experimentation are most useful. For example, Regional “accelerators”, possibly associated to Business Incubation Centres, may be useful mechanisms at for promoting business experimentation and learning by fast failure.

While clearly, the first step has a planning component, Entrepreneurial Discovery is essential to implement steps 2 and 3 – which involves the discovery of the path to transformation (within a given priority area, or re-definition of the priority) and then the discovery of which experimental projects may have real transformative potential. However, knowledge of entrepreneurial discovery is also useful at the first stage, and therefore EDP is present in all three stages.

Because the specialization trajectory that really happens depends on discovery and niche experimentation, monitoring cannot just focus on knowing how much funding has been used by priority domains. Although financial monitoring and auditing is required and useful, monitoring should also focus on supporting the experimentation spaces referred above. Ideally, some form of participatory-monitoring events should be used, enabling to learn when it is too early to stop experimenting with initiatives that may still have transformation potential, or whether there are risks of becoming locked-in specialisation experiments leading to nowhere. Based on project implementation reviews, group discussions, participatory monitoring events may be a fundamental tool. This kind of monitoring engages all participants in gathering inputs and on critical analysis of successes and constraints, inviting to reflect on adjustments as needed, while at the same time contributing to empowerment of regional actors in their experimental actions/projects.

Finally, implementation of these three stages needs to be adapted to regional differences in terms of human capital and financial resources. In addition, tradition of collaboration for policy design and implementation in particular university-industry collaboration, are also much different across regions resulting from differences in multi-level governance (in particular the national – regional) and in how innovation policy is integrated/associated to other policy domains i.e. energy, agriculture, education, employment, etc.

4.2.3 The implementation of the support to EDP

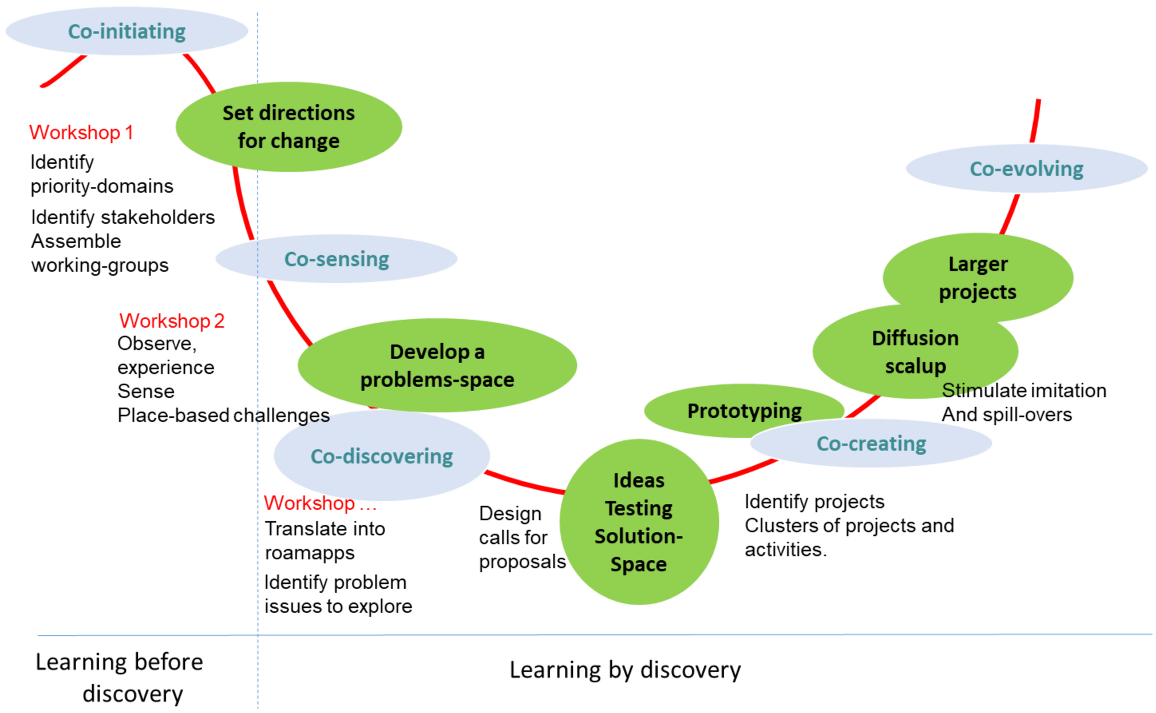
Implementation of the support to the EDP i.e. the role and function of the organisations (government agency) in charge of pulling and facilitating EDP is usually undertaken through a series of different stakeholder dialogue workshops. That is, the organisation of workshops that support stakeholder dialogues is a process of policy support to EDP. The "Entrepreneurial discovery" process itself i.e. defining place-based challenges and exploring innovative solutions, is a process driven by regional actors and stakeholders, in particular driven by private sector business actors that have entrepreneurial knowledge.

However, for the government agency in charge of organising the support to EDP by priority domains and using specific facilitation techniques, one important first step is to design a "master EDP workshops schedule". This may comprise, for example a general kick-off event for all priority domains (all regions), followed by workshops/events for different domains and/or different regions. The type of event will depend on the stage of the EDP.

Figure 8 suggests that the sequence of events in each priority domain could follow a U curve starting with events that help the stakeholder to gain commitment, co-initiate the process by co-designing a shared-agenda of measures in each domain. Towards the bottom of curve stakeholders collaborate to better define their collective specific problems and then ideate possible projects to develop and test possible solutions. Systems change, however requires that solutions with higher transformative potential get support for wider diffusion and in some case to scale-up.

The following table suggests a categorization of different events along the EDP, following the 3 stages model described earlier. Events at the beginning of the cycle should be used to stimulate debate about the regional context and identify acceptable pathways for transformative change i.e. priority domains. These reflections should explore not only how science and technology may contribute to such directions of change but also focus on markets where the regional sectors have, or intend to have in the longer term, competitive advantages.

Figure 8. Implementation of EDP



Source. PRI Playbook, also based on Laranja (2022).

Table 2. Types of events at each of the 3 stages of EDP

Steps of the S3 policy cycle	Types of Events
Explore and define thematic priority domains	Ideation events to explore possibilities for sustainability driven innovation and entrepreneurial discovery Mapping the value chain systems to visualise the bigger picture and then identify specific (smaller challenges) to zoom in Understand regional commons (science and engineering, manufacturing skills) need for transformative change
Translating and Roadmapping	Workshops for roadmapping and identification of a diverse set of project and actions to experiment
Implementation, follow up and Monitoring	Workshops to gather feedback and provide input and information about what projects show most potential

Source: own elaboration

4.3 Launching the participation of stakeholders in dialogue workshops

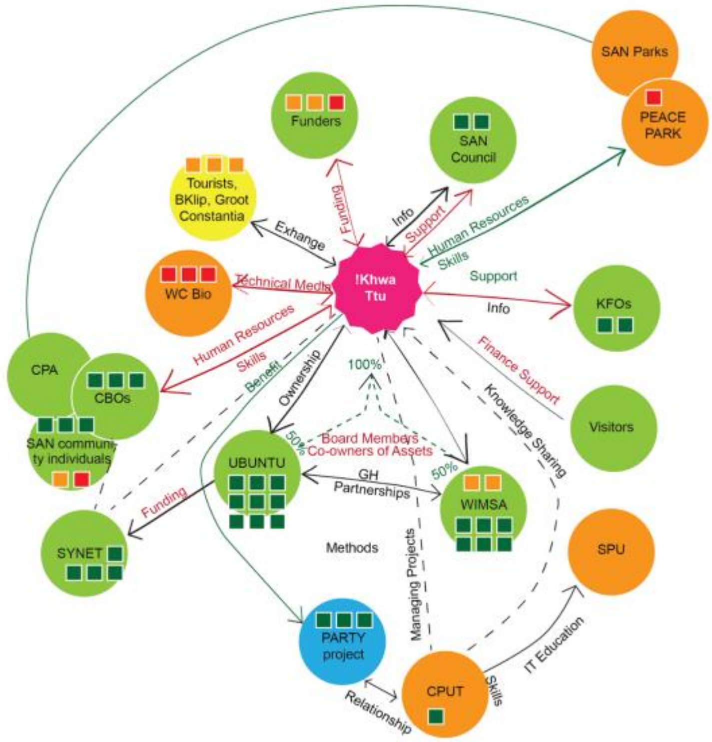
Launching stakeholder dialogue is the stage at which Tunisian S3 policy process is now entering. It starts with identification of stakeholders by priority domains. This identification should consider all relevant actors across the value chains included in the priority domains. However, value chains do not exist in isolation they are framed by a wider system of supporting functions, rules & regulations, informal networks, public sector organisations, etc., see Figure 9.

Relevant stakeholders, must also extend beyond the “usual suspects” of Innovation policy (Businesses who regularly undertake R&D, Industrial Associations, Research institutions, Universities, Public sector research laboratories) and include all kinds of other businesses, craft industries, culture and creative industries, citizens, potential users, final consumers etc.

One useful technique to help identify relevant stakeholders is “system mapping”. A systems map, is a graphic representation of stakeholders, their relationships, their influence on each other and/or information flows between stakeholders in a given system. Designers are used to use systems mapping to make sense of complex systems such as value chains (or parts of the value chains), cities, hospitals, education systems, etc. Figure 10 is an example of a stakeholder map of the Ikhwa Ttu Reserve Park in South Africa.

Figure 9. Stakeholders map across the value chain

Figure 10. Ikhwa Ttu Reserve Park scheme



Finally, another important issue once stakeholders are identified, is how to attract and retain their interest and participation? In general, all stakeholders want to be active in the innovation policy process i.e. all stakeholders want to be seen as key stakeholders in setting and exploring the priority domains that shape the S3 strategy. However, there are positive and negative motivations – see the following table.

Table 3. Attracting and retaining stakeholders' interest in the S3 development process: positive and negative motivation

	Business	Intermediaries and Business support organisations and chambers of commerce	Research
Positive	Opportunity to shape domains into markets Access to sources of financing Networking future project partners Co-creation of new project ideas	Opportunities for bridging / brokerage Part of new policy making process Collaboration with business and with research	Opportunity to shape domains in science areas Opportunity to shape policy instruments Access to sources of financing Networking Opportunities for knowledge transfer

Negative	Small businesses are busy, have fewer human resources to dedicate to the process. may consider participation as loss of time Distrust in the effectiveness of the approach	Lots of effort / same financial compensation Distrust regarding novel & unknown approach Need to change mind-set Vested interests / lobbying	Distrust in the effectiveness of the novel approach Revealing plans Disclosing informal IP

Source: own elaboration

Another important aspect relates to how formal should be the organisation of the working groups in each priority domain. For example, how does a stakeholder becomes a member of a priority-domain working group to participate in a particular dialogue workshop-series?

Working groups may be open i.e. organized by an open call but there are risks. Open calls may attract too many actors or attract the actors which have more “free time” to participate, but not necessarily the key actors. Hence, regional authorities may prefer to organize the priority-domains working groups and their associated workshop-events by formal invitation only. A key aspect in organization of working groups is to involve ministries from different sectors of public administration, and at different regional levels of the multi-level government structure. In addition, priority domains groups may have the participation of industrial associations and representatives of the private sector. These later, however, should not be taken as substitutes of the direct participation of private sector business actors are a fundamental stakeholder in the whole process.

4.4 Collaborative events

Stakeholder dialogue workshops that will support EDP in Tunisia should be different from the usual workshops. They should be events designed to maximise participation and engagement i.e. collaborative events. The general objectives of these collaborative events are to:

- **Increase the quality** of the Smart Specialisation Strategies.
- Emphasise the place-based inclusivity and environmental focus of innovation policy.
- Increase **stakeholders’ awareness of and support for innovation and innovation policy** aimed at advancing specific regional social, environmental and economic challenges.
- **Enhancement of collaboration and trust** between stakeholders, government and public administration.

While there is no right or wrong way to organise these workshop events that help to push forward the EDP process the following principles should be kept in mind:

- Workshops may be coordinated / **facilitated** by national or regional governments or their agencies. However, it is useful to use professional facilitator-consultants.
- Every workshop must **have its own well defined objectives**, ideally its own playbook.
- Workshops **should not last more than 4 hours or half-day** (full day workshops tend to have fewer participants).
- For a particular domain / shared agenda, think of an initial flow of events, but **be flexible** to change.
- Announce and **invite** with at least 3 weeks in advance.
- **Preparatory materials** should be sent 1 week before the workshop.
- During the workshop form smaller working groups …. Need not be fixed groups.
- **Use “open space” technologies** to regulate the flow of each event (over the next sections we will return to this point in more detail).
- **Harvest** the outputs of the events. These outputs are suggestions for policy decisions, produced by **“consent”** (need not be by **“consensus”).** They may need to be supported by further evidence.

- Each event needs to have **workshop minutes** based on the conclusions and suggestions of the participants.

In addition, governments and/or regional authorities do not necessarily need to centralize and concentrate the organization of the all the events (all domains, all regions) in one single organizer. There may be benefits from delegating events to different event-organisers such as intermediary agencies, foundations or industrial associations that have activities related to innovation policy. There is also a need to consider the periodicity or at least to schedule an initial periodicity that can later be revised and changed. The following table summarises issues to bear in mind in the organisation of collaborative events (see also Laranja et al., 2021).

Table 4. Organising collaborative workshop events to support the stakeholders' dialogue

Before the event	Planning • Type of event depends on the stage of the EDP. • Timing for the event. Target periods when you think participants could use learnings from the event. • Form a core event organiser teams. Define roles and responsibilities. Invite good moderators / facilitators. • Define the key target audience to take part in the event. Ensure that expected target audiences includes diverse relevant stakeholder groups. • Find the most relevant content and speakers for the event. • Define how the event will roll out (e.g. plenary session vs parallel/breakouts….). • Prepare a draft programme. • Write the event playbook, for the organisers' team - timeline of tasks with milestones and what happens if they are not reached. • Define / co-create the question, topic, challenge, to explore in the event. Involve the most experienced stakeholders and understand key points of interest, questions and challenges related to the domain - topic. • Invite good experienced moderators for the whole event (a host and a co-host) • Use the list of participants to set-up in advance the group discussions. If possible, define in advance who to invite as rapporteurs for the breakout sessions. • Share documentation (email, event site, …) • Provide in advance a small guide to participants with topics/questions to debate (world café round questions) Call for Participation • Design a communication strategy. • Design a brief information sheet of the event: focus, dates, who participates…. • Reach out to new members and organizations for collaboration and to spread the invitations. • Invite / confirm speakers. • Build awareness of the particular topic and event. • Send calendar invitations with short and clear guidance on how to participate. • Define how materials will be shared before, during and after the event. • Provide in advance a small guide to participants with topics/questions to debate
	• Ensure participation is not hindered by late technical difficulties.

During the event	• During the event, Monitor the participation during the event. • Start by explain the whole structure of the event i.e. how different sessions are organised and how the virtual room sessions will work. • Enable people to join at any time. • Stimulate engagement by and participation. • Provide participants, speakers and partners with concise summaries of the event results. • In case the sessions were recorded, process and upload the recordings to the event site and send a message to the participants. • Update the event site with the presentation slides, and with copies of the messages exchanges in the chat during the event • Formally request feedback at the end of the event (share the results afterwards!) • Before closure the event, inform participants about next steps and how they can continue in, or leave the process
After the event	• Send messages acknowledging all participants and their contributions. • Send a summary with the main findings of the event (or post it on the event website) • Follow up and keep the dialogue going. Invite participants to continue to share their contributions on alternative online channels i.e. a EDP blog. • Schedule and announce the next events (continuous dialogue/process) • Create Communities of Practice associated to each domain.

Source: own elaboration

Collaborative events require however special types of event-formats that help to create the appropriate group environment, encourage participation, and facilitate a group to reach its objectives.

There is today a wide range of facilitation tools and techniques to help engage people and mobilize different types of evidences needed to understand and sense the complex place-based problems within each priority-domain, involving multiple stakeholders, such as the case of transformative regional social and economic changes through Smart Specialisation Strategies. In general any facilitation technique will enable to:

- Create an environment for **high-quality** conversation.
- Define **question(s)**, topic(s), challenge(s).
- Divide participants in **small groups** (up to 6 people per group) - corresponding to **rooms, tables** (breakout sessions).
- Divide the time in "rounds" of conversation (e.g. 20 minutes).
- Use the different questions / challenges in each round. Alternatively, use the same question for more than one round, or build questions round after round to focus the conversation or guide its direction.
- **Harvest the conversation.** After the small groups (and/or in between rounds, as needed), individuals are invited to share insights or other results from their conversations with the rest of the large group.

In the following we summarise three of the most commonly used facilitation methods that might be useful to use in EDP collaborative events.

a) Open Space Technology [30]

[30] https://openspaceworld.org/wp2/

Open Space Technology is an alternative to the usual meeting, conference or summit format, in organizations, communities, groups and networks, which is especially useful for complex questions, involving a wide variety of stakeholders and/or with a wide variety of interests. In addition when there is real or potential risk for conflict and the time for decisions and action is very short. Open Space relies on the following practices:

Invitation – includes defining the purpose or a question of importance to participants. Also includes defining the list of invitees and a place and time to meet. Invitation should contain the definition of breakout topics. Inviting is something to do and to aspire to be (a vision). It should remind participants to focus on purposes that matter.

Circle –the arrangement of participants in circles let everyone see everyone else, and address everyone else. Circles support clear, but permeable, boundaries, belonging, commitment and communication. Circles create space for caring, connecting, sharing, learning, working, celebrating.

Bulletin Board – One of the simplest ways to maximize information with minimum effort is to organize a bulletin board. However you do it, there needs to be some way to see all of the issues raised and all of the comments, answers and suggestions pit forward. In online settings, the whole platform can be used as a bulletin board. For example in many workshops, facilitators use large white flipcharts or boards to write notes or use post-its.

Market places – This is about making room to move, for people to create the structures they need to work on their ideas and give them the right and the responsibility for managing their own learning and contribution during the event. For example anyone participating in an event may propose a topic and organize a parallel session on his and her topic, inviting others to contribute.

Breathing, Pulsation or Iteration – open space technology is about making it easy for people to move between plenary sessions and breakouts, the iterative nature of having several rounds of breakouts, means that it might well take several iterations for a group to learn to maximize its potential contributions. Open Space allows to ask big questions and therefore it is normal to take several rounds to arrive at meaningful answers.

Storytelling – An invitation is a story about what we want. The circle is a container for stories and bulletin board helps share them around. Stories are what we're trading in the marketplace. And the notes we capture, the stuff we take away, the stories we tell about what happened… are all fodder for the next invitation(s). Stories literally keep us, and our work, going. When all else fails, invite some stories about what's good and right and working.

b) World Café [31]

World Café is one facilitation technique to increase the quality of participatory events. It is most used when there is a need to stimulate engagement and reflexive thinking. It is useful to capture different perspectives from the stakeholders about the same problem. World Café works as a set of conversation rounds for small groups (6 or 7 participants), in which each round has different question and participants may change group between rounds.

c) Art of Hosting – AoH [32]

The Art of Hosting is a highly effective method of harnessing the collective wisdom and self-organizing capacity of groups of any size. Based on the assumption that participants will give their time and energy to what matters most to them, AoH joins techniques that promote high quality conversational processes (like Circle, World Café, Open Space Technology, storytelling …) with an invitation to people to step into a process and take initiative to solve common challenges that the group of participants face.

In complement to facilitation techniques there are also many tools, posters and canvas, that can be used (both online and in-person) to help focus the dialogue while at the same time making it easier to perform iterations and capture all learnings associated with the process.

[31] http://www.theworldcafe.com/
[32] https://www.artofhosting.org/

4.5 The use of systems thinking and visual tools: making the EDP support process participatory not just participated

For the Tunisia stakeholder dialogue process, participatory workshop events should use specific systems thinking techniques and visual tools (canvas) that help adopting systems thinking approach and at the same time make the process more participatory.

Systems thinking is a very broad area that seeks to understand social and economic complex challenges as intimately interconnected and comprehensible with reference to the whole system or environment they form part of. The primary aim of systems thinking is to elevate our thinking from just seeing parts and linear interactions to seeing and understanding whole complex systems. Too many times our initial diagnostic of the regional/national innovation system (including the quantitative and qualitative assessments referred earlier) refers to static situations and simplified relations at very high level, using proximate economic and innovation indexes and indicators.

Rarely these diagnostics are able to illustrate the broader system i.e. go beyond specific associations between components of the system. While initial diagnostics are piecemeal, the reality of the place-based challenges regions/countries face is complex, messy and interconnected. Systems thinking helps to illuminate how a complex challenges may be tackled. By becoming aware of the systems that stakeholders and actors are part of, and of the consequences of their actions within a systemic broader context stakeholders may start to act from a different place, as individuals, as organizations, and from this start to overcome their problems

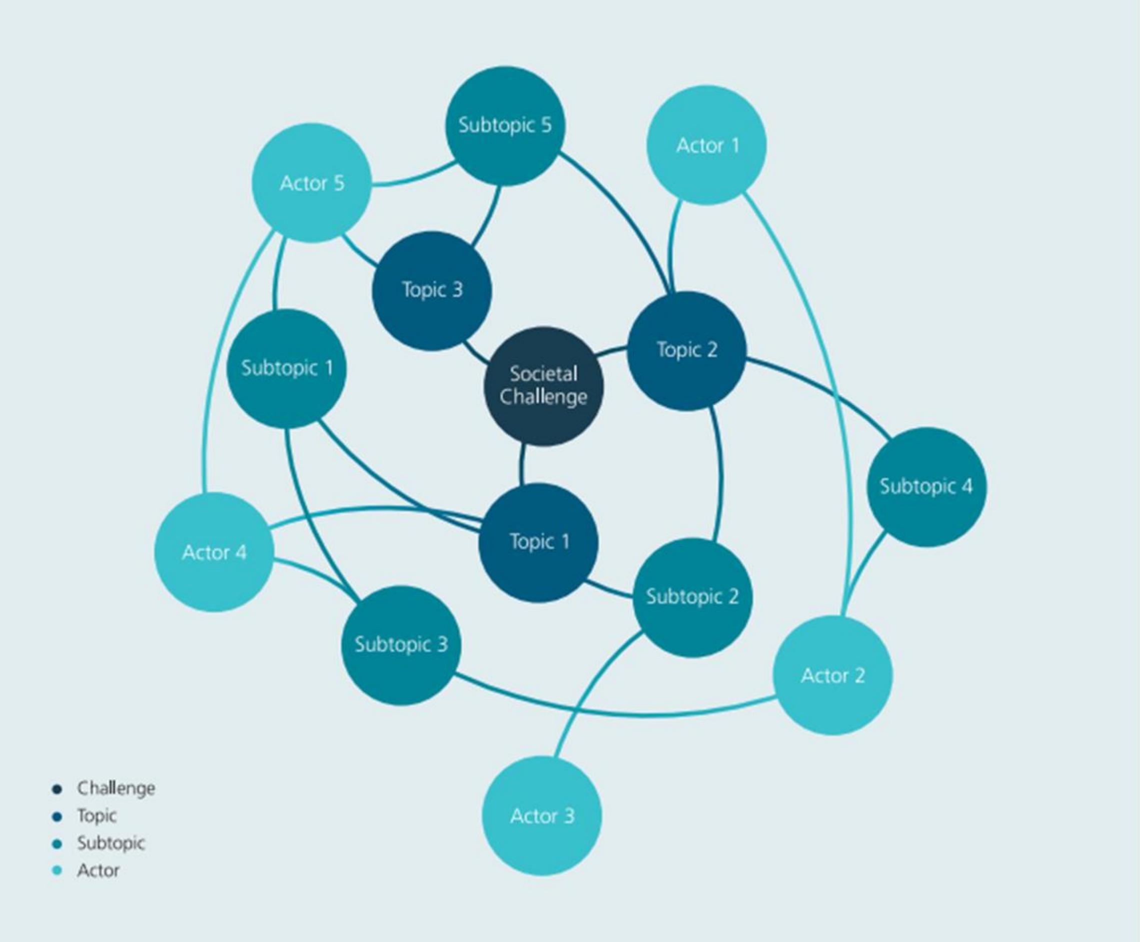
There is no single or easy definition of Systems Thinking. However, in general, we can say it involves:

- Synthetic modes of reasoning meaning that problems are understood by putting components together rather than taking them apart.
- Modeling a system to interpret events and phenomena.
- A relational paradigm i.e. interpreting problems and challenges in the context of the network of relations they form part of.
- A dynamic way of looking at the world, understanding change in terms of nonlinear feedback processes that shape system structure and outcomes.

The use of stakeholders maps as suggested in the previous sections, enabling not just to identify who are the stakeholders but also their relations is an example of the use of systems thinking tools. System mapping may complemented by the use of **Social Network Analysis.**

However, another important tool to use at the initial stages of EDP that greatly enhances stakeholders' ability to understand how to explore their priority-domains is problem mapping – see Figure 11.

Figure 11. Problem mapping



Source: own elaboration

Problem mapping is a technique that helps to understand complex problems by figuring out the relation between problem-components. It enables to visualize and choose what component to prioritize first in tackling the problem as whole. It is a visual way of representing the problem and its causes, which can help to identify the root cause of the problem and develop solutions that are more likely to be effective.

Our suggestion is to use problem mapping to visualise all the components associated to the larger place-based challenge that needs to be tackled.

Here are the steps involved in problem mapping:

- Define the problem – the definition of the challenge associated to the priority-domain
- Brainstorm the causes of the problem. What are the factors that are contributing to the problem?
- Identify the root cause of the problem. What is the underlying issue that is causing the problem?
- Create a problem map. Visually represent the problem and its causes. This can be done using a mind map, flowchart, or other diagramming tool.
- Prioritize the causes of the problem. Not all causes of the problem will be equally important. Prioritize the causes so that you can focus on the most important ones first.
- Develop solutions for the problem. Once you have identified the root cause of the problem, you can develop solutions to address it.
- Implement the solutions and evaluate the results. Once you have implemented the solutions, you need to evaluate the results to see if they are effective. If the solutions are not effective, you may need to go back to the problem mapping process and identify new solutions.

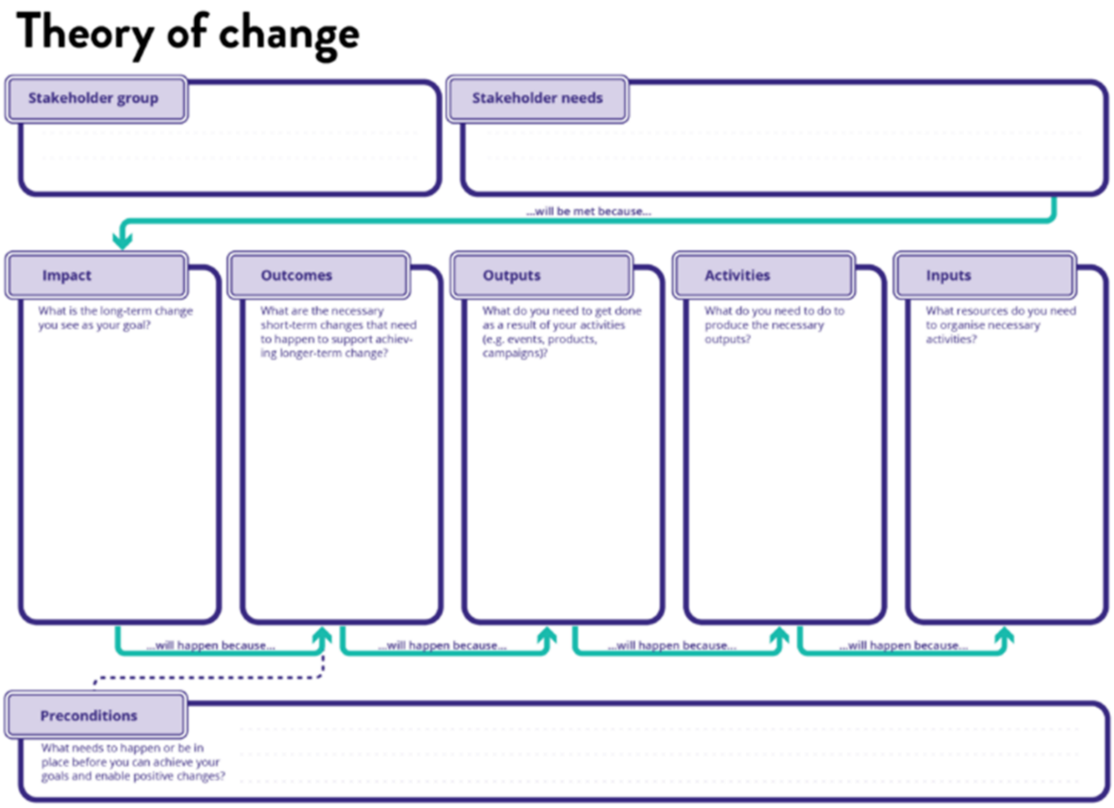
Problem mapping is a powerful tool that can help you to understand complex problems and develop solutions that are more likely to be effective. If you are facing a complex problem, I encourage you to try problem mapping.

Other techniques that can be used to facilitate, improve understanding of the regions' innovation challenges and the quality of the participatory process are for example:

- **Sensing Journeys** - pull participants out of their daily routine and allow them to experience domain challenges through the lens of other stakeholders.
- **Case Clinics** - guide a group through a process in which a case giver presents a case, and a group of 5-7 peers or team members help as consultants.

After a better understanding of the problem another interesting tool often used in systems thinking related to policy design and implementation is to formulate a Theory of Change – see Figure 12.

Figure 12. ToC



Source: own elaboration

Theory of Change (ToC) is a framework to illustrate explains how to reach desired outcomes. It is a way of thinking about how change happens and how the stakeholders work will contribute to that change A ToC typically includes the following elements:

- A long-term goal: What do we want to achieve?
- Intermediate outcomes: What are the steps that need to happen in order to achieve the long-term goal?
- Outputs: What are the specific activities that will be carried out to achieve the intermediate outcomes?
- Inputs: What resources are needed to carry out the activities?
- Assumptions: What are the things that need to happen in order for the ToC to be successful?
- Risks: What are the things that could go wrong and prevent the ToC from being successful?

There are many different ways to develop a ToC. One common approach is to start with the long-term goal and then work backwards to identify the intermediate outcomes, outputs, and inputs. It is important to involve all stakeholders in the development of the ToC, as this will help to ensure that it is realistic and achievable. A ToC is not a static document. It should be regularly reviewed and updated as the organization learns more about its work and the environment in which it operates.

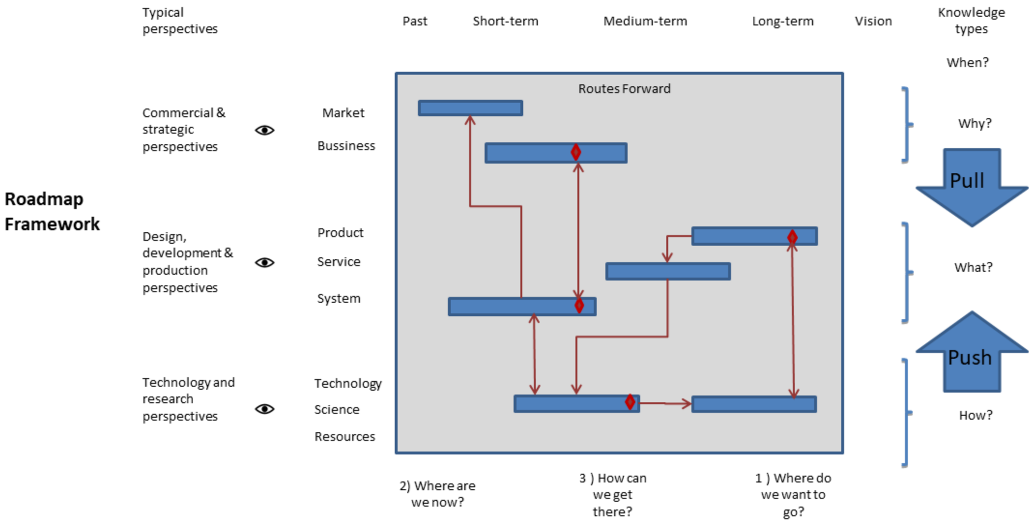
Finally, in complement to a ToC exercise, Roadmapping is also a usefull tool that helps to push the EDP process towards implementation of discovery through a project- portofolio approach.

Roadmapping is the process of determining which projects, actions, steps, and resources are needed to take a strategy from vision to reality (Phaal, Farrukh and Probert, 2004). In the context of S3, roadmapping should be taken as a process of transforming the initial vision and SWOT analysis of every priority domain (direction of change selected previously) into a programme of actions and projects.

Regional S3 roadmapping by priority-domain should involve all relevant and interested stakeholders of each domain. Together they determine the requirements to take vision of transformative change into projects leading to new product, processes or service trials. The first step could be that together stakeholders identify both markets and scientific research that may be useful to address these markets. Then, they lay out the roadmap, breaking markets and research into sub-themes, projects and resources. VPC may be useful to for innovation "pull" i.e. helping to define what new product development projects and resources would the region experiment – see Figure 13.

Note that Roadmapping is not simply the act of creating a roadmap. It is mostly the process of learning and jointly arriving at a consensual definition of which projects, large flagships and smaller projects, should the region experiment. As referred earlier Romania and Lithuania have successfully used Roadmapping for the design and implementation of their country level Smart Specialisation Strategies (Gheorghiu et al., 2016; Paliokaite et al., 2015, 2016).

Figure 13. Roadmap Framework



Source: www.ifm.eng.ac.uk/roadmapping/research

5 Conclusions

Mapping represents one of the crucial stages of the identification process for discovering real priority areas for Smart Specialisation in an evidence-based manner and by taking into account various data and qualitative analysis. The quantitative analysis of the economic, innovation and scientific potential of Tunisia aimed at revealing the promising areas based on various indicators and data that look into economic, innovation and scientific dimension or structure of these areas, i.e. economic sectors. Such exercise provided important information to the Managing Authorities on the potential of these sectors.

However, conducting a quantitative mapping exercise in the EU Enlargement and Neighbourhood Region traditionally faces challenges concerning the availability of data or their adequate disaggregation. The qualitative mapping phase intends to verify the findings through qualitative methods, such as interviews and surveys, and aims to support the work, and sometimes – the lack of information, in the quantitative mapping part with qualitative information where necessary. The qualitative mapping phase in Tunisia revealed very important information on the nature of previously identified sectors and brought them together into provisional priority domains. The survey included stakeholders from different layers of society with the overall aim of justifying the identification of preliminary priority areas through existence of critical mass and contribution to the Tunisian economy. The qualitative part listed the challenges for the remainder of the S3 process, per stakeholder group, and also, the key findings for Smart Specialisation as a driver of the sustainable economic development of Tunisia. This phase provided the grouped priority domains, together with new potential areas of specialisation based on the findings from the qualitative analysis.

The final part aimed at providing an overview of the main achievements within the mapping process but also revealing its limitations and ways to overcome them in the upcoming stakeholder dialogue process. It provides further elaboration of the proposed priority domains, bringing into light not only the justification based on economic, innovation and scientific data supported by the interview findings, but also putting a stronger focus on the twin transition elements and sustainability. Important focus is put on the governance process for EDP with real examples to assist the managing authorities. The guidelines for the EDP give advice on engaging stakeholders, attracting and retaining their interest in the S3 process, as well as on organising collaborative events to support the EDP.

In tackling the potential challenges and preparing the ground for effective EDP, the following actions are proposed:

- To support the justification for the choices of priority domains and defining these priority domains as directions for transformative change;
- To learn how to translate these broad directions of transformative change into more concrete place-based sub-specialisations and to formulate a portfolio of actions and projects, that stakeholders believe are the right projects and actions to experiment and test to see if they have potential to generate local externalities and bring significant transformative changes;
- To bring a higher number of stakeholders into the process. In particular business sector actors who have entrepreneurial knowledge i.e. knowledge about markets and user needs;
- To increase the capacity of the local team to deal with policy concepts related to S3 and EDP such as “socio-technical transitions”, “system level changes” or “regime changes”;
- To secure resources (both internal and externally contracted) needed for conducting the S3 design and implementation process. In particular, the resources needed for the stakeholders dialogue process and organisation of support events appear to be greatly underestimated;
- To learn how to organise and facilitate collaborative events, using ‘Design and Systems Thinking tools and canvas’. These tools are essential to help actors to engage in the process while helping with the experimental nature of entrepreneurial discovery;
- To improve stakeholder identification and input before entering in the EDP (i.e. at least 40 stakeholders for each priority area should be identified. The missing information from the mapping phase could be gathered during the “stakeholders dialogue” workshops and/or alternatively by making more interviews;

- To define the directionality in the domains is needed. This must include issues of ecological and social sustainability in each domain. In particular, it also needs to include possible sub-areas of specialisation, identification of products and services for international markets;
- To absorb the knowledge about how to push and facilitate the S3 policy process including stakeholder engagement, specifically during the EDP, by the local team;

Regarding the actual launch of the Stakeholder Dialogue itself, the recommendations include the following:

1. A general EDP kick-off workshop should be organised to officially announce the process of stakeholder dialogue, attract, and motivate stakeholders, and provide grounds for future collaboration between the priority domains. This initial workshop should gather all the priority domains, all types of stakeholders. To improve participation and the quality of the input collected from stakeholders EDP workshops should be organised with physical presence of all participants, if possible, and use participatory approaches such as Open Space Technology or World Café.
2. One key output of this initial workshop would be the formation of *cohort-groups* per priority domain and identification of coordinators in each group. These coordinators may be elected among participants or alternatively invited by the S3 working group for Tunisia. However, they need to have an adequate profile, i.e. they should have coordination experience on how to conduct multi-stakeholder processes, promoting trust and collaboration. Relevant actors, member of these groups, should not be just the "usual suspects", i.e. public sector authorities, academic and innovative businesses and intermediaries. Civic, social, cultural and creative associations and actors should also participate. Working groups should be constituted by at least 20 actors and stakeholders that all formally agreed to join;
3. In each priority domain, workshops for system and stakeholders mapping, for SWOT analysis and characterisation of subspecialisations and definition of specific placed-based problems and barriers should take place. Following from the SWOT and system mapping workshop, a "vision workshop" in each priority domain should be organised to support the co-creation of future visions, theory of change and definition of strategic goals. The next step would be to organise roadmaps of initiatives and projects and the corresponding policy mix that will support the desired "innovation projects portfolio". Further workshops organisation to follow up and cross-fertilize the initiatives may then be needed in each priority domain. All the stages of event-workshop organisation should be carefully managed (e.g. invitation, promotion, presence of experience and skilful facilitators, etc);
4. Develop an appropriate communication campaign with the help of the communication professionals. The campaign should reflect both the needs for identification of priority areas and related actions, as well as the subsequent strategy implementation needs.

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List of abbreviations and definitions

ANPR	National Agency for the Promotion of Scientific Research in Tunisia
EDP	Entrepreneurial Discovery Process
ICT	Information and communication technologies
IoT	Internet of things
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
MHESR	Ministry of Higher Education and Scientific Research
MOOC	Massive open online course
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne
PCT	Patent Cooperation Treaty
PPP	Purchasing power parity
PRI	Partnerships for Regional Innovation
R&D	Research and Development
R&I	Research and Innovation
S3	Research and Innovation Smart Specialisations Strategies
SWOT	Strengths, Weaknesses, Opportunities Threats
ToC	Theory of Change
UNEP	United Nations Environment Programme
SDGs	Sustainable Development Goals

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Annexes

Annex 1. Industries with revealed potential

Table 5. Industries with economic, innovation and scientific potential

NACE Rev. 2	Economic Potential	Innovation Potential	Product Exports (NACE Rev 1)	Innovation Activities (NACE Rev 1.1)	Patents (IPC) (NACE Rev. 2)	Patents (Fields of Technology)	Trademarks (Trademark classes)	Trademarks (NACE Rev. 2)	Scientific Potential
061: Extraction of crude petroleum	Current	Exports	Yes (111 Extraction of crude petroleum and natural gas)						Chemical Engineering; Energy
089: Mining and quarrying n.e.c.	*Current*	Exports	Yes (111 Extraction of crude petroleum and natural gas)						Chemical Engineering; Energy
091: Support activities for petroleum and natural gas extraction	*Current*	Exports	Yes (111 Extraction of crude petroleum and natural gas)						Chemical Engineering; Energy
104: Manufacture of vegetable and animal oils and fats	No	Exports, patents, trademarks	Yes (154 Vegetable and animal oils and fats)		Yes	18-Food Chemistry	Yes (29)	Yes	Agricultural & Biological Sciences
105: Manufacture of dairy products	Current	Patents, trademarks			Yes	18-Food Chemistry		Yes	Agricultural & Biological Sciences
106: Manufacture of grain mill products, starches and starch products	Current	Patents, trademarks			Yes		Yes (30)	Yes	Agricultural & Biological Sciences
109: Manufacture of prepared animal feeds	Current	Patents			Yes	18-Food Chemistry			Agricultural & Biological Sciences

NACE Rev. 2	Economic Potential	Innovation Potential	Product Exports (NACE Rev 1)	Innovation Activities (NACE Rev 1.1)	Patents (IPC) (NACE Rev. 2)	Patents (Fields of Technology)	Trademarks (Trademark classes)	Trademarks (NACE Rev. 2)	Scientific Potential
110: Manufacture of beverages	Current	Patents, trademarks			Yes	18-Food Chemistry	Yes (32)	Yes	Agricultural & Biological Sciences
131: Preparation and spinning of textile fibers	No	Exports, innovation activities, patents	Yes (171 Textile fibres)	Yes (17 Textiles)		28 - Textile and paper machines			Materials Science
132: Weaving of textiles	No	Exports, innovation activities, patents	Yes (172 Textile weaving)	Yes (17 Textiles)		28 - Textile and paper machines			Materials Science
139: Manufacture of other textiles	*Current*	Exports, innovation activities, patents	Yes (174 Made-up textile articles)	Yes (17 Textiles)		28 - Textile and paper machines			Materials Science
141: Manufacture of wearing apparel, except fur apparel	*Current*	Exports, innovation activities, patents	Yes (174 Made-up textile articles)	Yes (17 Textiles)	Yes	28 - Textile and paper machines			Materials Science
143: Manufacture of knitted and crocheted apparel	No	Exports, innovation activities, patents	Yes (177 Knitted and crocheted articles)	Yes (17 Textiles)	Yes	28 - Textile and paper machines			Materials Science
152: Manufacture of footwear	No	Exports, innovation activities	Yes (193 Footwear)	Yes (19 Leather)					Materials Science
172: Manufacture of articles of paper and paperboard	Current	Exports, innovation activities, patents	Yes (212 Articles of paper and paperboard)	Yes (21 Paper)		28 - Textile and paper machines			Materials Science

NACE Rev. 2	Economic Potential	Innovation Potential	Product Exports (NACE Rev 1)	Innovation Activities (NACE Rev 1.1)	Patents (IPC) (NACE Rev. 2)	Patents (Fields of Technology)	Trademarks (Trademark classes)	Trademarks (NACE Rev. 2)	Scientific Potential
201: Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	Current	Exports, patents	Yes (241 Basic chemicals)		Yes	14 - Organic fine chemistry			Chemical Engineering
203: Manufacture of paints, varnishes and similar coatings, printing ink and mastics	Current	Patents				14 - Organic fine chemistry			Chemical Engineering
204: Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	Current	Patents, trademarks			Yes	14 - Organic fine chemistry	Yes (03)	Yes	Chemical Engineering
205: Manufacture of other chemical products	Current	Patents			Yes	14 - Organic fine chemistry			Chemical Engineering
211: Manufacture of basic pharmaceutical products	*Current*	Patents				14 - Organic fine chemistry			Chemical Engineering
221: Manufacture of rubber products	Current								Chemical Engineering
234: Manufacture of other porcelain and ceramic products brackets	*Current*								Chemical Engineering
235: Manufacture of cement, lime and plaster	Current	Innovation activities, patents		Yes (26 Non-metallic mineral products)	Yes				Chemical Engineering
241: Manufacture of basic iron and steel and of ferro-alloys	Current								Engineering; Materials Science
242: Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	Emerging								Engineering
256: Treatment and coating of metals; machining	Emerging	Innovation activities		Yes (28 Fabricated metal products)					Engineering; Materials Science

NACE Rev. 2	Economic Potential	Innovation Potential	Product Exports (NACE Rev 1)	Innovation Activities (NACE Rev 1.1)	Patents (IPC) (NACE Rev. 2)	Patents (Fields of Technology)	Trademarks (Trademark classes)	Trademarks (NACE Rev. 2)	Scientific Potential
257: Manufacture of cutlery, tools and general hardware	Emerging	Innovation activities		Yes (28 Fabricated metal products)					Engineering
259: Manufacture of other fabricated metal products	Current	Innovation activities		Yes (28 Fabricated metal products)					Engineering
261: Manufacture of electronic components and boards	No	Exports, innovation activities, patents	Yes (311 Electric motors, generators and transformers)	Yes (31-32 Electronics)		06-Computer Technology			Engineering; Computer Science
273: Manufacture of wiring and wiring devices	No	Exports, innovation activities	Yes (313 Isolated wire and cable)	Yes (31-32 Electronics)					Engineering
275: Manufacture of domestic appliances	Current	Innovation activities		Yes (31-32 Electronics)					Engineering
279: Manufacture of other electrical equipment	No	Exports, innovation activities	Yes (316 Electrical equipment n.e.c.)	Yes (31-32 Electronics)					Engineering
281: Manufacture of general-purpose machinery	Current	Innovation activities		Yes (28 Fabricated metal products)					Engineering
282: Manufacture of other general-purpose machinery	Emerging	Innovation activities		Yes (28 Fabricated metal products)					Engineering
293: Manufacture of parts and accessories for motor vehicles	*Current*	Innovation activities		Yes (28 Fabricated metal products)					Engineering
291: Manufacture of motor vehicles	Current	Exports, innovation activities, patents	Yes (354 Motorcycles and bicycles)	Yes (28 Fabricated metal products)	Yes				Engineering; Energy

NACE Rev. 2	Economic Potential	Innovation Potential	Product Exports (NACE Rev 1)	Innovation Activities (NACE Rev 1.1)	Patents (IPC) (NACE Rev. 2)	Patents (Fields of Technology)	Trademarks (Trademark classes)	Trademarks (NACE Rev. 2)	Scientific Potential
303: Manufacture of air and spacecraft and related machinery	Current	Innovation activities		Yes (28 Fabricated metal products)					Engineering
325: Manufacture of medical and dental instruments and supplies	No	Exports, patents	Yes (331 Medical equipment)			13-Medical Technology			Engineering; Computer Science; Materials Science; Immunology and Microbiology
411: Development of building projects	Current	Patents				35-Civil Engineering			Engineering
422: Construction of utility projects	Current	Patents				35-Civil Engineering			Engineering
451: Sale of motor vehicles	Current	Innovation activities		Yes (45 Wholesale)					
465: Wholesale of information and communication equipment	*Current*	Innovation activities		Yes (45 Wholesale)					
476: Retail sale of cultural and recreation goods in specialised stores	Emerging								
612: Wireless telecommunications activities	Current	Patents, trademarks				03-Telecommuni-cations 04-Digital Communi-cations		Yes	Computer Science; Decision Sciences
619: Other telecommunications activities	*Current*							Yes	Computer Science; Decision Sciences

NACE Rev. 2	Economic Potential	Innovation Potential	Product Exports (NACE Rev 1)	Innovation Activities (NACE Rev 1.1)	Patents (IPC) (NACE Rev. 2)	Patents (Fields of Technology)	Trademarks (Trademark classes)	Trademarks (NACE Rev. 2)	Scientific Potential
620: Computer programming, consultancy and related activities	*Current*								Computer Science; Decision Sciences
631: Data processing, hosting and related activities; web portals	*Current*								Computer Science; Decision Sciences
651: Insurance	*Current*								
711: Architectural and engineering activities and related technical consultancy	*Current*								
731: Advertising	*Current*								
732: Market research and public opinion polling	*Current*								
813: Landscape service activities	Emerging								Agricultural & Biological Sciences; Engineering; Environmental Science
822: Activities of call centres	Current								
829: Business support service activities n.e.c	*Current*								

Source: Own calculations.

Annex 2. Economic potential – data tables

Table 6. Industries with current or emerging economic potential

	Current economic potential					Emerging economic potential				
	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	Average wages relative to same industry in bench-mark coun-tries	All (4) criteria	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	*Average wages relative to same industry in bench-mark countries*	All (first 3) criteria
	130	58	92	149	22	110	59	41	*23*	11
SECTION A — AGRICULTURE, FORESTRY AND FISHING										
011 = Cultures non permanentes / Growing of non-perennial crops	1	n/a	0	n/a	0	0	n/a	0	*n/a*	0
012 = Cultures permanentes / Growing of perennial crops	1	n/a	0	n/a	0	0	n/a	1	*n/a*	0
013 = Reproduction de plantes / Plant propagation	1	n/a	0	n/a	0	1	n/a	0	*n/a*	0
014 = Production animale / Animal production	1	n/a	0	n/a	0	1	n/a	0	*n/a*	0
015 = Culture et élevage associés / Mixed farming	1	n/a	0	n/a	0	0	n/a	1	*n/a*	0
016 = Activités de soutien à l'agriculture et traitement primaire des récoltes / Support activities to agriculture and post-harvest crop activities	0	n/a	0	n/a	0	1	n/a	0	*n/a*	0
021 = Sylviculture et autres activités forestières / Silviculture and other forestry activities	0	n/a	0	n/a	0	0	n/a	0	*n/a*	0
022 = Exploitation forestière / Logging	0	n/a	0	n/a	0	0	n/a	1	*n/a*	0
024 = Services de soutien à l'exploitation forestière / Support services to forestry	0	n/a	0	n/a	0	0	n/a	0	*n/a*	0
031 = Pêche / Fishing	1	n/a	0	n/a	0	0	n/a	0	*n/a*	0
032 = Aquaculture / Aquaculture	1	n/a	0	n/a	0	1	n/a	0	*n/a*	0
SECTION B — MINING AND QUARRYING										
061 = Extraction de pétrole brut / Extraction of crude petroleum	1	1	1	1	1	0	0	0	*0*	0
062 = Extraction de gaz naturel / Extraction of natural gas	0	0	1	0	0	0	0	1	*0*	0
071 = Extraction de minerais de fer / Mining of iron ores	0	0	0	0	0	0	0	0	*0*	0

	Current economic potential					Emerging economic potential				
	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	Average wages relative to same industry in bench-mark coun-tries	All (4) criteria	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	*Average wages relative to same industry in bench-mark countries*	All (first 3) criteria)
	130	58	92	149	22	110	59	41	*23*	11
081 = Extraction de pierres, de sables et d'argiles / Quarrying of stone, sand and clay	1	1	0	0	0	0	1	1	*0*	0
082 = Extraction de phosphates naturels / "Extraction of natural phosphates"	0		0		0	1	0	0	*0*	0
089 = Activités extractives n.c.a / Mining and quarrying n.e.c.	0	1	1	1	0	1	0	0	*0*	0
091 = Activités de soutien à l'extraction d'hydrocarbures / Support activities for petroleum and natural gas extraction	0	1	1	1	0	0	0	0	*0*	0
SECTION C — MANUFACTURING										
101 = Transformation et conservation de la viande et préparation de produits à base de viande / Processing and preserving of meat and production of meat products	1	0	0	0	0	0	0	0	*0*	0
102 = Transformation et conservation de poisson, de crustacés et de mollusques / Processing and preserving of fish, crustaceans and molluscs	1	1	0	0	0	1	1	0	*0*	0
103 = Transformation et conservation de fruits et légumes / Processing and preserving of fruit and vegetables	1	1	0	0	0	0	0	1	*1*	0
104 = Fabrication d'huiles et graisses végétales et animales / Manufacture of vegetable and animal oils and fats	1	1	0	1	0	0	0	0	*0*	0
105 = Fabrication de produits laitiers / Manufacture of dairy products	1	1	1	1	1	1	0	0	*0*	0
106 = Travail des grains; fabrication de produits amylacés / Manufacture of grain mill products, starches and starch products	1	1	1	1	1	1	0	0	*1*	0
107 = Fabrication de produits de boulangerie pâtisserie et de pâtes alimentaires / Manufacture of bakery and farinaceous products	1	1	0	1	0	1	0	0	*0*	0
108 = Fabrication d'autres produits alimentaires / Manufacture of other food products	1	0	1	1	0	1	1	0	*0*	0
109 = Fabrication d'aliments pour animau / Manufacture of prepared animal feeds	1	1	1	1	1	1	0	0	*1*	0
110 = Fabrication de boissons / Manufacture of beverages	1	1	1	1	1	1	1	0	*0*	0
120 = Fabrication de produits à base de tabac / Manufacture of tobacco products	0	0	1	0	0	0	0	0	*1*	0

	Current economic potential					Emerging economic potential				
	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	Average wages relative to same industry in bench-mark coun-tries	All (4) criteria	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	*Average wages relative to same industry in bench-mark countries*	All (first 3) criteria)
	130	58	92	149	22	110	59	41	*23*	11
131 = Préparation de fibres textiles et filature / Preparation and spinning of textile fibres	1	1	0	1	0	0	0	0	*0*	0
132 = Tissage / Weaving of textiles	1	0	1	1	0	0	0	0	*0*	0
133 = Ennoblissement textile / Finishing of textiles	1	1	0	1	0	0	0	0	*0*	0
134 = Fabrication de tapis et moquettes / "Manufacture of rugs and carpets"	0		0		0	0	0	0	*0*	0
139 = Fabrication d'autres textiles / Manufacture of other textiles	1	1	0	1	0	1	1	1	*0*	1
141 = Fabrication de vêtements, autres qu'en fourrure / Manufacture of wearing apparel, except fur apparel	1	1	0	1	0	0	0	0	*0*	0
142 = Fabrication d'articles en fourrure / Manufacture of articles of fur	0	0	0	0	0	0	0	0	*0*	0
143 = Fabrication d'articles à mailles / Manufacture of knitted and crocheted apparel	1	1	0	1	0	0	0	0	*0*	0
151 = Apprêt et tannage des cuirs; préparation et teinture des fourrures; fabrication d'articles de voyage, de maroquinerie et de sellerie / Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness; dressing and dyeing of fur	1	1	0	1	0	0	0	0	*0*	0
152 = Fabrication de chaussures / Manufacture of footwear	1	1	0	1	0	0	0	0	*0*	0
161 = Sciage et rabotage du bois / Sawmilling and planing of wood	0	0	0	1	0	1	1	0	*0*	0
162 = Fabrication d'articles en bois, liège, vannerie et sparterie / Manufacture of products of wood, cork, straw and plaiting materials	1	0	0	1	0	1	1	0	*0*	0
171 = Fabrication de pâte à papier, de papier et de carton / Manufacture of pulp, paper and paperboard	0	1	1	0	0	1	0	0	*0*	0
172 = Fabrication d'articles en papier ou en carton / Manufacture of articles of paper and paperboard	1	1	1	1	1	1	0	0	*0*	0
181 = Imprimerie et services annexes / Printing and service activities related to printing	1	0	0	1	0	0	0	0	*0*	0
182 = Reproduction d'enregistrements / Reproduction of recorded media	0	0	0	1	0	0	0	0	*0*	0
192 = Raffinage du pétrole / Manufacture of refined petroleum products	0	0	1	1	0	1	0	0	*0*	0

	Current economic potential					Emerging economic potential				
	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	Average wages relative to same industry in bench-mark coun-tries	All (4) criteria	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	*Average wages relative to same industry in bench-mark countries*	All (first 3) criteria
	130	58	92	149	22	110	59	41	*23*	11
201 = Fabrication de produits chimiques de base, de produits azotés et d'engrais, de matières plastiques de base et de caoutchouc synthétique / Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	1	1	1	1	1	1	1	0	*0*	0
202 = Fabrication de pesticides et d'autres produits agrochimiques / Manufacture of pesticides and other agrochemical products	0	0	1	1	0	1	1	0	*0*	0
203 = Fabrication de peintures, vernis, encres et mastics / Manufacture of paints, varnishes and similar coatings, printing ink and mastics	1	1	1	1	1	0	0	0	*0*	0
204 = Fabrication de savons, de produits d'entretien et de parfums / Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	1	1	1	1	1	1	1	0	*0*	0
205 = Fabrication d'autres produits chimiques / Manufacture of other chemical products	1	1	1	1	1	1	0	0	*0*	0
206 = Fabrication de fibres artificielles ou synthétiques / Manufacture of man-made fibres	0	0	0	0	0	0	0	0	*0*	0
211 = Fabrication de produits pharmaceutiques de base / Manufacture of basic pharmaceutical products	1	1	1	0	0	1	1	0	*0*	0
212 = Fabrication de préparations pharmaceutiques / Manufacture of pharmaceutical preparations	1	0	1	1	0	1	0	0	*0*	0
221 = Fabrication de produits en caoutchouc / Manufacture of rubber products	1	1	1	1	1	0	0	0	*0*	0
222 = Fabrication de produits en plastique / Manufacture of plastic products	1	1	0	0	0	1	1	0	*0*	0
231 = Fabrication de verre et d'articles en verre / Manufacture of glass and glass products	1	0	1	1	0	0	0	0	*0*	0
232 = Fabrication de produits réfractaires / Manufacture of refractory products	0	0	0	0	0	1	1	0	*0*	0
233 = Fabrication de matériaux de construction en terre cuite / Manufacture of clay building materials	1	1	0	0	0	0	0	0	*0*	0
234 = Fabrication d'autres produits en céramique et en porcelaine / Manufacture of other porcelain and ceramic products	1	1	0	1	0	0	0	0	*0*	0
235 = Fabrication de ciment, chaux et plâtre / Manufacture of cement, lime and plaster	1	1	1	1	1	0	0	0	*0*	0

	Current economic potential					Emerging economic potential				
	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	Average wages relative to same industry in bench-mark coun-tries	All (4) criteria	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	*Average wages relative to same industry in bench-mark countries*	All (first 3) criteria)
	130	58	92	149	22	110	59	41	*23*	11
236 = Fabrication d'ouvrages en béton, en ciment ou en plâtre / Manufacture of articles of concrete, cement and plaster	1	1	0	1	0	0	0	0	*0*	0
237 = Taille, façonnage et finissage de pierres / Cutting, shaping and finishing of stone	0	0	0	0	0	0	0	0	*0*	0
239 = Fabrication de produits abrasifs et de produits minéraux non métalliques n.c.a / Manufacture of abrasive products and non-metallic mineral products n.e.c.	0	0	0	0	0	1	1	0	*0*	0
241 = Sidérurgie / Manufacture of basic iron and steel and of ferro-alloys	1	1	1	1	1	0	0	0	*1*	0
242 = Fabrication de tubes, tuyaux, profilés creux et accessoires correspondants en acier / Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	0	0	0	0	0	1	1	1	*0*	1
243 = Fabrication d'autres produits de première transformation de l'acier / Manufacture of other products of first processing of steel	0	0	1	1	0	0	0	0	*0*	0
244 = Production de métaux précieux et d'autres métaux non ferreu / Manufacture of basic precious and other non-ferrous metals	0	0	1	1	0	1	1	0	*0*	0
245 = Fonderie / Casting of metals	0	0	0	1	0	1	0	1	*0*	0
251 = Fabrication d'éléments en métal pour la construction / Manufacture of structural metal products	1	0	0	1	0	0	0	0	*0*	0
252 = Fabrication de réservoirs, citernes et conteneurs métalliques / Manufacture of tanks, reservoirs and containers of metal	0	1	1	1	0	0	0	0	*0*	0
253 = Fabrication de générateurs de vapeur, à l'exception des chaudières pour le chauffage central / Manufacture of steam generators, except central heating hot water boilers	0	0	0	0	0	0	0	1	*1*	0
255 = Forge, emboutissage, estampage; métallurgie des poudres / Forging, pressing, stamping and roll-forming of metal; powder metallurgy	0	0	0	0	0	0	0	0	*0*	0
256 = Traitement et revêtement des métaux; usinage / Treatment and coating of metals; machining	1	0	0	1	0	1	1	1	*1*	1
257 = Fabrication de coutellerie, d'outillage et de quincaillerie / Manufacture of cutlery, tools and general hardware	1	0	1	1	0	1	1	1	*0*	1

	Current economic potential					Emerging economic potential				
	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	Average wages relative to same industry in bench-mark coun-tries	All (4) criteria	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	*Average wages relative to same industry in bench-mark countries*	All (first 3) criteria)
	130	58	92	149	22	110	59	41	*23*	11
259 = Fabrication d'autres ouvrages en métau / Manufacture of other fabricated metal products	1	1	1	1	1	1	0	0	*0*	0
261 = Fabrication de composants et cartes électroniques / Manufacture of electronic components and boards	1	1	0	0	0	1	1	0	*0*	0
262 = Fabrication d'ordinateurs et d'équipements périphériques / Manufacture of computers and peripheral equipment	0	0	0	0	0	0	0	0	*0*	0
263 = Fabrication d'équipements de communication / Manufacture of communication equipment	0	0	0	0	0	0	0	0	*0*	0
264 = Fabrication de produits électroniques grand public / Manufacture of consumer electronics	0	0	0	1	0	0	0	0	*0*	0
265 = Fabrication d'instruments et d'appareils de mesure, d'essai et de navigation; horlogerie / Manufacture of instruments and appliances for measuring, testing and navigation; watches and clocks	0	0	0	0	0	0	0	0	*0*	0
266 = Fabrication d'équipements d'irradiation médicale, d'équipements électromédicaux et électrothérapeutiques / Manufacture of irradiation, electromedical and electrotherapeutic equipment	1	1	0	0	0	1	1	0	*0*	0
267 = Fabrication de matériels optique et photographique / Manufacture of optical instruments and photographic equipment	0	0	0	0	0	1	1	0	*0*	0
268 = Fabrication de supports magnétiques et optiques / Manufacture of magnetic and optical media	0	0	0	0	0	0	1	1	*0*	0
271 = Fabrication de moteurs, génératrices et transformateurs électriques et de matériel de distribution et de commande électrique / Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus	1	1	0	0	0	1	0	0	*0*	0
272 = Fabrication de piles et d'accumulateurs électriques / Manufacture of batteries and accumulators	0	1	1	1	0	0	0	1	*1*	0
273 = Fabrication de fils et câbles et de matériel d'installation électrique / Manufacture of wiring and wiring devices	1	1	0	0	0	1	0	1	*0*	0
274 = Fabrication d'appareils d'éclairage électrique / Manufacture of electric lighting equipment	0	0	0	1	0	0	0	0	*0*	0
275 = Fabrication d'appareils ménagers / Manufacture of domestic appliances	1	1	1	1	1	0	0	0	*0*	0
279 = Fabrication d'autres matériels électriques / Manufacture of other electrical equipment	1	1	0	0	0	1	1	0	*0*	0

	Current economic potential					Emerging economic potential				
	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	Average wages relative to same industry in bench-mark coun-tries	All (4) criteria	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	*Average wages relative to same industry in bench-mark countries*	All (first 3) criteria)
	130	58	92	149	22	110	59	41	*23*	11
281 = Fabrication de machines d'usage général / Manufacture of general-purpose machinery	1	1	1	1	1	1	1	1	*1*	1
282 = Fabrication d'autres machines d'usage général / Manufacture of other general-purpose machinery	1	0	1	1	0	1	1	1	*0*	1
283 = Fabrication de machines agricoles et forestières / Manufacture of agricultural and forestry machinery	0	0	0	1	0	0	0	0	*0*	0
284 = Fabrication de machines de formage des métaux et de machines-outils / Manufacture of metal forming machinery and machine tools	0	0	0	0	0	0	0	0	*0*	0
289 = Fabrication d'autres machines d'usage spécifique / Manufacture of other special-purpose machinery	0	0	0	0	0	1	1	0	*0*	0
291 = Construction de véhicules automobiles / Manufacture of motor vehicles	1	1	1	1	1	1	0	1	*0*	0
292 = Fabrication de carrosseries et remorques / Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	0	1	1	1	0	0	0	0	*0*	0
293 = Fabrication d'équipements automobiles / Manufacture of parts and accessories for motor vehicles	1	1	0	1	0	0	0	1	*1*	0
301 = Construction navale / Building of ships and boats	1	0	1	1	0	0	0	0	*0*	0
303 = Construction aéronautique et spatiale / Manufacture of air and spacecraft and related machinery	1	1	1	1	1	1	1	1	*0*	1
309 = Fabrication de matériels de transport n.c.a / Manufacture of transport equipment n.e.c.	0	0	0	1	0	0	0	1	*0*	0
310 = Fabrication de meubles / Manufacture of furniture	1	0	0	1	0	0	0	0	*0*	0
321 = Fabrication d'articles de joaillerie, bijouterie et articles similaires / Manufacture of jewellery, bijouterie and related articles	0	0	0	1	0	0	0	0	*0*	0
322 = Fabrication d'instruments de musique / Manufacture of musical instruments	0	0	0	1	0	1	1	0	*0*	0
323 = Fabrication d'articles de sport / Manufacture of sports goods	0	1	0	1	0	1	0	0	*0*	0
324 = Fabrication de jeux et jouets / Manufacture of games and toys	0	1	0	1	0	0	0	1	*0*	0

	Current economic potential					Emerging economic potential				
	Size (employment share)	Specialisation (employment)	Average wages relative to all industries in Tunisia	Average wages relative to same industry in benchmark countries	All (4) criteria	Size (employment share)	Specialisation (employment)	Average wages relative to all industries in Tunisia	*Average wages relative to same industry in benchmark countries*	All (first 3) criteria)
	130	58	92	149	22	110	59	41	*23*	11
325 = Fabrication d'instruments et de fournitures à usage médical et dentaire / Manufacture of medical and dental instruments and supplies	1	0	0	1	0	1	1	0	*0*	0
329 = Activités manufacturières n.c.a / Manufacturing n.e.c.	1	1	0	1	0	0	0	0	*0*	0
331 = Réparation d'ouvrages en métaux, de machines et d'équipements / Repair of fabricated metal products, machinery and equipment	1	0	1	1	0	0	0	0	*0*	0
332 = Installation de machines et d'équipements industriels / Installation of industrial machinery and equipment	0	0	0	0	0	0	1	1	*0*	0
SECTION D — ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY										
351 = Production, transport et distribution d'électricité / Electric power generation, transmission and distribution	0	0	1	1	0	0	0	0	*0*	0
352 = Production et distribution de combustibles gazeu / Manufacture of gas; distribution of gaseous fuels through mains	0	0	0	0	0	0	0	0	*0*	0
353 = Production et distribution de vapeur et d'air conditionné / Steam and air conditioning supply	0	0	0	0	0	1	1	0	*0*	0
SECTION E — WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES										
360 = Captage, traitement et distribution d'eau / Water collection, treatment and supply	0	0	0	0	0	0	0	1	*1*	0
370 = Collecte et traitement des eaux usées / Sewerage	1	1	0	1	0	1	1	0	*0*	0
381 = Collecte des déchets / Waste collection	1	0	0	0	0	0	0	0	*0*	0
382 = Traitement et élimination des déchets / Waste treatment and disposal	0	0	0	1	0	0	0	0	*1*	0
383 = Récupération / Materials recovery	0	0	1	1	0	0	0	0	*0*	0
390 = Dépollution et autres services de gestion des déchets / Remediation activities and other waste management services	0	0	0	0	0	0	0	0	*0*	0
SECTION F — CONSTRUCTION										

	Current economic potential					Emerging economic potential				
	Size (employment share)	Specialisation (employment)	Average wages relative to all industries in Tunisia	Average wages relative to same industry in benchmark countries	All (4) criteria	Size (employment share)	Specialisation (employment)	Average wages relative to all industries in Tunisia	*Average wages relative to same industry in benchmark countries*	All (first 3) criteria)
	130	58	92	149	22	110	59	41	*23*	11
411 = Promotion immobilière / Development of building projects	1	1	1	1	1	0	0	0	*0*	0
412 = Construction de bâtiments résidentiels et non résidentiels / Construction of residential and non-residential buildings	1	1	0	1	0	0	0	0	*0*	0
421 = Construction de routes et de voies ferrées / Construction of roads and railways	1	0	0	0	0	0	0	0	*0*	0
422 = Construction de réseaux et de lignes / Construction of utility projects	1	1	1	1	1	0	0	0	*0*	0
429 = Construction d'autres ouvrages de génie civil / Construction of other civil engineering projects	0	0	1	1	0	0	0	1	*0*	0
431 = Démolition et préparation des sites / Demolition and site preparation	0	0	0	1	0	1	0	0	*0*	0
432 = Travaux d'installation électrique, plomberie et autres travaux d'installation / Electrical, plumbing and other construction installation activities	1	0	0	1	0	0	0	1	*0*	0
433 = Travaux de finition / Building completion and finishing	1	0	0	1	0	0	0	1	*0*	0
439 = Autres travaux de construction spécialisés / Other specialised construction activities	0	0	0	1	0	0	0	0	*0*	0
SECTION G — WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES										
451 = Commerce de véhicules automobiles / Sale of motor vehicles	1	0	1	1	0	1	1	1	*0*	1
452 = Entretien et réparation de véhicules automobiles / Maintenance and repair of motor vehicles	1	0	0	1	0	0	0	1	*0*	0
453 = Commerce d'équipements automobiles / Sale of motor vehicle parts and accessories	1	0	0	1	0	1	0	0	*0*	0
454 = Commerce et réparation de motocycles / Sale, maintenance and repair of motorcycles and related parts and accessories	0	0	0	1	0	0	0	0	*0*	0
461 = Intermédiaires du commerce de gros / Wholesale on a fee or contract basis	1	0	1	1	0	0	0	0	*0*	0
462 = Commerce de gros de produits agricoles bruts et d'animaux vivants / Wholesale of agricultural raw materials and live animals	1	0	0	1	0	0	0	0	*0*	0

	Current economic potential					Emerging economic potential				
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	130	58	92	149	22	110	59	41	*23*	11
463 = Commerce de gros de produits alimentaires, de boissons et de tabac / Wholesale of food, beverages and tobacco	1	0	0	0	0	0	0	0	*0*	0
464 = Commerce de gros de biens domestiques / Wholesale of household goods	1	0	1	1	0	1	1	0	*0*	0
465 = Commerce de gros d'équipements de l'information et de la communication / Wholesale of information and communication equipment	1	0	1	1	0	0	0	0	*0*	0
466 = Commerce de gros d'autres équipements industriels / Wholesale of other machinery, equipment and supplies	1	0	1	1	0	1	1	0	*0*	0
467 = Autres commerces de gros spécialisés / Other specialised wholesale	1	0	1	1	0	1	0	0	*0*	0
469 = Commerce de gros non spécialisé / Non-specialised wholesale trade	1	0	1	1	0	1	1	0	*0*	0
471 = Commerce de détail en magasin non spécialisé / Retail sale in non-specialised stores	1	0	0	1	0	1	1	0	*0*	0
472 = Commerce de détail alimentaire en magasin spécialisé / Retail sale of food, beverages and tobacco in specialised stores	1	0	0	1	0	0	0	0	*0*	0
473 = Commerce de détail de carburants en magasin spécialisé / Retail sale of automotive fuel in specialised stores	1	0	0	1	0	1	1	0	*0*	0
474 = Commerce de détail d'équipements de l'information et de la communication en magasin spécialisé / Retail sale of information and communication equipment in specialised stores	1	0	1	1	0	1	1	0	*0*	0
475 = Commerce de détail d'autres équipements du foyer en magasin spécialisé / Retail sale of other household equipment in specialised stores	1	0	0	1	0	0	0	0	*0*	0
476 = Commerce de détail de biens culturels et de loisirs en magasin spécialisé / Retail sale of cultural and recreation goods in specialised stores	1	0	0	1	0	1	1	1	*0*	1
477 = Autres commerces de détail en magasin spécialisé / Retail sale of other goods in specialised stores	1	0	0	1	0	1	1	0	*0*	0
478 = Commerce de détail de biens neufs sur éventaires et marchés; Commerce de biens d'occasion / Retail sale via stalls and markets	0	0	0	1	0	0	0	0	*0*	0
479 = Commerce de détail hors magasin, éventaires ou marchés / Retail trade not in stores, stalls or markets	0	0	0	1	0	0	0	1	*1*	0

	Current economic potential					Emerging economic potential				
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	130	58	92	149	22	110	59	41	*23*	11
SECTION H — TRANSPORTATION AND STORAGE										
493 = Autres transports terrestres de voyageurs / Other passenger land transport	1	0	0	1	0	0	0	0	*0*	0
494 = Transports routiers de fret et services de déménagement / Freight transport by road and removal services	1	0	0	1	0	1	0	0	*0*	0
495 = Transports par conduites / Transport via pipeline	0	0	1	1	0	0	0	1	*0*	0
501 = Transports maritimes et côtiers de passagers / Sea and coastal passenger water transport	0	0	1	1	0	1	0	0	*0*	0
502 = Transports maritimes et côtiers de fret / Sea and coastal freight water transport	0	0	0	0	0	0	0	0	*0*	0
511 = Transports aériens de passagers / Passenger air transport	0	0	1	1	0	0	0	0	*0*	0
512 = Transports aériens de fret et transports spatiau / Freight air transport and space transport	0	0	1	0	0	0	0	0	*0*	0
521 = Entreposage et stockage / Warehousing and storage	1	0	0	0	0	1	0	0	*0*	0
522 = Services auxiliaires des transports / Support activities for transportation	1	0	1	1	0	0	0	0	*0*	0
531 = Activités de poste dans le cadre d'une obligation de service universel / Postal activities under universal service obligation	0	0	0	0	0	0	0	0	*0*	0
532 = Autres activités de poste et de courrier / Other postal and courier activities	0	0	0	0	0	1	1	0	*0*	0
SECTION I — ACCOMMODATION AND FOOD SERVICE ACTIVITIES										
551 = Hôtels et hébergement similaire / Hotels and similar accommodation	1	0	0	1	0	0	0	0	*0*	0
552 = Hébergement touristique et autre hébergement de courte durée / Holiday and other short-stay accommodation	0	0	0	1	0	0	0	0	*0*	0
553 = Terrains de camping et parcs pour caravanes ou véhicules de loisirs / Camping grounds, recreational vehicle parks and trailer parks	0	0	0	0	0	0	0	0	*0*	0
559 = Autres hébergements / Other accommodation	0	0	0	1	0	0	0	0	*0*	0

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	130	58	92	149	22	110	59	41	*23*	11
561 = Restaurants et services de restauration mobile / Restaurants and mobile food service activities	1	0	0	1	0	1	0	0	*0*	0
562 = Traiteurs et autres services de restauration / Event catering and other food service activities	0	0	0	0	0	1	1	0	*0*	0
563 = Débits de boissons / Beverage serving activities	1	0	0	1	0	0	0	0	*0*	0
SECTION J — INFORMATION AND COMMUNICATION										
581 = Édition de livres et périodiques et autres activités d'édition / Publishing of books, periodicals and other publishing activities	0	0	1	1	0	0	0	0	*0*	0
582 = Édition de logiciels / Software publishing	0	0	0	0	0	0	0	0	*0*	0
591 = Activités cinématographiques, vidéo et de télévision / Motion picture, video and television programme activities	0	0	1	1	0	0	0	0	*0*	0
592 = Enregistrement sonore et édition musicale / Sound recording and music publishing activities	0	0	0	0	0	0	0	0	*0*	0
601 = Édition et diffusion de programmes radio / Radio broadcasting	0	0	1	1	0	1	1	0	*0*	0
602 = Programmation de télévision et télédiffusion / Television programming and broadcasting activities	0	0	1	1	0	1	1	0	*0*	0
611 = Télécommunications filaires / Wired telecommunications activities	0	0	0	0	0	0	0	0	*0*	0
612 = Télécommunications sans fil / Wireless telecommunications activities	1	1	1	1	1	0	0	0	*1*	0
619 = Autres activités de télécommunication / Other telecommunications activities	1	0	1	1	0	1	0	1	*1*	0
620 = Programmation, conseil et autres activités informatiques / Computer programming, consultancy and related activities	1	0	1	1	0	0	0	0	*0*	0
631 = Traitement de données, hébergement et activités connexes; portails Internet / Data processing, hosting and related activities; web portals	1	0	1	1	0	1	0	0	*1*	0
639 = Autres services d'information / Other information service activities	0	0	1	1	0	0	0	0	*0*	0
SECTION K — FINANCIAL AND INSURANCE ACTIVITIES										

	Current economic potential					Emerging economic potential				
	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	Average wages relative to same industry in bench-mark coun-tries	All (4) criteria	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	*Average wages relative to same industry in bench-mark countries*	All (first 3) criteria)
	130	58	92	149	22	110	59	41	*23*	11
641 = Intermédiation monétaire / Monetary intermediation	1	n/a	1	n/a	0	1	n/a	0	*n/a*	0
642 = Activités des sociétés holding / Activities of holding companies	0	n/a	1	n/a	0	1	n/a	1	*n/a*	0
643 = Fonds de placement et entités financières similaires / Trusts, funds and similar financial entities	0	n/a	1	n/a	0	0	n/a	0	*n/a*	0
649 = Autres activités des services financiers, hors assurance et caisses de retraite / Other financial service activities, except insurance and pension funding	0	n/a	1	n/a	0	1	n/a	0	*n/a*	0
651 = Assurance / Insurance	1	0	1	1	0	1	1	0	*0*	0
652 = Réassurance / Reinsurance	0	0	1	1	0	1	1	0	*0*	0
661 = Activités auxiliaires de services financiers, hors assurance et caisses de retraite / Activities auxiliary to financial services, except insurance and pension funding	0	n/a	1	n/a	0	1	n/a	0	*n/a*	0
662 = Activités auxiliaires d'assurance et de caisses de retraite / Activities auxiliary to insurance and pension funding	1	n/a	0	n/a	0	1	n/a	0	*n/a*	0
663 = Gestion de fonds / Fund management activities	0	n/a	1	n/a	0	1	n/a	1	*n/a*	0
SECTION L — REAL ESTATE ACTIVITIES										
681 = Activités des marchands de biens immobiliers / Buying and selling of own real estate	0	0	0	0	0	0	0	0	*0*	0
682 = Location et exploitation de biens immobiliers propres ou loués / Rental and operating of own or leased real estate	1	0	0	1	0	0	0	0	*0*	0
683 = Activités immobilières pour compte de tiers / Real estate activities on a fee or contract basis	0	0	0	1	0	1	0	0	*0*	0
SECTION M — PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES										
691 = Activités juridiques / Legal activities	1	0	0	1	0	0	0	0	*0*	0
692 = Activités comptables / Accounting, bookkeeping and auditing activities; tax consultancy	1	0	1	1	0	1	1	0	*0*	0
701 = Activités des sièges sociau / Activities of head offices	0	0	0	0	0	0	0	0	*0*	0

	Current economic potential					Emerging economic potential				
	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	Average wages relative to same industry in bench-mark coun-tries	All (4) criteria	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	*Average wages relative to same industry in bench-mark countries*	All (first 3) criteria)
	130	58	92	149	22	110	59	41	*23*	11
702 = Conseil de gestion / Management consultancy activities	1	0	1	1	0	1	1	0	*1*	0
711 = Activités d'architecture et d'ingénierie / Architectural and engineering activities and related technical consultancy	1	0	1	1	0	0	0	0	*1*	0
712 = Activités de contrôle et analyses techniques / Technical testing and analysis	1	0	1	1	0	0	0	0	*0*	0
721 = Recherche-développement en sciences physiques et naturelles / Research and experimental development on natural sciences and engineering	0	0	1	1	0	1	1	0	*0*	0
722 = Recherche-développement en sciences humaines et sociales / Research and experimental development on social sciences and humanities	0	0	1	1	0	0	1	0	*0*	0
731 = Publicité / Advertising	1	0	1	1	0	1	0	0	*0*	0
732 = Études de marché et sondages / Market research and public opinion polling	1	0	1	1	0	1	1	0	*0*	0
741 = Activités spécialisées de design / Specialised design activities	0	0	0	1	0	1	1	0	*0*	0
742 = Activités photographiques / Photographic activities	0	0	0	1	0	0	0	0	*0*	0
743 = Traduction et interprétation / Translation and interpretation activities	0	0	0	1	0	1	1	0	*1*	0
749 = Autres activités spécialisées, scientifiques et techniques n.c.a / Other professional, scientific and technical activities n.e.c.	0	0	1	1	0	0	0	1	*1*	0
750 = Activités vétérinaires / Veterinary activities	0	0	0	1	0	1	0	0	*0*	0
SECTION N — ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES										
771 = Location et location-bail de véhicules automobiles / Rental and leasing of motor vehicles	1	0	0	1	0	0	0	0	*1*	0
772 = Location et location-bail de biens personnels et domestiques / Rental and leasing of personal and household goods	0	0	0	1	0	0	0	0	*0*	0

	Current economic potential					Emerging economic potential				
	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	Average wages relative to same industry in bench-mark coun-tries	All (4) criteria	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	*Average wages relative to same industry in bench-mark countries*	All (first 3) criteria)
	130	58	92	149	22	110	59	41	*23*	11
773 = Location et location-bail d'autres machines, équipements et biens / Rental and leasing of other machinery, equipment and tangible goods	0	0	0	1	0	0	0	0	*0*	0
781 = Activités des agences de placement de main-d'œuvre / Activities of employment placement agencies	1	1	0	0	0	0	0	0	*0*	0
782 = Activités des agences de travail temporaire / Temporary employment agency activities	1	0	0	0	0	1	0	0	*0*	0
791 = Activités des agences de voyage et voyagistes / Travel agency and tour operator activities	1	0	1	1	0	0	0	0	*0*	0
799 = Autres services de réservation et activités connexes / Other reservation service and related activities	0	0	0	0	0	0	0	0	*0*	0
801 = Activités de sécurité privée / Private security activities	1	0	0	1	0	1	1	0	*1*	0
802 = Activités liées aux systèmes de sécurité / Security systems service activities	0	0	0	0	0	1	1	0	*0*	0
811 = Activités combinées de soutien lié aux bâtiments / Combined facilities support activities	0	0	0	1	0	0	0	0	*0*	0
812 = Activités de nettoyage / Cleaning activities	1	0	0	1	0	1	0	0	*0*	0
813 = Services d'aménagement paysager / Landscape service activities	1	1	0	1	0	1	1	1	*1*	1
821 = Activités administratives / Office administrative and support activities	0	0	0	1	0	1	1	0	*0*	0
822 = Activités de centres d'appels / Activities of call centres	1	1	1	1	1	1	1	1	*0*	1
823 = Organisation de salons professionnels et congrès / Organisation of conventions and trade shows	0	0	1	1	0	1	0	0	*0*	0
829 = Activités de soutien aux entreprises n.c.a / Business support service activities n.e.c.	1	0	1	1	0	1	0	0	*0*	0
SECTION O — PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY										
841 = Administration générale, économique et sociale / Administration of the State and the economic and social policy of the community	0	n/a	1	n/a	0	1	n/a	0	*n/a*	0
843 = Sécurité sociale obligatoire / Compulsory social security activities	0	n/a	0	n/a	0	0	n/a	0	*n/a*	0
SECTION P — EDUCATION										

	Current economic potential					Emerging economic potential				
	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	Average wages relative to same industry in bench-mark coun-tries	All (4) criteria	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	*Average wages relative to same industry in bench-mark countries*	All (first 3) criteria)
	130	58	92	149	22	110	59	41	*23*	11
851 = Enseignement pré-primaire / Pre-primary education	0	n/a	0	n/a	0	0	n/a	0	*n/a*	0
852 = Enseignement primaire / Primary education	0	n/a	0	n/a	0	0	n/a	0	*n/a*	0
853 = Enseignement secondaire / Secondary education	1	n/a	0	n/a	0	1	n/a	0	*n/a*	0
854 = Enseignement supérieur et post-secondaire non supérieur / Higher education	1	n/a	1	n/a	0	1	n/a	0	*n/a*	0
855 = Autres activités d'enseignement / Other education	1	n/a	0	n/a	0	0	n/a	0	*n/a*	0
856 = Activités de soutien à l'enseignement / Educational support activities	0	n/a	0	n/a	0	0	n/a	0	*n/a*	0
SECTION Q — HUMAN HEALTH AND SOCIAL WORK ACTIVITIES										
861 = Activités hospitalières / Hospital activities	1	n/a	1	n/a	0	1	n/a	0	*n/a*	0
862 = Activité des médecins et des dentistes / Medical and dental practice activities	1	n/a	0	n/a	0	1	n/a	0	*n/a*	0
869 = Autres activités pour la santé humaine / Other human health activities	1	n/a	0	n/a	0	1	n/a	0	*n/a*	0
871 = Hébergement médicalisé / Residential nursing care activities	0	n/a	0	n/a	0	0	n/a	0	*n/a*	0
872 = Hébergement social pour personnes handicapées mentales, malades mentales et toxicomanes / Residential care activities for mental retardation, mental health and substance abuse	0	n/a	0	n/a	0	0	n/a	0	*n/a*	0
873 = Hébergement social pour personnes âgées ou handicapées physiques / Residential care activities for the elderly and disabled	0	n/a	0	n/a	0	1	n/a	1	*n/a*	0
881 = Action sociale sans hébergement pour personnes âgées et pour personnes handicapées / Social work activities without accommodation for the elderly and disabled	0	n/a	0	n/a	0	0	n/a	0	*n/a*	0
889 = Autre action sociale sans hébergement / Other social work activities without accommodation	1	n/a	0	n/a	0	1	n/a	0	*n/a*	0
SECTION R — ARTS, ENTERTAINMENT AND RECREATION										
900 = Activités créatives, artistiques et de spectacle / Creative, arts and entertainment activities	0	n/a	0	n/a	0	1	n/a	1	*n/a*	0

	Current economic potential					Emerging economic potential				
	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	Average wages relative to same industry in bench-mark coun-tries	All (4) criteria	Size (employ-ment share)	Specia-lisation (employ-ment)	Average wages relative to all indus-tries in Tunisia	*Average wages relative to same industry in bench-mark countries*	All (first 3) criteria)
	130	58	92	149	22	110	59	41	*23*	11
910 = Bibliothèques, archives, musées et autres activités culturelles / Libraries, archives, museums and other cultural activities	0	n/a	0	n/a	0	1	n/a	1	*n/a*	0
920 = Organisation de jeux de hasard et d'argent / Gambling and betting activities	0	n/a	1	n/a	0	0	n/a	0	*n/a*	0
931 = Activités liées au sport / Sports activities	0	n/a	0	n/a	0	1	n/a	0	*n/a*	0
932 = Activités récréatives et de loisirs / Amusement and recreation activities	1	n/a	0	n/a	0	1	n/a	0	*n/a*	0
SECTION S — OTHER SERVICE ACTIVITIES										
942 = Activités des syndicats de salariés / Activities of trade unions	0	n/a	0	n/a	0	0	n/a	0	*n/a*	0
951 = Réparation d'ordinateurs et d'équipements de communication / Repair of computers and communication equipment	0	0	0	1	0	0	0	0	*0*	0
952 = Réparation de biens personnels et domestiques / Repair of personal and household goods	0	0	1	1	0	0	0	0	*0*	0
960 = Autres services personnels / Other personal service activities	1	n/a	0	n/a	0	0	n/a	0	*n/a*	0

Source: Own calculations, based on Eurostat, Institut National de la Statistique, World Bank.

Annex 3. Scientific potential – data tables

Table 7. Location Quotients for Scopus Subject Areas

Subject Area	TN output	Location Quotient	
		2010-2014	2015-2019
Agricultural and Biological Sciences	**7 061**	1.53614	1.13991
Arts and Humanities	600	0.22251	0.19328
Biochemistry, Genetics and Molecular Biology	**6 292**	0.84328	0.70986

Business, Management and Accounting	**2 486**	1.23244	1.26658
Chemical Engineering	**3 496**	1.31061	1.34953
Chemistry	**6 001**	1.10208	1.31310
Computer Science	**17 394**	1.52118	1.88703
Decision Sciences	**1 853**	1.43313	1.73205
Dentistry	124	0.26836	0.24549
Earth and Planetary Sciences	**2 205**	0.53395	0.56467
Economics, Econometrics and Finance	**1 925**	1.04706	1.20136
Energy	**3 350**	1.19271	1.47005
Engineering	**17 615**	1.27365	1.45942
Environmental Science	**4 759**	1.14304	1.11069
Health Professions	676	0.96911	0.75771
Immunology and Microbiology	**2 410**	1.31509	1.01087
Materials Science	**7 819**	1.35980	1.54697
Mathematics	**9 558**	1.27874	1.77040
Medicine	**13 774**	0.79078	0.63568
Multidisciplinary	552	0.48121	0.44150
Neuroscience	585	0.26424	0.29778
Nursing	344	0.45542	0.41092
Pharmacology, Toxicology and Pharmaceutics	1 719	0.76112	0.77493
Physics and Astronomy	**8 149**	0.76863	1.06293
Psychology	267	0.15406	0.18360
Social Sciences	**2 442**	0.47974	0.40750
Undefined	1	0.32192	0.00000
Veterinary	410	0.80535	0.72693

Source: Own calculations, based on Scopus.

Annex 4. Innovation potential – data tables. WB Innovation Survey Data

Table 8. Industries with an innovation potential according to the World Bank Innovation Survey

NACE	Industry	Tunisia	Degree of Specialisation		Benchmark countries		Croatia	Cyprus	Greece	Italy	Malta	Portugal
			Weighted	Unweighted	Weighted	Unweighted						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
27	Basic metals	0.0	0.000	0.000	46.0	35.7	67.1	0.0	67.8	43.7	--	0.0
24	Chemicals	24.0	0.656	0.740	36.6	32.4	27.8	19.4	13.7	39.4	64.3	30.0
45	Construction	7.8	0.819	0.352	9.6	22.3	23.2	35.1	42.5	6.6	21.1	5.0
31-32	Electronics	81.4	1.864	1.341	43.7	60.8	100.0	--	50.0	45.3	100.0	8.5
28	Fabricated metal products	19.8	1.110	0.531	17.9	37.4	45.7	73.3	20.7	17.2	58.5	8.8
15	Food	18.9	0.659	0.382	28.7	49.6	69.6	70.1	36.5	22.9	65.7	32.6
36	Furniture	0.0	0.000	0.000	13.8	37.1	78.5	40.2	21.2	11.8	70.0	1.1
18	Garments	13.8	0.264	0.269	52.4	51.3	47.1	--	23.9	62.0	100.0	23.8
55	Hotel and restaurants	9.4	0.521	0.320	18.0	29.3	30.4	45.7	19.3	15.7	31.6	33.1
72	IT	20.1	0.558	0.349	36.1	57.6	55.8	100.0	12.5	35.8	44.6	97.1
19	Leather	43.2	2.503	1.064	17.2	40.6	100.0	--	--	18.1	--	3.7
29-30	Machinery and equipment	1.1	0.041	0.020	26.9	56.1	34.1	100.0	59.5	22.6	66.7	54.0
26	Non-metallic mineral products	12.0	1.931	0.279	6.2	43.1	13.2	78.8	60.0	0.0	77.4	29.1
21	Paper	81.8	1.154	1.236	70.9	66.2	100.0	--	92.8	100.0	37.5	0.8
25	Plastics & rubber	24.0	0.817	0.435	29.3	55.1	86.2	60.7	93.3	9.0	31.8	49.4
33	Precision instruments	--	--	--	30.7	29.6	40.0	--	--	30.1	0.0	48.1
22	Publishing, printing, and Recorded media	30.7	0.472	0.574	65.1	53.5	0.0	66.4	68.0	68.0	70.0	48.8
37	Recycling	0.0	--	--	0.0	0.0	0.0	--	--	--	0.0	0.0
23	Refined petroleum product	13.3	--	--	0.0	0.0	0.0	0.0	0.0	--	--	0.0
52	Retail	11.4	0.930	0.390	12.2	29.1	21.7	57.8	32.5	5.5	44.4	12.5
50	Services of motor vehicles	0.0	0.000	0.000	18.0	34.7	11.4	37.5	58.8	15.8	73.1	11.4
17	Textiles	35.8	12.267	1.893	2.9	18.9	26.7	--	42.1	0.0	--	6.8

NACE	Industry	Tunisia	Degree of Specialisation Weighted	Unweighted	Benchmark countries Weighted	Unweighted	Croatia	Cyprus	Greece	Italy	Malta	Portugal
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
16	Tobacco	--	--	--	0.0	0.0	--	--	0.0	0.0	--	--
34-35	Transport machines	0.0	0.000	0.000	2.7	30.9	80.0	--	0.0	0.0	--	43.7
60-64	Transport	0.0	0.000	0.000	4.1	28.8	31.3	44.6	0.0	1.3	71.2	24.5
51	Wholesale	18.4	1.413	0.516	13.0	35.6	43.5	47.2	40.3	4.5	65.9	11.9
20	Wood	23.5	0.695	0.853	33.8	27.5	82.2	29.4	1.4	36.7	0.0	15.3
	All industries	16.3	0.880	0.487	18.5	33.4	33.4	49.8	32.0	15.2	50.3	19.5

Source: Own calculations, based on World Bank (WB Enterprise Survey, WITS), UN Comtrade, WIPO, EUIPO.

Annex 5. Exports

Table 9. Critical mass and location quotients for value of exports per NACE Rev1 industries

NACE Rev. 1 / Industry name		%-share of total product exports								Degree of specialisation							
		2012	2013	2014	2015	2016	2017	2018	2019	2012	2013	2014	2015	2016	2017	2018	2019
11	Growing of crops; market gardening; horticulture	6.6%	6.8%	5.4%	10.6%	6.9%	7.0%	9.4%	7.4%	0.527	0.549	0.492	0.986	0.492	0.578	0.829	0.619
12	Farming of animals	0.5%	0.5%	0.5%	0.7%	0.6%	0.6%	0.5%	0.5%	0.202	0.222	0.228	0.368	0.315	0.265	0.230	0.270
20	Forestry, logging and related services activities	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.112	0.107	0.134	0.158	0.178	0.238	0.264	0.209
50	Fishing, operation of fish hatcheries and fish farms	0.3%	0.4%	0.4%	0.5%	0.4%	0.4%	0.5%	0.5%	0.266	0.441	0.442	0.371	0.287	0.292	0.446	0.344
101	Mining and agglomeration of hard coal	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000	0.031	0.004	0.000	0.000	0.006	0.000	0.001
102	Mining and agglomeration of lignite	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000	0.000	41.066	0.000	0.000	50.763	0.000	0.000
103	Extraction and agglomeration of peat	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.190	1.070	0.797	0.252	0.142	0.399	0.221	0.673
111	Extraction of crude petroleum and natural gas	12.4%	11.2%	9.6%	4.7%	4.4%	4.0%	3.6%	4.4%	57.342	27.352	49.150	34.854	43.876	44.649	48.264	20.985
120	Mining of uranium and thorium ores	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000							0.000
131	Mining of iron metals	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	119.838	770.961	137.938	1077.3	43.171	0.042	0.001	0.173
132	Mining of non-ferrous metal ores, except uranium and thorium ores	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000	0.012	0.000	0.001	0.004	0.017	0.009	0.099
141	Quarrying of stone	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.344	0.353	0.396	0.321	0.368	0.290	0.362	0.464

NACE Rev. 1 / Industry name		%-share of total product exports								Degree of specialisation							
		2012	2013	2014	2015	2016	2017	2018	2019	2012	2013	2014	2015	2016	2017	2018	2019
142	Quarrying of sand and clay	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.195	0.168	0.300	0.228	0.216	0.314	0.286	0.801
143	Mining of chemical and fertilizer minerals	0.1%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	6.648	1.079	4.687	6.320	5.323	5.083	5.326	6.268
144	Production of salt	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	2.904	2.487	2.805	2.933	3.208	3.552	4.670	5.332
145	Other mining and quarrying n.e.c.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.044	0.104	0.117	0.054	0.099	0.203	0.171	0.090
151	Meat products	0.2%	0.2%	0.2%	0.3%	0.4%	0.3%	0.3%	0.3%	0.092	0.092	0.122	0.206	0.250	0.183	0.195	0.213
152	Fish and fish products	1.0%	0.8%	0.9%	1.1%	0.9%	0.8%	0.3%	0.3%	0.841	0.556	0.684	1.036	1.065	0.652	0.234	0.283
153	Fruits and vegetables	1.2%	1.3%	1.1%	1.0%	1.3%	1.4%	1.2%	1.2%	0.487	0.505	0.469	0.399	0.517	0.523	0.479	0.463
154	Vegetable and animal oils and fats	3.4%	4.1%	2.7%	8.1%	3.9%	3.9%	6.2%	4.0%	3.523	3.735	3.069	6.808	3.386	3.561	5.428	4.589
155	Dairy products; ice cream	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.191	0.204	0.145	0.141	0.114	0.125	0.116	0.080
156	Grain mill products and starches	1.3%	0.4%	0.2%	0.3%	0.4%	0.5%	0.4%	0.2%	3.822	1.403	0.792	0.863	1.175	1.391	1.195	0.797
157	Prepared animal feeds	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.2%	0.1%	0.288	0.237	0.288	0.326	0.341	0.461	1.281	0.815
158	Other food products	1.9%	1.9%	1.9%	1.9%	2.2%	2.4%	2.3%	2.4%	0.551	0.540	0.543	0.535	0.661	0.687	0.660	0.687
159	Beverages	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.3%	0.204	0.203	0.230	0.268	0.271	0.241	0.197	0.224
160	Tobacco products	0.2%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.254	0.251	0.236	0.516	0.445	0.340	0.337	0.381
171	Textile fibres	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	1.945	1.631	1.723	1.601	1.668	1.426	1.532	2.037
172	Textile weaving	0.6%	0.6%	0.6%	0.7%	0.6%	0.5%	0.5%	0.4%	1.729	1.676	1.720	1.779	1.549	1.389	1.299	1.278
174	Made-up textile articles	1.4%	1.3%	1.4%	1.4%	1.5%	1.5%	1.3%	1.4%	4.715	4.350	4.098	4.468	4.894	4.990	4.219	4.738
175	Other textiles	0.4%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%	0.4%	0.838	0.824	0.822	0.758	0.724	0.701	0.708	0.818
176	Knitted and crocheted fabrics	0.1%	0.1%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.113	0.150	0.144	0.125	0.157	0.155	0.122	0.103
177	Knitted and crocheted articles	1.1%	1.0%	1.1%	0.9%	1.0%	1.0%	0.9%	0.8%	1.695	1.592	1.528	1.463	1.583	1.641	1.336	1.168
181	Leather clothes	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	1.793	1.298	1.546	1.433	1.340	1.804	1.452	2.991
182	Other wearing apparel and accessories	16.9%	17.0%	17.5%	15.3%	16.2%	16.6%	16.0%	15.5%	7.210	7.527	6.884	6.189	6.758	6.853	6.690	6.111
183	Dressing and dyeing of fur; articles of fur	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.022	0.012	0.014	0.011	0.004	0.001	0.000	0.000
191	Tanning and dressing of leather	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	1.443	0.935	0.958	0.773	0.860	0.839	0.674	0.470
192	Luggage, handbags, saddlery and harness	0.5%	0.5%	0.6%	0.6%	0.8%	1.1%	1.0%	0.7%	0.964	1.054	1.215	1.250	1.545	2.123	1.951	1.080
193	Footwear	3.3%	3.0%	3.1%	2.8%	3.0%	3.1%	3.1%	3.1%	2.278	2.072	2.117	1.959	2.080	1.971	2.007	1.976

NACE Rev. 1 / Industry name		%-share of total product exports								Degree of specialisation							
		2012	2013	2014	2015	2016	2017	2018	2019	2012	2013	2014	2015	2016	2017	2018	2019
201	Sawmilling, planing and impregnation of wood	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000	0.002	0.004	0.006	0.013	0.023	0.035	0.030
202	Panels and boards of wood	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.031	0.035	0.022	0.018	0.043	0.031	0.141	0.138
203	Builders' carpentry and joinery	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.163	0.150	0.154	0.119	0.219	0.075	0.060	0.100
204	Wooden containers	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.310	0.300	0.314	0.287	0.299	0.255	0.258	0.297
205	Other products of wood; articles of cork, etc.	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.327	0.347	0.370	0.408	0.479	0.458	0.465	0.511
211	Pulp, paper and paperboard	0.2%	0.2%	0.3%	0.4%	0.4%	0.5%	0.4%	0.3%	0.225	0.234	0.325	0.415	0.385	0.472	0.434	0.340
212	Articles of paper and paperboard	0.8%	1.1%	1.0%	1.0%	1.0%	0.9%	0.8%	0.9%	1.734	2.169	1.950	1.936	1.833	1.738	1.380	1.475
221	Publishing	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.157	0.083	0.080	0.120	0.084	0.080	0.058	0.107
222	Printing	0.2%	0.2%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.244	0.229	0.305	0.185	0.385	0.418	0.201	0.135
231	Coke oven products	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000	0.000	0.000	0.066	0.005	0.001	0.000	0.000
232	Refined petroleum and nuclear fuel	0.1%	0.1%	0.1%	0.3%	0.1%	0.1%	0.1%	0.0%	0.224	0.323	0.324	0.977	0.308	0.343	0.216	0.116
233	Nuclear fuel	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.560	0.717	0.165	0.151	0.061	0.206	0.280	0.406
241	Basic chemicals	7.8%	7.6%	7.5%	5.4%	6.3%	5.1%	4.7%	5.3%	1.924	1.936	2.077	1.528	2.234	1.571	1.471	1.453
242	Pesticides, other agro-chemical products	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.090	0.139	0.210	0.155	0.231	0.171	0.177	0.228
243	Paints, coatings, printing ink	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.467	0.502	0.451	0.435	0.417	0.489	0.401	0.584
244	Pharmaceuticals	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.5%	0.037	0.045	0.050	0.057	0.040	0.057	0.069	0.069
245	Detergents, cleaning and polishing, perfumes	0.6%	0.5%	0.5%	0.6%	0.6%	0.6%	0.6%	0.8%	0.621	0.550	0.540	0.684	0.708	0.597	0.663	0.710
246	Other chemical products	0.3%	0.4%	0.4%	0.3%	0.4%	0.4%	0.4%	0.3%	0.663	0.762	0.770	0.608	0.635	0.601	0.587	0.516
247	Man-made fibres	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.066	0.036	0.099	0.056	0.105	0.038	0.083	0.135
251	Rubber products	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.1%	0.257	0.233	0.254	0.232	0.205	0.148	0.122	0.134
252	Plastic products	2.2%	2.3%	2.4%	2.3%	2.7%	3.0%	3.0%	3.3%	0.993	1.002	1.060	0.946	1.171	1.158	1.186	1.225
261	Glass and glass products	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.394	0.493	0.549	0.528	0.597	0.647	0.693	0.702
262	Ceramic goods	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	1.031	1.008	0.907	0.895	0.900	0.975	0.902	0.814
263	Ceramic tiles and flags	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.762	0.585	0.409	0.386	0.479			
264	Bricks, tiles and construction products	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.044	1.720	0.618	0.193	0.191	0.497	0.326	0.274
265	Cement, lime and plaster	0.5%	0.7%	1.2%	1.3%	0.9%	0.6%	0.7%	0.8%	0.952	0.811	1.515	1.582	1.287	1.325	1.969	2.596

NACE Rev. 1 / Industry name		%-share of total product exports								Degree of specialisation							
		2012	2013	2014	2015	2016	2017	2018	2019	2012	2013	2014	2015	2016	2017	2018	2019
266	Articles of concrete, plaster and cement	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.669	0.637	0.520	0.334	0.327	0.245	0.186	0.356
267	Cutting, shaping, finishing of stone	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.203	0.223	0.181	0.122	0.103	0.094	0.095	0.149
268	Other non-metallic mineral products	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.069	0.107	0.186	0.257	0.336	0.293	0.197	0.231
271	Basic iron and steel, ferro-alloys (ECSC)	0.4%	0.3%	0.2%	0.1%	0.1%	0.2%	0.4%	0.9%	0.196	0.219	0.185	0.138	0.112	0.173	0.345	0.809
272	Tubes	0.4%	0.3%	0.4%	0.3%	0.3%	0.3%	0.3%	0.3%	0.582	0.532	0.647	0.387	0.479	0.353	0.193	0.328
273	Other first processing of iron and steel	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.052	0.031	0.019	0.019	0.061	0.054	0.066	0.148
274	Basic precious and non-ferrous metals	1.3%	1.2%	1.2%	0.9%	1.2%	1.3%	1.3%	1.0%	0.265	0.297	0.350	0.325	0.440	0.431	0.434	0.323
281	Structural metal products	0.5%	0.5%	0.5%	0.4%	0.5%	0.4%	0.6%	0.7%	0.773	0.781	0.719	0.606	0.747	0.622	0.835	1.012
282	Tanks, reservoirs, central heating radiators and boilers	0.1%	0.1%	0.1%	0.1%	0.3%	0.2%	0.2%	0.2%	0.696	0.776	0.683	0.633	1.723	0.945	1.101	1.104
283	Steam generators	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.414	0.254	0.445	0.253	0.224	0.171	0.313	0.461
286	Cutlery, tools and general hardware	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.459	0.466	0.461	0.417	0.472	0.473	0.406	0.418
287	Other fabricated metal products	1.5%	1.5%	1.7%	1.6%	1.8%	1.9%	1.9%	1.9%	1.189	1.114	1.295	1.200	1.421	1.353	1.357	1.529
291	Machinery for production, use of mech. power	0.6%	0.6%	0.6%	0.6%	0.8%	0.7%	0.7%	0.6%	0.396	0.389	0.377	0.353	0.510	0.429	0.447	0.450
292	Other general purpose machinery	0.8%	0.9%	1.0%	1.0%	1.0%	1.0%	0.9%	0.9%	0.461	0.467	0.507	0.562	0.562	0.521	0.496	0.485
293	Agricultural and forestry machinery	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.084	0.178	0.185	0.229	0.150	0.121	0.088	0.143
294	Machine-tools	0.1%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.104	0.083	0.081	0.091	0.127	0.121	0.083	0.124
295	Other special purpose machinery	0.8%	0.7%	1.0%	1.0%	1.8%	1.3%	1.0%	1.2%	0.350	0.330	0.460	0.483	0.888	0.528	0.419	0.493
296	Weapons and ammunition	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001
297	Domestic appliances n. e. c.	0.4%	0.3%	0.3%	0.3%	0.3%	0.4%	0.3%	0.3%	0.731	0.586	0.530	0.500	0.553	0.624	0.596	0.621
300	Office machinery and computers	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.619	0.532	0.360	0.221	0.181	0.138	0.237	0.162
311	Electric motors, generators and transformers	2.2%	2.2%	2.5%	2.4%	2.6%	2.5%	2.3%	2.4%	1.887	1.935	2.112	2.507	2.701	2.664	2.689	2.976
312	Electricity distribution and control apparatus	3.6%	4.1%	4.7%	4.7%	5.5%	6.0%	5.3%	5.5%	1.640	1.603	1.949	2.199	3.243	2.584	2.836	3.761
313	Isolated wire and cable	0.4%	0.5%	0.9%	0.8%	0.9%	0.8%	1.0%	1.4%	1.892	2.477	2.203	3.811	3.799	3.457	5.064	4.030
314	Accumulators, primary cells and primary batteries	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.2%	1.618	1.408	1.673	1.561	1.333	1.141	1.445	1.158
315	Lighting equipment and electric lamps	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.823	0.987	0.928	0.795	0.603	0.502	0.648	0.626
316	Electrical equipment n. e. c.	3.5%	3.4%	3.9%	3.8%	4.0%	4.1%	3.1%	3.7%	9.329	8.404	10.082	8.602	9.625	9.686	7.784	8.999

NACE Rev. 1 / Industry name		%-share of total product exports								Degree of specialisation							
		2012	2013	2014	2015	2016	2017	2018	2019	2012	2013	2014	2015	2016	2017	2018	2019
321	Electronic valves and tubes, other electronic comp.	0.9%	0.9%	1.0%	0.7%	0.7%	0.7%	0.8%	0.8%	0.953	0.395	0.373	0.360	0.552	1.118	1.308	1.077
322	TV, and radio transmitters, apparatus for line telephony	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	1.3%	1.3%	0.176	0.109	0.102	0.017	0.013	0.027	1.141	2.180
323	TV, radio and recording apparatus	3.7%	3.4%	2.9%	2.5%	3.3%	2.8%	1.6%	1.7%	5.386	6.533	5.801	4.486	6.080	6.090	3.194	3.528
331	Medical equipment	0.8%	1.0%	1.1%	1.1%	1.3%	1.5%	1.5%	1.8%	1.095	1.387	1.626	1.523	2.028	1.699	1.614	2.666
332	Instruments for measuring, checking, testing, navigating	1.5%	1.5%	1.8%	2.2%	2.4%	2.9%	2.8%	3.0%	1.889	1.867	2.189	2.607	3.208	2.995	2.720	2.754
334	Optical instruments and photographic equipment	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%	0.310	0.318	0.350	0.185	0.208	0.201	0.159	0.177
335	Watches and clocks	0.1%	0.1%	0.1%	0.2%	0.2%	0.3%	0.2%	0.2%	0.175	0.159	0.421	0.785	0.713	0.728	0.683	0.682
341	Motor vehicles	0.1%	0.2%	0.4%	0.2%	0.2%	0.3%	0.2%	0.3%	0.051	0.105	0.181	0.084	0.104	0.150	0.091	0.124
342	Bodies for motor vehicles, trailers	0.3%	0.4%	0.4%	0.2%	0.5%	0.4%	0.2%	0.3%	2.834	3.625	4.493	2.506	5.975	4.086	2.115	3.767
343	Parts and accessories for motor vehicles	2.2%	2.6%	3.0%	3.0%	3.7%	3.7%	3.6%	3.4%	1.361	1.540	1.796	1.693	2.046	1.835	1.735	1.633
351	Ships and boats	0.2%	0.3%	0.2%	0.2%	0.2%	0.3%	0.5%	0.5%	0.142	0.323	0.029	0.023	0.028	0.048	0.071	0.080
352	Railway locomotives and rolling stock	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.058	0.102	0.139	0.279	0.258	0.092	0.170	0.242
353	Aircraft and spacecraft	1.7%	2.2%	2.7%	2.1%	2.3%	2.6%	2.7%	3.3%	0.710	0.781	2.334	0.976	1.895	1.281	1.416	1.781
354	Motorcycles and bicycles	0.3%	0.2%	0.3%	0.3%	0.4%	0.3%	0.3%	0.3%	1.473	1.419	1.660	1.641	1.688	1.660	1.244	1.344
355	Other transport equipment n. e. c.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.396	0.465	0.284	0.434	0.332	0.933	0.603	0.665
361	Furniture	0.2%	0.2%	0.2%	0.9%	1.2%	1.1%	1.2%	1.3%	0.139	0.128	0.120	0.597	0.862	0.800	0.993	1.069
362	Jewellery and related articles	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.230	0.106	0.008	0.013	0.029	0.007	0.029	0.025
363	Musical instruments	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	1.590	2.508	3.962	3.515	3.141	4.615	5.330	3.408
364	Sports goods	0.1%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	2.565	3.312	3.279	2.780	2.627	1.962	1.640	1.630
365	Games and toys	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.0%	0.0%	3.640	5.432	4.528	4.125	2.715	7.313	0.338	1.005
366	Miscellaneous manufacturing n. e. c.	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	2.014	1.921	2.148	2.528	2.438	2.412	2.324	2.127
401	Production and distribution of electricity	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
402	Manufacture of gas; distribution of gaseous fuels through mains	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000	0.000	17.605	0.000	0.000	0.000	0.000	0.033
722	Software consultancy and supply	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%								
742	Architectural and engineering activities and related technical consultancy	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.026	0.021	0.000	0.000	0.065	0.000	0.010	0.391

NACE Rev. 1 / Industry name		%-share of total product exports								Degree of specialisation							
		2012	2013	2014	2015	2016	2017	2018	2019	2012	2013	2014	2015	2016	2017	2018	2019
748	Miscellaneous business activities n.e.c.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000	0.062	0.000	0.472	0.188	0.000	0.000	0.000
921	Motion picture and video activities	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.000	0.000	7.809	0.000	0.000	0.000	0.000	0.000
923	Other entertainment activities	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.030	0.019	0.000	0.000	0.003	0.000	0.000	0.000
930	Other service activities	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	2635.6	453.312	5650.0	20500.8	8876.1	12752.8	522.0	0.000

Source: Own calculations, based on World Bank data.

Annex 6. Patents – fields of technology

Table 10. Location Quotients for WIPO Fields of Technology

Field of technology	TN output	Location Quotient	
		2010-2014	2015-2019
01 - Electrical machinery, apparatus, energy	1	0.41527	0.00000
02 - Audio-visual technology	0		
03 - Telecommunications	**6**	4.10749	6.30921
04 - Digital communication	**3**	1.13971	2.56155
05 - Basic communication processes	1	3.23265	0.00000
06 - Computer technology	**11**	4.34910	4.97640
07 - IT methods for management	2	0.00000	17.69656
08 - Semiconductors	0		
09 - Optics	0		
10 - Measurement	2	0.59663	0.52311
11 - Analysis of biological materials	0		
12 - Control	1	1.23838	0.00000
13 - Medical technology	**7**	0.85479	1.68813
14 - Organic fine chemistry	**4**	1.72318	0.00000
15 - Biotechnology	1	1.03628	0.00000
16 - Pharmaceuticals	**25**	2.00691	5.55511
17 - Macromolecular chemistry, polymers	0		
18 - Food chemistry	**8**	4.34152	6.48399
19 - Basic materials chemistry	2	0.00000	2.57747
20 - Materials, metallurgy	1	1.46248	0.00000
21 - Surface technology, coating	2	1.17191	0.98581
22 - Micro-structural and nano-technology	0		
23 - Chemical engineering	0		
24 - Environmental technology	0		
25 - Handling	2	0.25966	0.27023
26 - Machine tools	1	0.50613	0.00000
27 - Engines, pumps, turbines	2	1.13194	0.00000
28 - Textile and paper machines	**3**	0.73513	1.62227
29 - Other special machines	**3**	0.66626	0.33873
30 - Thermal processes and apparatus	1	0.90580	0.00000
31 - Mechanical elements	2	0.45993	0.42617
32 - Transport	1	0.00000	0.32868

Field of technology	TN output	Location Quotient	
		2010-2014	2015-2019
33 - Furniture, games	1	0.48979	0.00000
34 - Other consumer goods	**3**	1.56091	0.00000
35 - Civil engineering	**3**	0.68951	0.34575
Unknown	**3**	14.87532	0.00000

Source: Own calculations, based on WIPO data.

Annex 7. PCT patents – IPC classes and NACE v2 industries

Table 11. Location Quotients for IPC Class counts in PCT patents (only non-zero entries listed)

IPC Class	Location Quotient		TN Output	NACE rev2
	2010-2014	2015-2019		
A61K	3.876985	0.835476	**10**	20.4
A01G	27.89192	11.35412	**5**	28.3
A23L	18.31288	0	**5**	10.0
A61B	0	4.435202	**4**	32.5
A61P	2.575249	0.73537	**4**	21.0
C05B	0	340.6235	**3**	20.1
F03B	15.90329	11.58583	**3**	28.1
G06Q	3.873878	4.400821	**3**	62.0
A01B	35.54853	13.84648	2	28.3
A41D	0	11.2417	2	
A61C	0	9.622134	2	
C05C	0	567.7059	2	
F03D	6.230155	9.622134	2	
G06F	5.301096	0	2	
A01M	0	10.51307	1	
A21C	23.24327	0	1	
A23D	46.48654	0	1	
A23P	50.36042	0	1	
A41B	0	22.70824	1	
A47G	0	10.51307	1	
A61F	2.280472	0	1	
A61M	2.59367	0	1	

IPC Class	Location Quotient		TN Output	NACE rev2
	2010-2014	2015-2019		
A61Q	0	4.268465	1	
B01D	0	2.217601	1	
B42D	16.33311	0	1	
B60J	0	29.87926	1	
B64D	0	16.22017	1	
B65D	1.194318	0	1	
C01B	0	8.348616	1	
C02F	0	4.333633	1	
C03C	26.275	0	1	
C04B	0	5.734403	1	
C07K	0	2.956801	1	
C09K	0	9.622134	1	
C10B	0	25.80481	1	
C10L	0	17.74081	1	
C10M	0	28.38529	1	
C12P	8.758333	0	1	
D01D	60.4325	0	1	
D01F	40.28833	0	1	
E02B	21.58304	0	1	
E03D	27.46932	0	1	
E04B	0	3.615961	1	
E04G	0	12.07885	1	
F01B	0	43.66968	1	
F02B	0	13.20246	1	

IPC Class	Location Quotient		TN Output	NACE rev2
	2010-2014	2015-2019		
F16K	4.648654	0	1	
F17C	0	16.22017	1	
F41H	0	19.57606	1	
G01D	0	13.51681	1	
G01R	0	5.734403	1	
G01V	0	17.20321	1	
G09F	0	14.19265	1	
H04M	0	11.13149	1	
H04N	0	6.104364	1	
H04W	0	3.784706	1	

Source: Own calculations, based on WIPO data.

Annex 8. Trademarks

Table 12. Location Quotients for Nice Class counts in EUIPO trademark registrations

Nice Class	NACEv2 Sector(s)	TN output	Location Quotient	
			2010-2014	2015-2019
Class 01		1	0.25893	0.00000
Class 02		1	0.66100	0.00000
Class 03	**20.4; 23.9**	**28**	1.27629	2.18172
Class 04		2	1.24469	0.00000
Class 05	**10.8; 20.2; 21.1; 21.2**	**13**	0.96771	0.74978
Class 06		4	0.40368	0.92041
Class 07		5	0.26714	0.79645
Class 08		4	0.92843	1.21034
Class 09	**25.7; 26.x; 27.2-3; 27.9; 29.3**	**18**	0.39833	0.76697
Class 10		5	0.78782	0.96101
Class 11		5	0.23409	0.77961
Class 12		7	0.78503	1.19168
Class 13		1	2.72875	0.00000
Class 14		9	0.90051	0.64213
Class 15		1	2.20562	0.00000
Class 16	**17.2; 22.1-2; 28.2; 32.9**	**13**	0.76356	0.60924
Class 17		1	0.31910	0.00000
Class 18		8	0.41355	0.30512
Class 19		3	0.76700	0.00000
Class 20		11	1.11218	0.73055
Class 21		8	1.03657	0.58409
Class 22		6	3.65395	3.72051
Class 23		4	6.70370	0.00000
Class 24	**13.2; 13.3; 13.9; 16.2; 22.1; 32.9**	**18**	2.89705	0.86858
Class 25	**01.1; 10.1; 10.3; 10.4; 10.5; 10.8**	**22**	0.46891	1.03425
Class 26		5	3.49495	0.00000
Class 27		5	2.87625	1.75228
Class 28		6	0.61228	0.56323
Class 29	**01.1; 10.1; 10.3; 10.4; 10.5; 10.8**	**56**	3.01660	3.61034
Class 30	**01.1; 01.2; 10.6-8**	**50**	2.18339	3.05972
Class 31		12	2.82534	0.00000

Nice Class	NACEv2 Sector(s)	TN output	Location Quotient	
			2010-2014	2015-2019
Class 32	**10.3; 11.0**	**27**	3.58678	1.64995
Class 33	**11.0**	**26**	2.64664	0.19076
Class 34		1	0.94178	0.00000
Class 35		**21**	0.41069	0.75852
Class 36		8	0.90507	0.56010
Class 37		7	0.58193	0.89620
Class 38	**61; 63.9**	**15**	1.40238	1.13038
Class 39		7	0.59260	1.42067
Class 40		2	0.30363	0.52205
Class 41		**19**	0.58570	0.95335
Class 42		**17**	0.51411	1.03647
Class 43		7	0.36249	0.74345
Class 44		4	0.70439	0.37363
Class 45		3	0.32948	1.13738
Other		0	0.00000	0.00000

Source: Own calculations, based on WIPO and EUIPO data.

Science for policy

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