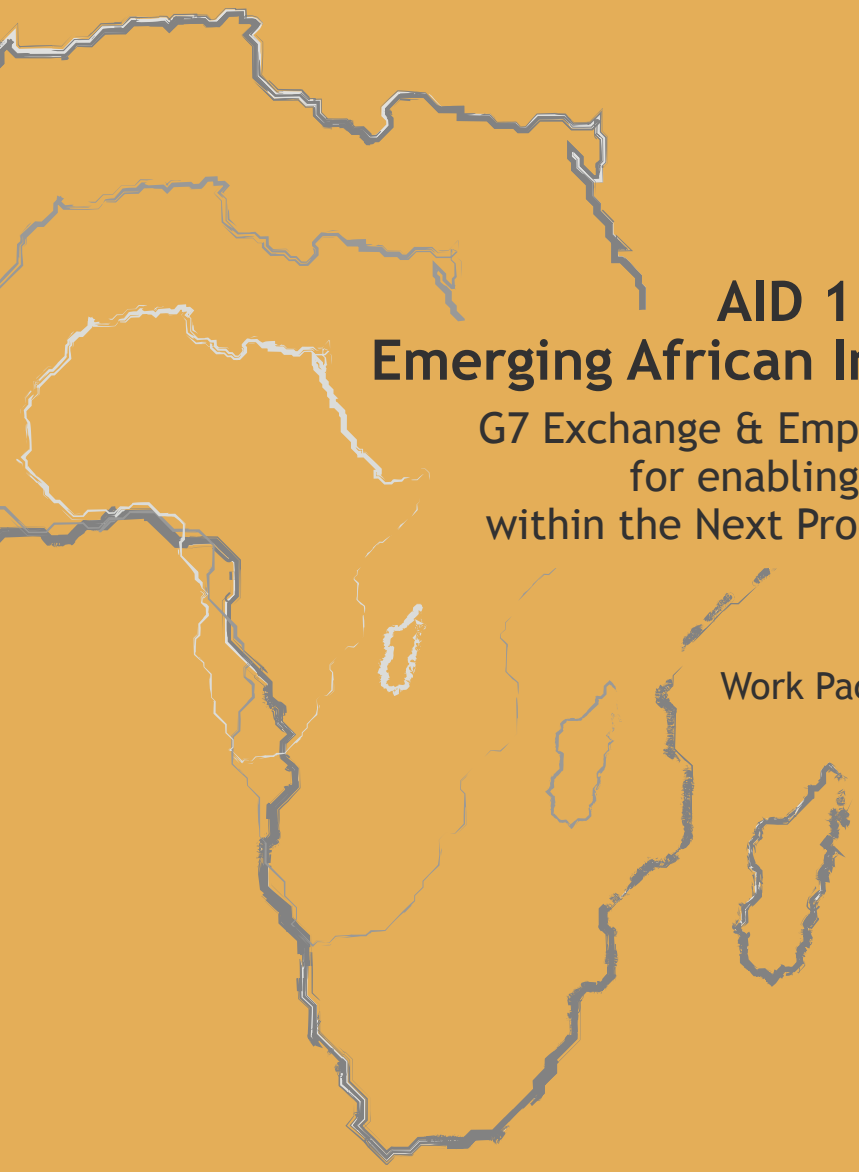
AFRICA
INNOVATION LEADERS

COUNTRY OVERVIEW
MOZAMBIQUE

An Introduction to the Country Economy and the National Innovation System



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Emerging African Innovation Leaders

G7 Exchange & Empowerment Program
for enabling Innovation
within the Next Production Revolution

Work Package 1

POLITECNICO MILANO 1863
POLITECNICO DI TORINO
AGENZIA ITALIANA PER LA COOPERAZIONE ALLO SVILUPPO
in collaboration with
POLITECNICO DI MILANO GRADUATE SCHOOL OF BUSINESS

COUNTRY OVERVIEW: MOZAMBIQUE
An Introduction to the Country Economy and the National Innovation System

This report describes Mozambique's National Innovation System (NIS) under the lens of the Next Production Revolution (NPR). After summarizing the main characteristics of the country's economy, it introduces the NIS players and institutions that are considered to sustain the diffusion of NPR technologies and business models across the main domestic industries. The report is primarily aimed at introducing all the members of the Emerging African Innovation Leaders project, including trainers and mentors, to the country's economy, its potential for the NPR technologies and the NIS components that can foster the embracement of the NPR in Mozambique. The report content may also be of interest to local and international policymakers, enterprises and civil sector organizations that are working toward the NPR adoption in the country.

The document was produced by Fabio Lamperti between April and August 2018 as a researcher of Politecnico di Milano, School of Management. The report is part of a serie of six Country Overviews, which were designed and reviewed by the "Emerging African Innovation Leaders" research team composed by Emanuela Colombo, Paola Garrone, Andrea Gumina, Fabio Lamperti, Boris Mrkajic, Felipe Repetto, Nicolo' Stevanato and Stefano Pistolese from Politecnico di Milano, and Pierluigi Leone and Leonardo Rosciarelli from Politecnico di Torino.

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Graphic design: Silvia Isaia

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Executive Summary

This report describes Mozambique's National Innovation System (NIS) under the lens of the Next Production Revolution (NPR). After summarizing the main characteristics of the country's economy, it introduces the NIS players and institutions that are considered to sustain the diffusion of NPR technologies and business models across the main domestic industries. The report is primarily aimed at introducing all the members of the Emerging African Innovation Leaders project, including trainers and mentors, to the country's economy, its potential for the NPR technologies and the NIS components that can foster the embracement of the NPR in Mozambique. The report content may also be of interest to local and international policymakers, enterprises and civil sector organizations that are working toward the NPR adoption in the country.

The first Section of the report describes the country focusing on several important aspects (e.g. geography, politics, economy, industry structure, etc.) with the aim of providing an insight of the local situation and to critically understand the starting point for the spreading of the NPR. Even if Mozambique has not fully recovered from the long civil war started shortly after the end of the Portuguese government and from the recent financial crisis that heavily hit the country, slowing down the economic growth, it still possesses a huge potential for economic development. The population, mainly concentrated in rural areas, still experiences wide disparities in living standards related with geographical location, economic conditions (almost 70% of population lives in poverty), access to basic services and political freedom. These barriers play a role in preventing the country from moving on from the factor-driven stage of economic development: in fact, Mozambique's economy is heavily focused on agriculture and natural resources endowments' exploitation. Coherently, the most relevant sectors are represented by the agri-food production, mining/extraction of a wide array of minerals, metals and fossil fuels, and ancillary or correlated industries such as fabrication of basic metals (e.g. the Mozal Smelter Project). Nonetheless, the strategic position of the country holds potential to develop a local logistic hub to serve the SubSaharan region as well as the Indian ocean. Another promising source of economic development resides in the energy production from renewable sources: Mozambique holds the highest potential in terms of power generation capacity from renewables in the whole Sub-Saharan region. Overall, the degree of development along the three dimensions of Energy, Mobility and Digitalization remains low and

affected by several barriers.

Section 2 present a synthetic insight of the Mozambican NIS, critically analysing the major categories of actors, their actions and readiness towards the embracement of the NPR, and the existing linkages and interactions between them. Depicting an accurate picture of the firms' ecosystem in the country represent a major challenge due to the scarce availability of data. Furthermore, the extreme predominance of the informal economy adds another barrier (almost 90% of employed people carry out informal economic activities; the informal economy contributes for more than 60% of GDP). The vast majority of registered firms are micro-businesses, facing challenges in terms of credit accessibility, innovation attitude, long-term strategic vision, compliance to international standards. However, the peculiar situation of Mozambique made it still possible to develop examples of entrepreneurship: digital-based start-ups find space to operate even within the informal economy (e.g. Biscate). At the same time, policymakers seem not to prioritise specific industrial policies aimed at developing key sectors for the country. The government capability to provide such development instruments is mainly weakened by the strong political dominance of the leading party and widespread corruption. Manufacturing development through Industrial Parks, as seen in other African countries, is still at a very early stage, not bringing to consistent results. Government's incentives are not really addressing local firms, but rather offering international investors cheap access to the country's natural resources. Regarding Higher Education Institutions (HEIs), the educational reforms addressing science and engineering instruction and TVET (fundamental for the successful diffusion of the NPR) lack the clear strategic vision shown by other African peers. As a matter of fact, from 2010 on, research activity and employment in STEM fields have dropped heavily.

Overall, the NIS is highly fragmented and needs time, attention and competencies to reach concrete results.

Finally, Section 3 has two distinct aims: first, it sums up the major findings around the NIS, exploring few key actors of the NIS, highlighting their degree of involvement, actions and potential to foster the diffusion of the NPR in Mozambique. Second, it presents the line of thought and a preliminary version of a "Canvas" ideated to sum up the major findings on the industry structure, the NPR-related potential and the specific learning needs of the country. In particular, relative to the first part, the Ministry of Science and Technology, Higher and Technical Vocational Education has been selected as first key actor for its involvement in the economic and social development of the country. Then, the Engineering Faculty of Eduardo Mondlane University, Mozambique Chamber of Commerce and ideiaLab incubator/accelerator have been selected for their roles in various fields of action within the NIS. To conclude, concerning the second part of Section 3, after a critical assessment five key sectors have been identified and cross-analysed with the three NPR-enabling transformation fields of Energy, Mobility and Digitalization. Few example of actions have been proposed, along with a pool of Italian investors operating at these intersections, leaving a full and comprehensive evaluation and Canvas formulation to the AIL project participants.

1.

Country overview

Figure 1.1 - Map of Mozambique

This first Section of the report presents a synthetic but comprehensive overview of Mozambique in terms of social, political, economic and infrastructural aspects. The aim is to provide the necessary information to support the definition and the analysis of the potential scenarios deriving from the diffusion of the Next Production Revolution (NPR).

1.1 Recent history

Mozambique is a **Presidential Republic** located in the South-East of Africa. After 10 years of sporadic warfare, contemporary to Portugal's own return to democracy, the country reached **independence** from Portugal in 1975. Between 1977 and 1992, Mozambique was plagued by a long and violent **civil war** in which the opposition forces of anti-Communist Mozambican National Resistance (RENAMO) and the Front for the Liberation of Mozambique (FRELIMO) regime contended the lead of the country. In 1994, the country had its **first elections**. These were won by FRELIMO, which has remained in power ever since, with RENAMO at the opposition.

Mozambique is a member of the Commonwealth of Nations, and a founding member of the Community of Portuguese Language Countries (CPLP), and maintains close ties with other Portuguese-speaking countries.

1.2 Geography

The country has a **total surface** of about 0.8M km^2, and half of its borders consist of a coastline that is 2,470 km long. **Water surface** corresponds to about 1.6% of the total. **Land surface** is made up of agricultural land for 63.5%, but just the 7.2% of that is arable; forests accounts for about 48.3%. Mozambique is **bordered** by Swaziland to the south, South Africa to the south-west, Zimbabwe to the west, Zambia and Malawi to the northwest, and Tanzania to the north. **Natural hazards** mainly consist of severe droughts, harmful cyclones and floods, such as the one that hit and devastated the country in 2000. Current **environmental issues** include increased migration of the population to urban and coastal areas with adverse environmental consequences, desertification, pollution of surface and coastal waters, and elephant poaching for ivory. Mozambican **climate conditions** are tropical, with two seasons: a wet season from October to March and a dry season from April to September.

1.3 Demography

As of 2016, Mozambique's **population** was about 28.8M people, and the country has experienced an average annual growth rate of 2.9% over the period 2000–2016. However, the growth rate is in decline. Population is

almost all dispersed in rural areas**:** **urban population** currently accounts for 32.5% of the total, increasing by 3.8% during 2016. Latest available data show that **life expectancy** in the country is low, at 57.6 years, but rapidly rising. In fact, Mozambicans are extremely young: the share of population between the ages 0 to 14 is about 45%, whereas the share of population aged 65+ is just 3.1%. As a matter of fact, **fertility rate** is about 5.3 births/woman, declining, but nonetheless well far beyond developed countries standards. Due to the important challenges (war, political instability and economic hardship) that Mozambique experienced in the past decades, **migration** is not a new phenomenon to the country. Due to the relatively higher instability of the country with respects of its neighbours in the region, Mozambique has been mainly a source country for migrants. However, in recent years, migration was mainly due to economic reasons, so Mozambicans looking for better living conditions were mainly ahead to the neighbour South Africa. In fact, as of 2013, South Africa accounted for about 60% of the whole emigrant population (766,928 people between migrants transiting by the country or directly coming from Mozambique). So, just about 9.5% of migrants had Europe as final destination (in particular Portugal, mainly due to the language and ex-colony ties).

Population is distributed in three large **clusters**: the first, along the southern coast around the capital; the second, in the central area along the Zambezi River; and the third, in and around the northern cities located near the coast. The northwest and southwest are the least populated areas. The capital, **Maputo** (UTC +2), has a population of around 1.2M people, and around 2.7M people in the metropolitan (statistical) area. There are several **ethnic groups** in Mozambique, clustered in different areas of the country. Christians represent more than 60% of the population. The official **national language** is Portuguese.

1.4 Living standards

The Mozambican economy is showing some signs of recovery after a difficult 2016, which saw a sharp slowdown in growth. Living conditions had been improving continuously from 2000 on, until this process slowed down and even stagnating since 2013. The result has been increasing inequality and a markedly uneven distribution of poverty, left concentrated in rural areas and among illiterate female-headed households. Access to improved **water sources** as of 2015 was fairly good (51.1% of the

Access to water

as of 2015 was fairly good

51.1%

of the population

80.6%

in urban areas

Sanitation facilities

20.5%

Access to sanitation facilities is low with great disparities between **urban 42.4%** and **rural 10.1%** areas

Food availability

25%

of malnutrition

Chronic food insecurity among the population now sits at **24%** (down from 61% in late '90s)

Population

28.8 M

As of 2016, Mozambique's population was about 28.8M people

Average annual growth rate

2.9%

The country has experienced an average annual growth rate of 2.9% over the period 2000–2016

Urban population

32.5%

of the total increasing by **3.8%** during 2016

Life expectancy

57.6 years

in the country is low, but rapidly rising.

Average Age

45%

the share of population between the ages 0 to 14

3.1%

whereas the share of population aged 65+

population, 80.6% in urban areas). Access to **sanitation facilities** was extremely poor, at 20.5% with great disparities between urban (42.4%) and rural (10.1%) areas. As of 2015, **food shortages** were decreasing, with malnutrition at 25% (down from 56% in the early '90s). Chronic food insecurity among the population now sits at 24% (down from 61 % in late '90s). Mozambique's low living standards are confirmed by UN's Human Development Report (HDR) indicators, focusing on how human development can be ensured for everyone, now and in future, exploring progresses on many fronts. The country is among the least developed countries in **human development**, ranking 181st/188 and lagging behind in inequality issues, gender development and inequality, and multidimensional poverty.

1.5 Politics

The current Constitution of Mozambique was adopted in 1990, and revised two times, in 2004 and 2007. Yet beneath strong economic growth and political progress marked by five consecutive multiparty elections, problems such as poverty, inequality, corruption and **political violence** persist. Most worryingly, economic prosperity has been undermined since the return of political instability and violence in 2012. That year, renewed tensions between RENAMO and the ruling FRELIMO parties called into question the political progress made since 1992, worrying investors and tarnishing the country's image as a post-war success story. From 2013 onwards, there has been a climate of constant political instability due to RENAMO's hostilities and refusal of electoral results. Peace talks have gathered momentum in 2017, with next elections scheduled for 2019. In fact, Mozambique political issues are not strictly related to **political freedom**, but with tensions between political forces.

The recent political situation is reflected also by poor performance in the Worldwide Governance Indicators (WGI). The overall good performance Mozambique had up to 2012 steeply declined in subsequent years. Aspects such as freedom of expression and association, and regulatory quality remain relatively high. However, absence of violence and corruption are among the worst worldwide.

1.6 Economy

Mozambique has a **GDP** of about 32.5B at PPP constant 2011 international $, and the country is rapidly recovering from the growth stop of 2016. First quarter GDP growth in 2017 picked up to 2.9%, doubling performances of the preceding quarter. **GDP per capita** was 1,128.3 PPP constant 2011 international $,

showing an annual growth rate of about 7% until 2015 and sharply decreasing to about 3.7% from 2016 on. Mozambican metical, the national currency, had been constantly depreciating for most of 2016. The **currency** is now more stable, having strengthened by 28% against the US$ during 2017. A strong monetary policy was key to this shift, which also helped **inflation** to slowly begin stabilizing, but remaining very high at 18%, with direct implications for Mozambican households. **Unemployment**, as a share of total labor force, reached 24.5% in 2017, still high and stagnating over the last decade mainly because of the recent economic crisis. In 2016, about 69% of total population lived with less than $1.90/day (PPP constant 2011 international $), under the **poverty line**.

Mozambican **economy competitiveness**, as measured in the Global Competitiveness Report 2017– 2018 is extremely poor, including social, institutional and economic measures, as well as efficiency and innovation factors.

The country ranks 136th/137, especially lagging behind in macroeconomic environment performances and higher education. Mozambique remains in the **factor-driven stage** of economic development, heavily relying on agriculture and natural resources endowments. However, the country has received growing international attention since 2010, with inward **FDIs** peaking at $6.7B in 2013. However, these large investments had almost no impact on the improvement of Mozambicans' living conditions, since they had limited links to the rest of the economy. Most problematic factors in **doing business** are related to contract enforcement issues, electricity outages and access to financing.

As regards trade statistics, as of 2016, Mozambique had a negative **trade balance** of $2.9B. **Exports** of goods and services as a share of GDP have been quite unstable, fluctuating by about 3% year-onyear, reaching 34.8% in 2016. Mozambique's top **export destinations** are South Africa ($1.09B), the Netherlands ($998M), India ($628M). Exports, at 4-digits aggregation level, are led by Raw Aluminium (19.3% of the total exports), followed by Aluminium Bars (15%), and Electricity (7.4%). On the other hand, the top **import origins** are South Africa ($2.37B), China ($1.05B), the Netherlands ($554M) and imports at 4-digits aggregation level consist mainly of Refined Petroleum (9.2%), Raw Aluminium (5%), and Packaged Medicaments (3.1%). As import/export data show, ties with the neighbour country of South Africa are very strong. Among **G7 member countries**, Mozambique has notable economic ties with Italy and

GDP
of about
32.5B at PPP constant 2011 international $, and the country is rapidly recovering from the growth stop of 2016

Unemployment 24.5%
in 2017,
still high and stagnating over the last decade mainly because of the recent economic crisis.

economy competitiveness 136th/137
The country ranks low in the Global Competitiveness Report 2017– 2018 lagging behind in macroeconomic environment performances and higher education.

Trade balance

$2.9B

Exports

3% year on-year reaching **34.8%** in 2016

Export destinations

$1.09B

South Africa

$998M

Netherlands

$628M

India

Exports

at 4-digits aggregation level

Raw Aluminium

19.3% of the total exports

Aluminium Bars 15%

Electricity 7.4%

Import origins

$2.37B

South Africa

$1.05B

China

$554M

Netherlands

Imports

at 4-digits aggregation

Refined Petroleum 9.2%

Raw Aluminium 5%

Packaged Medicaments 3.1%

Germany (6.6% and 2.5% of exports, respectively). Minor ties exist with France, Japan, United States and the United Kingdom.

The country is signatory of bilateral **trade agreements** with the United Sates, the EU, Malawi and Zambia. Mozambique is also member of the Southern African Development Community (SADC), which is working on the elimination of trade tariffs among the 15 member countries. About 34.8% of imported goods face no duty, the maximum rate is 20%, and the weighted duty average is 4.2%.

1.7 Industry structure

All economic sectors, from agriculture and manufacturing to services, declined sharply after Mozambique's independence from Portugal. However, they started a strong recovery in the 2000s after the end of the civil war, although there is still a huge growth potential.

As of 2016, **agriculture** accounts for 24.8% of GDP, 25% of exports, and 71% of total employment. The sector has a declining annual growth rate of about 2.6%. Mozambique has experienced a boost in the **industrial sector** between 2013 and 2015: the sector share of GDP raised from 18.7% to 21.6%, with an annual growth rate peaking at 12.4% in 2015, and sector employment at 4.1% of total employment. In particular, the **manufacturing** share of GDP increased accounts for about 10%, with exports of manufactured goods reaching 7% of total exports in 2016. **Exports of high-tech products** as a share of exports of manufactured goods have not been stable, fluctuating widely across years and settling at 11.6%. Relatively to both domestic and inter-regional trade, factors such as competition from foreign imports, unreliable electricity and a costly and bureaucratic business environment are contributors to the sector's underperformances, even if Mozambique has good transport linkages to neighbouring countries. Finally, Mozambican **service** sector, the related share of GDP has remained constant over the period 2012–2016, at about 53.6%, although the sector has experienced a declining annual growth rate and a stagnant employment at 21%. As of today, Mozambique's **extractive industry** of oil, gas, and mineral resources is among the key drivers of the country's growth. There are large deposits, but exploration has been constrained by the civil war and poor infrastructures. In 2005, the World Bank (WB) has estimated that there was the potential for exports worth $200M; now the sector exports account for 63% of total exports. In fact, apart from aluminium (raw and semi-processed), other **key strategic products** exported mainly consist of minerals, especially rare ones: marble, bentonite, gold, bauxite, titanium and gemstones. However,

going in depth in the analysis of the industrial structure of the country, it is evident that the vast majority of the value added in the industrial, service and extractive sectors is created through FDIs. MNEs then export most of these sectors' output. So, it is clear that the concrete participation of local businesses and the real benefit for Mozambican economy coming from these industries is extremely limited. In fact, the economy is strongly based on import-export businesses, and most of goods consumed internally comes from neighbour countries such as South Africa.

Like almost all low-income countries, tracking the **informal economy** is extremely complex. According to the International Labor Organization (ILO), the percentage of informal economy in the continent ranges between 45% and 90%. Mozambique is also among the countries with the highest rate of employment in the informal economy, with just the 10% of workers across different sectors of activity having a formal job, paying taxes and having a bank account. Informal economy is estimated to contribute for more than 60% to Mozambique's GDP. In particular, illegal exports from artisanal mineral production are estimated at $50M.

Labour productivity is among the lowest worldwide; GDP per person employed has experienced a strong growth, reaching about 3,440 PPP constant 2011 international $ in 2015, remaining constant in years after.

1.8 Natural resources

Most important **natural resource** endowments of Mozambique are represented by coal, titanium, natural gas, tantalum, graphite, and hydropower. As presented in the industry overview, the extractive sector represents the most important growth engine in the country; **natural resources rent** as a share of GDP has increased by about 35% during the period 2011–2015, going from 9.7% to 13.1%. Mozambique's discovery of **gas reserves** of 100T feet^3 have created excitement over the potential economic benefits from these resource; however, revenue management and environmental impact associated to resource exploitation have not been efficient so far.

A more attractive way of exploiting Mozambique's resources, creating wealth and improving living standards is connected to **renewables**. According to a study conducted by the Government of Mozambique and the Mozambique Energy Fund Institute (FUNAE) between 2011 and 2013, the country has a total renewable **potential** of about 50 GW. Solar potential is the most abundant resource at 23 GW, followed by hydro (19 GW), wind (5 GW), biomass (2 GW), and geothermal (0.1 GW). In fact, Mozambique

Natural resources

rent as a share of GDP has increased by about

35%

during the period 2011–2015, going from **9.7% to 13.1%**

Total renewable potential

50 GW

Solar potential is the most abundant resource at

23 GW

followed by
hydro 19 GW
wind 5 GW
biomass 2 GW
geothermal 0.1 GW

Logistics Performance Index (LPI)

84th/160

Mozambique is over-performing several more developed African peers in international shipment performances

has the largest power generation potential of all Southern African countries.

1.9 Smart and integrated infrastructures

Quality infrastructures are a key enabler to pave the way for the developing of Mozambican economy, hence it is crucial to assess the readiness, quality, and actual performances. When looking at different indexes measuring infrastructural and logistic readiness, the situation is however contrasting. The Logistics Performance Index (LPI) by the WB, commonly used as a benchmark for countries to assess challenges and opportunities on trade logistics, highlight relatively good performances. Mozambique ranks 84th/160, over-performing several more developed African peers in international shipment performances (mainly due to Mozambique's natural easiness of access through maritime freight) and timeliness. However, looking at the Africa Infrastructure Development Index (AIDI) from the African Development Bank (AfDB), the country ranks at the top of the bottom 10% among African countries. Finally, even if according to the consultancy firm Ernst & Young, in 2016, Mozambique was the continent's 3rd FDI destination for investments in logistics and infrastructure, data gathered suggest that the situation should be carefully evaluated in order to have a more realistic view.

Access to electricity
34%
with huge disparities between urban (56.7%) and rural (6%) areas

Envirnomental Sustainability
by the World EconomicForum (WEF)
0.9/1
Mozambique shows great performances in environmental sustainability

1.9.1 Energy

Energy provision is a key factor enabling the fast spread and development of a competitive industrial apparatus aiming to leverage on the Next Production Revolution (NPR). Despite Mozambique's huge generation capacity potential, only 34% of the population has **access to electricity**, with huge disparities between urban (56.7%) and rural (6%) areas. In fact, despite ranking low in 2017's Energy Architecture Performance Index by the World Economic Forum (WEF), Mozambique shows great performances in **environmental sustainability** (0.9/1 score), driven by the country's extensive generation and utilisation of renewable resources. For example, as regards to **solar** power generation, the provinces of Maputo and Tete have the highest potential for grid-connected projects, essentially due to the relatively favourable grid infrastructure. The Government's renewable strategy also includes targets for the installation of 100,000 solar water heaters and 5,000 solar refrigerators up to 2025. Moreover, Mozambique is one of

Africa's largest **hydroelectricity** producers, and two large scale projects are planned for the short-medium term: the expansion of the Cahora Bassa Dam and the development of the Mphanda Nkuwa Dam. Almost 100% of power currently generated is from hydroelectric projects. However, other renewable energy sources and the recent discovery of fossil fuel reserves (coal and gas, in particular) are changing the energy sector and are expected to

*Ethiopian industry structure is strongly focused on **agriculture***

play a significant role in the future, with natural gas power plants expected to provide 44% of total energy generation. Nevertheless, as of today, the **quality of energy supply** is still low, as reflected by the WEF's Global Competitiveness Index (GCI). This is due to an underdeveloped power distribution network and the bureaucracy involved in developing new power projects. Energy demand in Mozambique will be driven by industry and business, mostly, as the majority of the population cannot afford current tariffs despite the fact they are highly subsidized.

1.9.2 Mobility

Also transportation infrastructures play a crucial role in the creation of the future Mozambican value chain: it will give fuel to domestic growth, as well as foster the few, but already existent inter-regional trade. As of 2015, **road coverage** was poor, with only 30,331 km, the 20% of which were paved (6,303 km), mainly located in urban areas. Coherently, roads quality evaluated by the WEF is weak: the country ranks 133rd/138. The **rail system** is composed of a total of 2,983 km rail compatible with neighbouring rail systems. The system is composed by three different and independent lines connecting ports of the Indian Ocean. There is no directly interconnecting rail service between the three lines, and this is a major shortcoming impacting on intra-country trade and, hence development. Overall, quality of the existent railways is average: despite the rehabilitation works, these infrastructures bear the signs of sabotages occurred during the civil war. Up to 2015, Mozambique had 98 registered **airports** (21 with paved runways), 7 of which are international airports. Registered carrier departures worldwide peaked at about 20,000 between 2012 and 2016; air transport freight as measured in M ton-km declined during the same period, going to 4.4. Quality of air transport infrastructures is low: in the GCI, Mozambique ranks

Road coverage

30,331 km

The road coverage is poor

As of 2015, the **20% of road** were **paved 6,303 km**

Rail system

2,983 km

It is compatible with neighbouring rail systems.

Airports

98

Mozambique had **98 registered** **7** of which are **international airports**

Mobile cellular subscriptions
67%
of total population
18.4M people
in the period 2012-2016
this number have more than doubled

Population with internet access
17.5%
It has tripled during the five years coming to 2016

Average internet speed
2.3 Mbps
The large majority of those who have the possibility access mainly via mobile devices

113rd/138. Overall, air transport is not much used in the country, especially for transport of goods. Finally, despite the geographical advantage, **maritime transport** is not well developed yet: even if the country has several ports, seabased trade is still in infancy. Between 2007 and 2014, the number of 20-foot containers passing through the ports went from about 0.21M to 0.33M (ranking 91st/118 according to 2014 Containerization International data). However, there is future potential for Mozambique to became a leading player in sea freight transportation in the Indian Ocean.

1.9.3 Digitalization

NPR in Mozambique first needs to go through an assessment of the quality and readiness level of digital infrastructure. As a matter of fact, during the period 2012–2016, the number of **mobile cellular subscriptions** have more than doubled, reaching a total coverage of about 67% of total population (18.4M people). Moreover, as of 2017, mobile data costs are among the cheapest in the continent: according to Research ICT Africa, one gigabyte cost just $2.7 compared with $7.7 in the much developed neighbour South Africa. **Fixed broadband subscriptions** have kept the increasing trend of mobile subscriptions over the same period, increasing by 37.1% reaching a total number of about 40,200 subscriptions (0.14% of total population). Clearly, broadband coverage remains limited to urban and very few industrial areas. The share of **population with internet access** has tripled during the five years coming to 2016, however reaching just 17.5% and highlighting that the large majority of those who have the possibility access mainly via mobile devices. As of 2017, **average internet speed** was about 2.3 Mbps. It is clear that these performances must be improved in order to reach digitization standard required by the newest production technologies. In fact, according to the GCI, Mozambique is among the least developed countries in terms of quality and diffusion of digital infrastructures.

1.10 Human capital

The country's young, growing population that is increasingly becoming better educated represents a potential source of dynamism for economic growth in Mozambique. Many changes in household behaviour and educational outcomes are expected to happen following the implementation of education reforms, at both the primary and secondary levels. However, data available are not updated. As of 2009, overall **literacy** among the

population aged 15 and older was relatively poor, at 50.6%, showing a peak of about 67.4% in the case of male literacy. Youth literacy (individuals aged 15–24) was higher, at 67.2%, again driven by male component (about 80%).

Compulsory education begins at 6 and lasts till the age of 12. However, its enforcement is inconsistent, due to the lack of resources and the scarcity of schools in the upper grades. As of 2015, gross **enrolment rate in secondary** and especially in **tertiary education** were rather low, respectively at 32.4% and 6.4%. Overall, the average school life expectancy is about 10 years, from primary to tertiary education. Mozambique especially lags behind when it comes to enrolment in sciences, technology, engineering and math disciplines. For this reason, in 2015, the WB approved an additional $45M in financing for the Mozambique Higher Education Science and Technology (S&T) Project, which builds Mozambique's capacity in technical and vocational education.

Most recent data on government **expenditure in education**, expressed as a share of total government expenditure corresponds to 2013, settling at 19%. Expenditure in education accounted for the 6.5% of GDP. Employment in knowledge-intensive sectors is rather difficult to estimates; however, latest estimates on **FTE researchers** amounted to 41.5 per M people, according to UNESCO.

1.11 Entrepreneurship

In Mozambique, in the last decade, initiatives to promote entrepreneurship multiplied. Such interest is reflected in the National Agenda to Combat Poverty, a governmental program for poverty reduction and creation of new jobs. Increasing the productivity of entrepreneurship and transforming microenterprises into SMEs is one of the major challenges facing local policy makers, international institutions, and NGOs. As regards the entrepreneurial context, according to the WB, Mozambique positions 138th/190 in overall ease of **doing business**, lagging behind especially in control over corruption, credit availability, and contract enforcement in terms of time and cost.

The Global Entrepreneurship and Development Institute (GEDI) monitors the degree of **entrepreneurship ecosystem development** across several institutional and individual firm dimensions. What emerge is the dichotomous nature of the business environment: in Mozambique, opportunity perception is extremely high, catching levels of most of developed countries. However, risk acceptance is extremely low, which prevents most of micro and small businesses from scaling up. In fact, credit constraints and

Compulsory education

aged 6-12

Enrolment rate
in **secondary 32.4%**
tertiary education 6.4%

Expenditure in research and development (GERD)

0.34%

of GDP in 2015, fluctuating widely in previous years; only the **0.5%** was performed by business enterprises

Share of firms offering formal training

22.1%

in 2007
performing relatively well

Patent and trademark activities

both experienced an increasing trend in latest years

24

reaching patent applications
and **1,157 trademark applications**,
by residents in 2015

little development in the financial industry goes hand-in-hand with low risk-taking attitude and a limited entrepreneurial attitude.
However, with such a higher employment in the informal sector and a major share of small and micro business which remains voluntarily outside the formal one, it becomes extremely difficult to track and analyse entrepreneurship.

1.12 Science, research and innovation

The Science, Technology and Innovation (STI) system of Mozambique has gathered the attention of many national and international institutions in recent years. The Ministry of S&T, Higher and Technical Vocational Education (MCTESTP) just completed a 10-year project (2006-2016) of strengthening and systematic review of the progress of the STI system. The country has also established a partnership with the EU in 2010, defined by the EU-Africa High Level Policy Dialogue (HLPD), based on which legal entities from Mozambique are eligible to receive funding through Horizon 2020. Moreover, in 2017, the country hosted Innovation Africa international conference under patronage of Mozambican government.
However, data on research and development are not updated: gross domestic **expenditure in research and development** (GERD) was about 0.34% of GDP in 2015, fluctuating widely in previous years; of this expenditure, only the 0.5% was performed by **business enterprises**. The 0.5% of total R&D expenditure was financed by businesses themselves, the 43.5% by Mozambican government, and the 39.9% was financed from abroad. Potential for knowledge absorption is quite limited as just the 33.6% of businesses adopt technology licensed from foreign companies.
According to the Global Innovation Index by the World Intellectual Property Organisation (WIPO), the share of firms offering formal training was about 22.1% in 2007, performing relatively well if considering that in 2016 the average share for Sub-Saharan countries was 29.7%. **Collaborations** between firms and universities or research institutions are fairly solid, too. **Knowledge clusters** deriving from the geographic concentrations of firms, suppliers, producers, and specialized institutions are emerging in Mozambique. Concerning **patent and trademark activities**, the country has been lagging behind yet slightly catching up according to the Global Innovation Index (GII) by WIPO (Mozambique ranks 107th/127): both experienced an increasing trend in latest years, reaching 24 patent applications and 1,157 trademark applications, by residents in 2015.

2.

Institutions of the national innovation system

In this second Section an overview of the main categories of actors constituting the National Innovation System (NIS) of Mozambique is presented. Consistently, the linkages between the highlighted institutions are explored, keeping a NPR-enabling standpoint.

2.1 Firms

The development of the business ecosystem in the agricultural and industrial sectors, as well as the formalization of the existing one and, consequently, the transition out of the predominantly informal economy, represent the main drivers of Mozambican growth in the coming years. However, updated firm-level data are not available and depicting an accurate image of the local business environment represent a major challenge. According to latest available data from the SME Finance Forum, less than 33,000 **business entities** were registered in the country, the 87.8% of which were Micro, Small and Medium Enterprises (MSMEs). With less than 10 employees, the great majority of MSMEs (about 23,000 entities) were classified as Micro business; this group is also the most interested by the informal economy, hence the real number of existing micro business is expected to be much higher. Overall, MSMEs employ about 43% of the population and produce less than the 30% of Mozambican GDP. According to the WB Enterprise Survey, gathering information from 479 respondents in 2007, firms' data reflects GDP composition by sectors presented in Section 1.7, with the 56.2% of firms operating at various levels in the service sector. **Manufacturing firms** represent just the 29% of the sample. Available data on manufacturing firms confirms the stage of infancy of the industrial sector, the little integration within global markets, and the difficulties related with credit accessibility. Only the 5.9% of firms do export directly or indirectly, just the 29.2% use material inputs and/or supplies of foreign origin, and when used these accounts for the 19.5% of total inputs used. Even if these data could signal different things (either strong reliance on local suppliers, reasonably due to higher price competitiveness relatively to foreign ones, or low participation to global value chains (GVCs)), the more likely case seems to be that of scarce involvement of Mozambique in **international production** chains. Of course, the gap in transportation infrastructures plays a huge role, both for formal and informal businesses; nonetheless, it is difficult to assess the real situation as local firms might heavily leverage on informal logistics. Another factor inducing scarce participation to GVCs is that local firms lag behind in compliance to international

standards and certifications. Concerning financial constraints, **access to credit** is one of the major difficulties new firms have to face. Specifically, about 90.6% of active loans require collaterals, with an average value of about 92% of the value of the underlying loan. These obstacles allow only 4.7% of firms to use banks to finance their investments. In fact, the degree of **financial literacy** by firms, is relatively low: as of 2007, the 75.7% of formal firms had a checking or savings account, and about 14.2% had active bank loans or lines of credit. These performances are poor if compared to the other Sub-Saharan countries, where shares are higher by about 10%, and most likely they worsen in the subsequent years.

These conditions clearly highlight the lack of long-term **strategic vision** in the vast majority of businesses, especially in micro-sized ones. This, in turn, reflects on the **innovation** by firms, which is generally poor and limited to incremental one. Examples of innovative and **digital-born firms** are however present. As reported by the Financial Times, Biscate, an online job platform accessible by smartphone, is connecting trades-people working in Mozambique's informal economy to middleclass customers. Latest data tells 47,000 workers had been connected to 25,000 customers. For payments, Biscate leverage on mobile money platforms such as M-Pesa, which is also preferred to formal bank accounts by many formal and informal businesses.

2.2 Government

For Mozambique, productivity growth is a precondition for increasing standards of living and competitiveness in the global economy. With this respect, the role of industrial policies gains much attention as there is the urgent need to foster broad-based sustainable economic development and generate income and jobs for Mozambican. The country's remarkable macroeconomic growth rates of past decades are in large part due to huge capital-intensive **FDIs**. However, these add very few jobs to the economy; hence their impact is bound to be limited.

These conditions clearly highlight the lack of long-term strategic vision in the vast majority of businesses, especially in micro-sized ones

Nevertheless, many sectors are regarded as sources of potential growth for Mozambique: agriculture and agro-industry,

tourism, mining and energy, to cite the most promising. However, country studies highlight a huge **gap** between the need for welfare-enhancing industrial policies able to leverage national resources and enhance existing infrastructures, and the capability of the government to design and implement them. Apart from periodical fluctuations, the shares of total GDP contributed by agriculture, industry, and services have not changed significantly during the last 10 to 15 years, nor there has been any significant increase in the share of employment in manufacturing (in fact, over the last 15 years the share of GDP coming from manufacturing even declined).

Several different governance features weaken the government's industrial policy

Several different governance features weaken the government's **industrial policy** management capability. Above all, the strong dominance of FRELIMO party blurs the boundaries between it and the governmental institution, weakening checks and balances. Moreover, the existence of very close ties between party members and leading businesses acquired during the privatization process further weaken the system, opening up to **market imperfections** such as moral hazard. Finally, a weak civil-society organization, the lack of an independent judiciary, and corruption act against the correct implementation of effective industrial policies. This situation results in an overall scarce selectivity and effective implementation of infrastructural investment policies.

Nonetheless, successful examples of effective projects from the Mozambican government do exist. For instance, the creation of Special Economic Zones (SEZs) such as Beluluane Export Processing Zone which hosts the Mozal Smelter Project and its suppliers with investment amounting to more than $2.3B, or the Nacala Rapid Development Zone. **Innovation policy** recently brought some results too: the creation of Technology Parks like the Maluana S&T Park, currently hosting a data center and a new technology development center, as well as start-up incubators and the nascent Mozambican data-hosting industry. However, parks development is still at a very early stage and they are not supposed to represent the engine of technological development and industrialization of the country for the years to come. Overall, the government of Mozambique does not follow a clear and inclusive strategy of outlining and guiding targeted policies to foster innovation

and competitiveness of **local enterprises**. Developing local-specific technological capabilities or creating agglomeration economies and other spillovers that would enable local enterprises to take advantage of the market enhancement achieved through FDI attraction policies still remains a missed target. This is confirmed by the UNESCO Science Report: Towards 2030: neither Mozambique's S&T Policy (2003), nor the Science, Technology and Innovation Strategy (2006–2016), have yet delivered on their promises. The government offers a set of tax credits and **incentives,** addressing local as well as international firms and investors. Examples are: deduction of credits correspondent to taxes paid abroad for resident companies, under certain conditions; incentives for inward investments; exemption from import duties and VAT for local importers; incentives on investments focused on advanced technologies, and incentives on exploration aimed at retrieving new endowments of natural resources, to cite a few.

Finally, key **governmental institutions** actively involved in the process of economic growth, and which may add a relevant contribution to the NPR, are:

- The yet mentioned MCTESTP, aimed at the creation of skilled and prepared future labor force and the dissemination of scientific knowledge that will enable rapid learning, adaptation and utilization of foreign technologies.
- The Ministry of Industry & Commerce, involved in the creation of effective policies for industrial development and in the organization of relationships with foreign trade partners and investors.
- The Ministry of Planning and Development, which leads and coordinates the planning process, guiding the country towards an integrated and territorial balanced social and economic development.
- Other important ministries are the Ministry of Transport and Communications, the Ministry of Agriculture and the Ministry of Energy, all focused on policy generation, infrastructural investments, research and technology development in the related fields.

2.3 Universities

In Mozambique there are 17 **universities** and colleges offering tertiary education and awarding degrees. The national system of higher education institutions (HEIs) dates back to the Portuguese era, before independence. The first HEI, Eduardo Mondlane University, a public institution based in Maputo, was founded in 1962. The term public refers to the **governmental institutions** and, conversely, private refers to non-governmental institutions. In fact, all the first

HEIs that were established in the country were public. Then, the country experienced a wave of expansion and diversification of the tertiary education system and many private universities were created; most of them with specific training and research focuses, such as the Higher Institute Polytechnic and University and the Catholic University of Mozambique. The **size** varies greatly from one HEI to another, mostly depending on the location and on the population living in neighbor areas. It ranges from few thousands up to the about 30,000 students in the case of Eduardo Mondlane University; the average size is around 20,000 students. Almost all universities in Mozambique offer undergraduate, postgraduate and

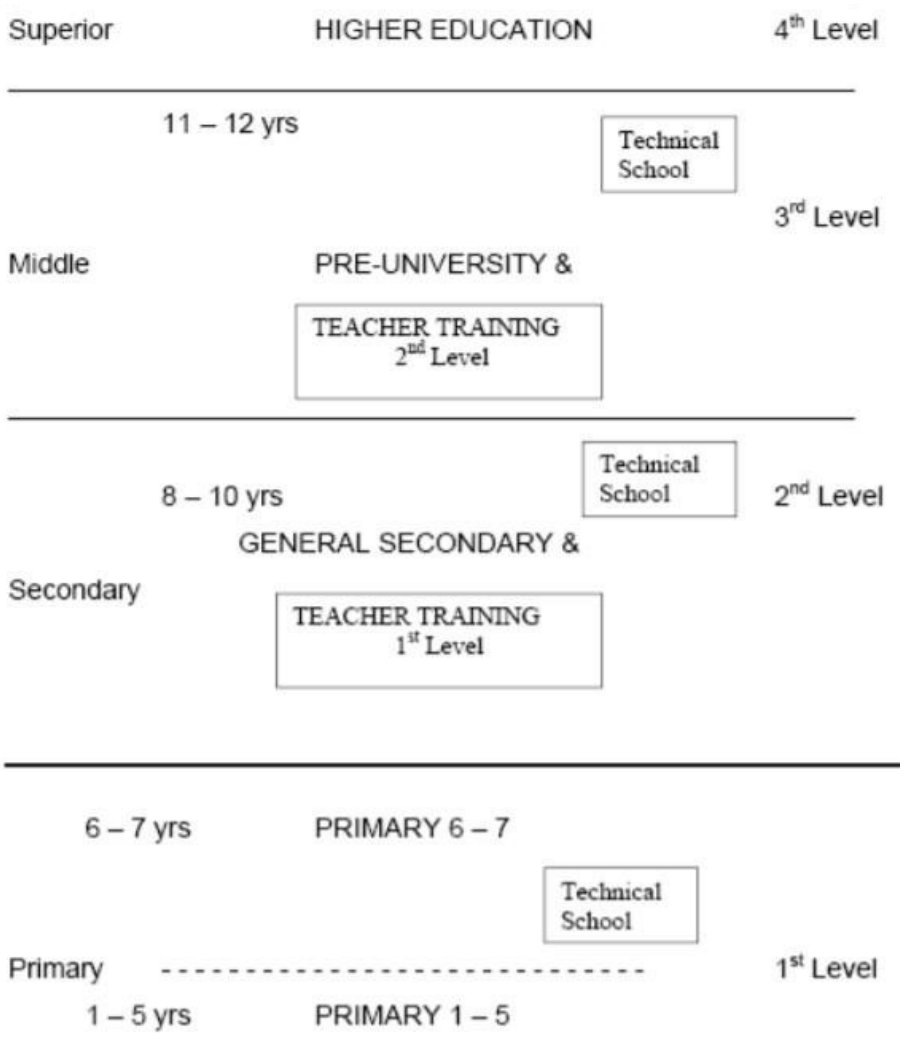

Figure 2.1 - Structure of Education and TVET System

doctoral programs on multiple **disciplines**, including: Arts and Human Sciences, Economics and Business Sciences, Healthcare and Medicine, Engineering, Science and Technology. However, almost all HEIs students are enrolled in undergraduate programs, whereas only few of them further proceed with their education. This is also due to the fact that **completion rate** among undergraduates is very low since in many cases there is no formal obligation for final thesis discussion, and most of students go to work after completing their courses without formally graduating. Relatively to the quality and performances of HEIs in Mozambique, none of them is mentioned neither among the best universities in Africa nor among the 2018's World University Rank.

Research activity is mainly related to academic purposes of new knowledge creation and dissemination. This is confirmed by UNESCO data: FTE researchers are concentrated mainly in Natural (22.1%) and Social Sciences (35.8%), keeping shares constant or experiencing a slight increase during the period 2010–2015. However, it is worth to mention that, over the same period, the share associated with FTE researchers in Engineering and Technology dropped from about 22% to 8.3%, whereas a reversed pattern is observable regarding Agricultural Sciences. This probably highlights the emphasis that recent industrial policies have posed on the agricultural sector.

Relatively to the employment of this research workforce, the majority (77.3%) of FTE researchers are employed in HEIs.

The lack of **entrepreneurial education** is probably among of the main causes of the current predominance of the informal sector, hand-in-hand with lack of vision from governmental bodies. This especially considers the surprising vitality of the Mozambican ecosystem of MSMEs when compared to peers from Sub-Saharan Africa. Hence, there is the urgent need to provide courses and a minimum entrepreneurial formation at any level of the education system. Especially given that, similarly to what happens for university completion, lower education attainment is also left before completion (many young Mozambican leave schools before concluding secondary and even primary education to find a job or even creating their own).

This gap can and should be filled also by Technical Schools, which offer **Technical-vocational Education and Training** (TVET). TVET is provided in three fields: agriculture, industry and business. Basic TVET corresponds to the first cycle of secondary education and trains skilled workers. Instead, middle-level TVET corresponds to the second cycle of secondary education and trains technicians. However, basic TVET programs are

Research activity

FTE researchers are concentrated mainly in

22.1%

Natural

35.8%

Social Sciences

during the 2010-2015 period the share associated with **FTE researchers in Engineering and Technology dropped from about 22% to 8.3%** whereas a reversed pattern is observable regarding **Agricultural Sciences**

Employment

Relatively to the employment of this research workforce, the majority

77.3%

of FTE researchers are employed in HEIs

There are several different independent institutions that play an active role in supporting businesses in the innovation process

also offered at the upper primary level. *Figure 2.1* present the scheme of the overall education system in Mozambique.

2.4 Innovation and enterprise support institutions

In Mozambique there are several different independent institutions that play an active role in supporting businesses in the innovation process. For example, in 2017, the Mozambique **Chamber of Commerce**, which gathers more than 600 members nationwide, in collaboration with the International Research, Innovation and Business Organization, launched an initiative to finance and support young entrepreneurs and businesses in the realization of their innovative ideas.

Furthermore, **Technology and Innovation Support Centers** (TISCs) offer Mozambican innovators access to locally based and high-quality technology information and services. This centers (generally hosted by universities, governmental institutions or international organizations) are managed by the WIPO with the aim of helping local entrepreneurs to exploit their innovative potential and to create, protect, and manage their intellectual property (IP) rights.

To have a complete picture of the institutions supporting the local **entrepreneurial environment** and to have a deeper clue of the feasibility and future impact that will eventually have the NPR, it is useful to analyse the accelerators, incubators and company builders' environment in Mozambique. Major actors are all located in Maputo: 2 accelerators and 2 incubators, mainly focused on promoting structured entrepreneurship in local micro-businesses, providing them with mentoring, technical know-how and training, ICT support, and in some cases even funds and physical space. However, there are also several non-local accelerators or incubators which provide support to Mozambican start-ups, and, as already mentioned, local businesses are even eligible for asking funds under the EU Horizon 2020 program.

Moreover, **non-governmental organizations** (NGOs) like Maputo Fast Forward satisfy the important need for meetings between businesses and organisations operating in different fields. Through several annual events, expositions and debates, they offer the possibility to establish a vibrant and active network among firms and other actors, fostering innovation and creativity. Other NGO like the Organization for Social and Economic Studies (IESE) act as independent research organizations with the aim of create knowledge and intellectual capacity to foster social and innovative progress, contributing with the government to the public debate on industrial and innovation policies.

2.5 Linkages between the institutions

Linkages among the previously analysed actors of the National Innovation System (NIS) are generally poor and fragmented. As highlighted by the WB enterprise survey, user-producer links **between firms** tend to be weak, if not non-existent, for firms belonging to several sectors. This gap is primarily due to the nature of firms, mainly Micro and Small businesses, and to the overall weak support from institutions. This situation results in Mozambican firms being not able to go beyond short and highly fragmented local supply chains which, paired with an overall lack of innovative skills, undermine also the existence of fundamental inter-firm innovative interactions. Vertical, as well as horizontal, interactions along the value chain are generally penalized by this situation.

user-producer links between firms tend to be weak, if not non-existent

MSMEs receive little support from the government, business associations and financial institutions. Analysing their nexus deeply requires to pay attention to the **government-firms relationships** in terms of significant policy and institutional developments. Looking at the incentives set by the government opens up to the critical issue of evaluating the impact of such instruments from the perspective of their intended beneficiaries, and the balance of the focus among them. Local SMEs and unbanked individuals and firms, in fact, benefit less than they should if compared to foreign investors. This highlight the need of going beyond the policy intent alone. Poor deals and not efficiently managed private-public partnerships highly undermine the potential of value capture and distribution among local businesses, privileging instead international investors.

Mozambican universities have rather poor research capabilities, especially in technological fields due to the latest trend, already presented; hence, research output ends up having little industrial relevance. Due to the lack of available information, it is reasonable to argue that **universityindustry/ firms links** are mainly based on individual connections. Long-term and formal links are presumably at early development stage. This gap is partially filled by **supporting institutions** (governmental or not), however playing a limited role in both the development of skills by businesses, particularly entrepreneurial ones, and in financial and technological support.

3.

Conclusions

Continuing from the assessment conducted in Section 2, the first part of Section 3 presents a synthetic overview of the few key actors within the Mozambican NIS. In particular, they have been analysed considering their actual commitment in the process of country innovation, and their potential role in fostering the diffusion of the NPR in the country. To conclude, merging the key highlights from the economic analysis in Section 1 with the critical considerations done in Section 2 and the first part of Section 3, a framework to synthetize opportunities and challenges deriving from the NPR, actual learning needs for the Emerging AIL project participants, as well as potential actions to be taken, has been formulated and presented to make sense of the analyses carried out all along the report.

3.1 Key actors in the national innovation system

Initially, a range of institutions has been identified to constitute Mozambique's NIS. Then, a number of key stakeholders were short-listed as the most active institutions as well as have the institutions with most potential for making the necessary change to move Mozambique toward the NPR. The objective was to identify at least one stakeholders per group of NIS actors (firms, government, universities, support institutions). As criteria, we used the following: (i) publicly communicated stakeholder's mission scope and objectives, (ii) available information on the stakeholder's activities and effectiveness, and (iii) interviews with experts familiar with the NIS of Mozambique stemming from author's professional network. In particular, the reason for inclusion as well as the main objectives, activities and achievements of each institution are elaborated in the following sections.

3.1.1 Ministry of Science and Technology, Higher and Technical Vocational Education

The already mentioned MCTESTP, is the core organ of the Government of Mozambique which is in charge of defining, coordinating and monitoring all the activities carried out at national level in the three fields of S&T, Higher Education and Professional Education. More specifically, the ministry aims at actively impacting the promotion and the provision of scientific and technological material and solutions to citizens. Moreover, given the plurality of the ministry's focuses and functions, it is actively involved in the access expansion and quality improvement of teaching and assurance of education both at the HEIs and at the TVET levels. Clearly, this is done through the formulation of policies meant to stimulate the creation of an integrated, articulated environment favouring development and with the long-term view of inducing growth and socio-economic welfare in Mozambique.

The triadic nature of the duties fulfilled by the institution makes it necessary for the ministry to be structured in several different and subordinated institutions, each one working on specific topics. For instance, the Mozambique Academy of Sciences promotes and stimulates scientific research and makes the results of this research public; the National Research Fund represent one of the financing bodies of the S&T system, financially supported by the government; The National Science and Technology Parks Enterprise is the public enterprise in charge of planning, building and managing S&T parks in Mozambique, to mention a few. The deeply rooted involvement in such fields makes the MCTESTP one of the key actors on the NIS, also covering a guiding role in the development of the path towards the NPR.

In the last few years, the ministry has become promotor of several programs and projects with the aim of boosting technology transfer and adoption of foreign technologies, but also to develop local ones through the acquisition of innovative and knowledge intensive skills. To mention but a few, examples of such programs are: Millennium Villages National Program, which is an integrated community development project based on the use of research approaches. It represents an innovative way of organizing poor communities in order to get the maximum benefit from technology transfer, innovations and other facilities, eventually incorporating them in the local social infrastructures and services. This project represents an attempt of fighting poverty in rural areas. Another one is the National Biotechnology Program, an initiative to promote the application of biotechnology as a strategic transversal technology able to address the limits of the socio-economic development in Mozambique. In fact, as holder of innumerable biological resources and due to the biodiversity of both terrestrial and marine ecosystems, Mozambique is in a position to take advantage of the potential of this technology for the benefit of its communities. Furthermore, the MCTESTP regularly produces a number of books and reports on specific topics related with S&T and several analyses of local business and innovation environment. It is also in charge of conferring studentships, offered by the government, to Master's and PhD students to allow them to participate to national and international programmes focused on specific research topics.

3.1.2 Eduardo Mondlane University – Engineering Faculty

The Faculty of Engineering was founded in 1962 with a centralized management structure according to which each course of study was associated with a specific department. Soon after the independence from the Portuguese government in 1975, the departments assumed the status of faculty with a non-

In the last few years, the Ministry of Science and Technology, Higher and Technical Vocational Educationhas become promotor of several programs and projects with the aim of boosting technology transfer and adoption of foreign technologies, but also to develop local ones

centralized governing body but with an inter-faculty coordination. In 1962 there were 4 courses, namely Civil Engineering, Electrical Engineering, Mechanical Engineering and Chemical Engineering. The courses included general basic subjects in the first years and Engineering disciplines, including management subjects in the final ones. During the years, courses' duration was reduced and new courses were introduced; among these featured the Mining Engineering and the Metallurgical Engineering courses. However, in time, the educational offer and its duration have proved to be not in line with the learning needs of the rising Mozambican economy and some courses were terminated. Currently, the Faculty of Engineering is composed of 5 academic departments which all together offer eight undergraduate courses in the areas of Civil Engineering, Electrical Engineering, Electronic Engineering, Computer Engineering, Mechanical Engineering, Industrial Management Engineering, Chemical Engineering and Environmental Engineering.

The Eduardo Mondlane University - Engineering Faculty offers access to patent, scientific and technical databases by the WIPO

The university, but especially the engineering faculty, due to the specificity of teaching fields is one of the main actor of the NIS which should be also able to provide a boost to the NPR. Moreover, the faculty and the university have received attention and financial support by several foreign and international actors such as the Swedish government, the Chinese government, USAID association and even private MNEs like the Italian company Eni, operating in the energy field, etc. These aids and partnerships have been, and still are, of crucial importance to foster the development of the knowledge specificity and background necessary to move the country towards industrialisation and better manage the exploitation of Mozambique's natural resources.

Furthermore, the Faculty of Engineering is one of the 3 TISCs hosted in the country. The center offers access to patent, scientific and technical databases by the WIPO and provides assistance and advice in using databases in order to boost innovation among young engineers and entrepreneurs. These services are offered both in Portuguese and in English language.

3.1.3 Mozambique Chamber of Commerce

The Mozambique Chamber of Commerce is a local organization

of businesses and companies in Maputo with the intention to develop and carry forward the interests of local companies and businesses in Mozambique. Many member businesses are international operating companies and MNEs with offices in Mozambique. In particular, members of the chamber operate in businesses such as lawyers, property developers, tourism companies, airlines, manufacturing companies, import and export businesses, banks, finance companies, legal advisors, IT and electronics manufacturers etc. Chambers of Commerce main activities are, among others, safeguarding business interests and sharing business experiences and business interests, contact with governments, civil society, local media and the press and organizing trade shows and events.

Even if the business climate and the economic environment of Mozambique still need to improve, the socio-political ecosystem as a whole is increasingly being perceived as stable from international investors. This is reflected by the numerous large-scale investments (for instance, the aluminium smelter MOZAL, the Moatize coal mine and several different energy projects) performed by foreign MNEs in recent years. In fact, these are proof of the growing attractiveness of the Mozambican market. In this scenario the role of the Chambers of Commerce has become increasingly relevant to in order to fasten the pace of economic development of the country and, in so doing, foster the introduction and the adoption of the most recent industrial technologies. Consistently, during the last decades the institution has built ties with other Chamber of Commerce worldwide in order to create a network of business opportunities for local SMEs operating in industries ranging from tourism to manufacturing. Example are the creation of the joint Mozambique-South Africa Chamber of Commerce and Industry (CCIMOSA), the Chamber of Commerce, Industry and Agriculture BrazilMozambique (CCIABM), the US-Mozambique Chamber of Commerce (CCMUSA), the cooperation agreement signed between the France-Mozambique Business Club and the Mozambican Chamber of Commerce, the opening of the Chinese Chamber of Commerce in Mozambique, to mention a few.

In addition to this, in the last few years, the Mozambican Chamber of Commerce launched different initiative to support entrepreneurship projects in the country. One of the most recent ones kickedoff in mid-2017 with the joint sponsorship of the international Research, Innovation and Business organization with the aim of helping local entrepreneurs to put their ideas into practice. Initiatives like this one have the objective to offer a solution to one of the biggest problems experienced by entrepreneurs with innovative and/or sustainable business ideas, the lack of financing instruments.

3.1.4 ideiaLab incubator/ accelerator

ideiaLab is a Mozambican business incubator and accelerator founded in 2010 with the guiding purpose of inspiring entrepreneurs, supporting the development of start-ups, accelerating the growth of Micro, Small and Medium enterprises, and promoting entrepreneurship and innovation. The incubator helps entrepreneurs to elevate ideas from papers and to take their initial steps into business. It empowers entrepreneurs with the competencies and inspiration they need to boost their businesses and achieve solid growth. In practical terms, ideiaLab guide the business model development and its practical implementation, helps in building personal capacities and skills through mentorship programs, provide spaces for information and knowledge sharing leveraging on peer-to-peer support and organize events that boost networking and access to critical start-up resources. ideiaLab also act as an accelerator providing consultancy in business service development to improve local MSMEs' performances and achieve higher economic growth and meet their goals sustainably. The consultancy service is provided in collaboration with other foreign consultancy firms specialized in start-ups and Small businesses.

Since it started its activity, ideiaLab created a community of over 11,000 members, training about 2,000 people and supporting more than 400 businesses during their kick-off and/or scale-up phases. The incubator is also active in organizing events to promote entrepreneurship for social development such as Hackathon challenges. For instance, one of the latest events of such kind, organized in early 2018, was focused on tackling the problems of Africa with the introduction and usage of virtual reality. The strong ties with the start-up and MSMEs economic environment and the expertise in latest ICT technologies make ideiaLab one of the actors highly involved in the NIS at an operational level, despite the existent limits related with the nature of its business.

3.2 Challenges, opportunities and learning needs

In order to clearly define and effectively tackle the challenges that the potential spreading of the NPR in Mozambique implies, as well as to concretely reach and take full advantage of the multitude of possibilities made available by this process of industrial innovation, a crucial preliminary step consists in the clear analysis of the necessary and locally tailored learning needs.

Consistently, hereafter it is presented a "Canvas" ideated as a framework to assess and provide clear information on:

- The local industrial landscape, in terms of **leading industries** for the country's economy and, hence have a high priority as a field of application of the NPR;
- The set of main **transformation fields/ enabling infrastructures**, crucial for the feasibility of the

adoption/diffusion of the NPR;

- The set of actions to be taken at each intersection **leading industry – NPR-enabling transformation**;
- The actual local **presence of Italian business enterprises**, their willingness to invest/ engage in new business opportunities in the specific leading industry;
- The locally defined demand for competencies aimed at the adoption/deployment of the NPR, the deriving **learning needs**, as well as the innovation and policy actions made it necessary to match demand and offering of skills specifically needed on the local job market.

Following the economic data provided in Section 1 (i.e. import and export data from UN Comtrade Database), the orientation of international investors (e.g. according to the Italian Ministry for Foreign Affairs, the UK Department for International Trade, etc.) and the critical assessment of the authors of this report, the leading industries for the Mozambican economy have been identified following ISIC 2-digits classification and the analysis of the potential benefits from the three key NPR-enabling transformation fields has been formulated. Consequently, Canvas 1 is shown in Table 3.1.

Table 3.1

Reports an example of Canvas 1: NPR-leading industries have been intersected with the NPR-enabling transformations and the resulting intersections have been analysed in terms of potential benefits. The current formulation of Canvas 1 is a critical re-elaboration of secondary data and grey literature. Hence, it may not be exhaustive. It is meant as a starting point for AIL project participants who will further build upon it, leveraging on their own expertise, first-hand knowledge of the Mozambican business and innovation environment and knowledge developed during the AIL training program.

The list of Italian investors presented in *Table 3.1* is meant to provide an example of the Italian businesses currently investing/engaged in economic relationships in the afore presented key industries, in Mozambique. A list, which is needed by AIL project participants to complete Canvas 1 (i.e. *Table 3.1*) is available on the Italian Ministry for Foreign Affairs' webpage (http://www.infomercatiesteri.it/paesi.php). Nonetheless, participants are invited to further deepen the research and to provide a critical and insightful assessment of the potential contribution to the NPR coming from these actors.

Finally, for the completion of Canvas 1 (i.e. the qualitative assessment of the feasibility of leapfrogging) and for the subsequent formulation of Canvas 2 (i.e. the concrete definition of learning needs and existent gaps), AIL project candidates should follow the methodology proposed in the "Learning Needs – Canvas formulation protocol" file.

This assignment has been ideated as a way to make sense of the overall "big picture" encompassing NPR potential, opportunities, challenges and learning needs of local innovators. This is a step necessary to pave the way for the actual diffusion of the NPR in Mozambique.

Leading Industries NPR Enabling Transformations	Crop and animal production, hunting and related service activities & Fishing and aquaculture (ISIC codes 01 & 03)	Mining of coal and lignite & Extraction of crude petroleum and natural gas & Mining of metal ores & Mining support service activities (ISIC codes 05,06, 07 & 09)
Energy	Use of renewables and independent mini-grid help to offset outages risk, compromising production; Energy efficiency allows for enhanced sustainability in agri-food production: Agri- food lifecycle is better-off; Improved energy stability allows for stable food storage and transportation; New opportunities for bio- fuels cultivations; …	Continuity and security of energy supply allow firms to undertake operational improvement and increase productivity; Use of renewables and independent mini-grid help to offset outages risk improving performances of local firms providing support services; …
Mobility	Improved road transportation allows to better reach local demand and to take part into regional/international supply chains; Prioritise linkages with regional airline and maritime hubs to enhance export opportunities; Improved road transportation allows tackle inefficiencies and wastes in agri-food chain (e.g. perishability issue); …	Improved road transportation allows for new opportunities in establishing ancillary services/ industries locally; Prioritise linkages with regional airline and maritime hubs to enhance export opportunities; …
Digitalization	/	Opportunities coming from ICT for handling, storing, transforming, safety controls; Broadband connectivity as a necessary condition for B2B marketplaces and platforms that disintermediate supply chains and foster partnerships between local supplier of mining ancillary services and mining sector's MNEs; …
Italian Investors	IGO SAMMARTINI LDA; AVIAM LDA; …	BONATTI S.P.A.; DIMMS CONTROL S.P.A. - MOZAMBIQUE BRANCH; STL OIL & GAS SERVICES LDA; …

Table 3.1 - Canvas 1: A few examples of the NPR potential for leading industries and Italian investing firms.
Source: the Italian Ministry for Foreign Affairs (http://www.infomercatiesteri.it/paesi.php).

Manufacture of basic metals (ISIC code 24)	Construction of buildings & Civil engineering & Specialized construction activities (ISIC codes 41, 42 & 43)	Land transport and transport via pipelines & Water transport & Air transport & Warehousing and support activities for transportation (ISIC codes 49, 50, 51 & 52)
Continuity and security of energy supply allow firms to undertake operational improvement and increase productivity; Use of renewables and independent mini-grid help to offset outages risk; Improved cost-efficiency result in higher international competitiveness; …	Expand power grid coverage, improve reliability and resilience; Invest in renewables (prioritise geothermal, hydro & solar); Opportunity for exporting energy; Energy stability allows firms for operational improvements and increased productivity; …	Continuity and security of energy supply allow operational improvement in warehousing; Use of renewables and independent mini-grid help to offset outages risk; Improved cost-efficiency result in higher international competitiveness (e.g. making the whole logistic sector appealing for international investors interested in the Indian ocean area); …
Improved road transportation allows for new opportunities in establishing ancillary services/industries locally; Prioritise linkages with regional airline and maritime hubs to enhance export opportunities; …	Improvement of paved roads network for peripheral transport; Improvements and maintenance of railways connecting north-south; Improve railways connection between Mozambican ports and neighbour countries; Private-public investment & FDIs opportunities in national logistic system build-up; …	Improvement of paved roads network for peripheral transport, railways and air transport for regional/international cargo routes, maritime hubs on the Indian ocean is the key for the whole industry success; Promotion of the strategic positioning of the country for international investors; …
Opportunities for operational improvements (e.g. firms adopting updated machineries); New automation opportunities (e.g. safety controls in foundries); Broadband connectivity as a necessary condition for B2B marketplaces and platforms that disintermediate supply chains and foster partnerships between local transformers and basic metal fabrication sector's MNEs; …	Private-public investment & FDIs opportunities in national digital system build-up; New automation opportunities (e.g. high-tech firms); Opportunities for enhanced logistic optimisation (e.g. goods & info flow management); Improved technology absorptive capacity; …	Opportunities for operational improvements (e.g. firms adopting RFID technologies to track transports); Opportunities for new business models leveraging on digital platforms; Opportunities for enhanced logistic optimisation (e.g. goods & info flow management); Improved technology absorptive capacity from international investors; …
/	ATB RIVA CALZONI S.P.A. - MOZAMBIQUE BRANCH; CMC AFRICA AUSTRAL LDA; IMACO S.P.A.; …	COECLERICI MOZAMBICO S.P.A.; I.MESSINA MOC LDA; LPL Moçambique LDA; …

Notes: the table presents an incomplete version of Canvas 1, for the full framework see the "Learning Needs – Canvas formulation protocol" file.

Appendix A

Table A.1
Presents an extended list of possible key actors and related contacts for Mozambique. Actors have been selected according to their relevance within the NIS, according to an interviewed local expert. Furthermore, each actor has been classified according to the specific type of institution and ownership (e.g. Government, University, Enterprise, etc./e.g. Private, Public, etc.).

Actor & website	Contact(s)	Type of Institution & Ownership
Ministry of Science and Technology, Higher and Technical Vocational Education (TISC identified by WIPO) http://www.mctestp.gov.mz/	Telephone: (+258) 213 528 00 (+258) 213 528 15 Fax: (+258) 213 528 00 Email: benilanga@hotmail.com benjamim.langa@mct.gov.mz Lourino Chemane (Eng at the Ministry of Science and Technology) LinkedIn: https://www.linkedin.com/in/lourino-chemane-b64547106/	Government
Eduardo Mondlane University – Engineering Faculty (TISC identified by WIPO) http://www.uem.mz/ http://www.engenharia.uem.mz/	Telephone: +258(21) 430-239 +258(21) 428-198 Fax: +258(21) 304-405 Email: xmahumane@uem.mz feedback@uem.mz	Public University (Gov. financed)
Mozambique Chamber of Commerce www.teledata.mz/cacomo	Telephone: +258 21 492210 +258 14 91970 Fax: +258 14 92210 Email: cacomo@teledata.mz Email: mzchamber.rc@teledata.mz	Supporting Institution (/)
ideiaLab http://ideialab.biz/en	Telephone: +258 84 625 3176 Email: info@ideialab.biz Sara Fakir (Co-Founder & CEO) LinkedIn: https://www.linkedin.com/in/sara-fakir- 363baa3/ Tatiana Alves Pereira (Co-Founder) LinkedIn: https://www.linkedin.com/in/tatiana-alves-pereira- 7289863/	Supporting Institution (Private)
Institute of Social and Economic Studies (IESE) http://www.iese.ac.mz/	Telephone: + 258 21 486043 Email: iese@iese.ac.mz	Supporting Institution – NGO (Private)
Ideário Hub http://idear.io/	Telephone: +258 84 44 22 789 Email: hub@idear.io	Supporting Institution (Private)

Maputo Living Lab http://www.maputolivinglab.org	Email: info@ict4g.org	Supporting Institution (Private)
LINK Mozambique https://iba.ventures/link-mozambique/	Telephone: +258 21486790 Email: mmutimucuio2@snvworld.org	Supporting Institution (Private)
Maputo Fast Forward https://maputofastforward.com/	Email: geral@qideia.co.mz	Supporting Institution (Private)
Empresa Nacional de Parques de Ciência e Tecnologia http://www.pctm.co.mz/	Telephone: +258 21 811200 Fax: +258 21 811210 Email: info@pctm.co.mz LinkedIn: https://www.linkedin.com/company/9200031/	Public Enterprise (Gov. financed)
Ministry of Industry and Commerce http://www.mic.gov.zw/	Telephone: +258 21 352600 Fax: 263-4-253137 Email: mic@mic.gov.zw mic@indandcom.co.zw itrade@indandcom.co.zw	Government
	Luis Sitoe (Senior policy advisor) LinkedIn: https://www.linkedin.com/in/luis-sitoe-4214a96/	
Ministry of Planning and Development http://www.mpd.gov.mz	Telephone: +258 21 490006 Fax: +258 21492708	Government
Ministry of Transport and Communications (no website)	Telephone: +258 21 430152 Fax: +258 21 431028	Government
Ministry of Energy (no website)	Telephone: +258 21 303265	Government
Ministry of Agriculture http://www.map.gov.mz/	Telephone: +258 1 460011 Fax: +258 1 460055 Email: mozmicro@teledata.mz	Government

Table A.1 – Extended list of possible key actors and contacts.

References

- AntónioSousaCruz,DinaGuambe,ConstantinoPedroMarrengulaandAmosse Francisco Ubisse (2016). Mozambique's Industrial Policy – Sufficient to Face the Winds of Globalization? Available at http://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780198776987.001.0001/acpr of-9780198776987-chapter-5
- Club of Mozambique (13 Apr. 2017). Chamber of Commerce launches initiative to support entrepreneurship projects in Mozambique. Available at: http://clubofmozambique.com/news/chamber-of-commerce-launches-initiative-to-supporthttp://clubofmozambique.com/news/chamber-of-commerce-launches-initiative-to-support-entrepreneurship-projects-in-the-country/entrepreneurship-projects-in-the-country/
- Commonwealth Governance (2018). National Development Plan of Mozambique. Available at: http://www.commonwealthgovernance.org/countries/africa/mozambique/nationalhttp://www.commonwealthgovernance.org/countries/africa/mozambique/national-development-plan/development-plan/
- Cornell University, SC Johnson Collage of Business – INSEAD – WIPO (2018). GLOBAL INNOVATION INDEX 2018 Report. Available at: https://www.globalinnovationindex.org/home
- Eduardo Mondlane University – Faculty of Engineering (2018). History of FEUEM. Available at: http://www.engenharia.uem.mz/index.php/sobrenos/historial
- ENI (2018). University courses and high-level training. Available at: https://www.eni.com/en_IT/careers/training-and-guidance/university-courses-and-high-levelhttps://www.eni.com/en_IT/careers/training-and-guidance/university-courses-and-high-level-training.pagetraining.page
- Ernst & Young (2017). EY's Attractiveness Program Africa – Connectivity redefined. Available at: https://www.ey.com/Publication/vwLUAssets/ey-africa-attractiveness-report/%24FILE/eyhttps://www.ey.com/Publication/vwLUAssets/ey-africa-attractiveness-report/%24FILE/ey-africa-attractiveness-report.pdfafrica-attractiveness-report.pdf
- Financial Times (8 Nov. 2016). Tech innovation puts Mozambican workers on firmer financial footing. Available at: https://www.ft.com/content/4da30abe-a2b0-11e7-8d56-98a09be71849
- GEDI – Global Entrepreneurship and Development Institute (2018). Global Entrepreneurship Index. Available at: https://thegedi.org/global-entrepreneurship-and-development-index/
- Harvard Business School – Institute For Strategy & Competitiveness (2018). Stages of Development. Available at: https://www.isc.hbs.edu/competitiveness-economic-development/frameworkshttps://

www.isc.hbs.edu/competitiveness-economic-development/frameworks-and-key-concepts/Pages/shapes-of-development.aspxand-key-concepts/Pages/shapes-of-development.aspx

- Jornal Verdade (22 May 2012). Government creates public company to manage Science and Technology Parks. Available at: http://www.verdade.co.mz/nacional/27408-governo-criahttp://www.verdade.co.mz/nacional/27408-governo-cria-empresa-publica-para-gerir-parques-de-ciencia-e-tecnologiaempresa-publica-para-gerir-parques-de-ciencia-e-tecnologia
- Maputo Corridor Logistics Initiative (2018). CCIMOSA. Available at: http://www.mcli.co.za/our http://www.mcli.co.za/our-partners/partners-ccimosa/partners/partners-ccimosa/
- Matthias Krause and Friedrich Kaufmann (2011). Industrial policy in Mozambique. Available at: https://www.files.ethz.ch/isn/132283/DP%2010.2011.pdf
- Michael Baxter, Lindsey Allwright and Khovete Panguene (2016). Local Procurement and Financial
- Access Opportunities for SMEs in Tete Province. Available at: http://fsdmoc.com/wphttp://fsdmoc.com/wp-content/uploads/2016/12/FSD-Tete-Case-Study_PUBLIC_Final_053016.pdfcontent/uploads/2016/12/FSD-Tete-Case-Study_PUBLIC_Final_053016.pdf
- Ministry of Science and Technology, Higher and Technical Vocational Education (2018). Science and Technology Park of Maluana. Available at: http://www.mctestp.gov.mz/?q=content/parque-dahttp://www.mctestp.gov.mz/?q=content/parque-da-ci%C3%AAncia-e-tecnologia-de-maluanaci%C3%AAncia-e-tecnologia-de-maluana
- PwC (2018). Mozambique – Corporate - Tax credits and incentives. Available at: http://taxsummaries.pwc.com/ID/Mozambique-Corporate-Tax-credits-and-incentives
- SME Finance Forum (2018). MSME Country Indicators. Available at: https://www.smefinanceforum.org/data-sites/msme-country-indicators
- Sociedade do Noticias – Mussa Mohamed (15 Jul. 2014). Established Science and Technology Park. Available at: http://www.jornalnoticias.co.mz/index.php/main/13-ciencia-e-ambiente/19409http://www.jornalnoticias.co.mz/index.php/main/13-ciencia-e-ambiente/19409-inaugurado-parque-de-ciencia-e-tecnologia.htmlinaugurado-parque-de-ciencia-e-tecnologia.html
- The African Development Bank Group (2016). The Africa Infrastructure Development Index (AIDI) 2016. Available at: https://www.afdb.org/en/documents/document/the-africa-infrastructurehttps://www.afdb.

org/en/documents/document/the-africa-infrastructure-development-index-aidi-2016-89476/development-index-aidi-2016-89476/

- The Italian Ministry for Foreign Affairs (2018). Scheda Sintesi (MOZAMBICO). Available at: http://www.infomercatiesteri.it/paese.php?id_paesi=21#
- The Observatory of Economic Complexity – MIT Edu (2018). Ethiopia Country Profile. Available at: https://atlas.media.mit.edu/en/profile/country/eth/
- The World Bank (2018). Easiness of Doing Business Database. Available at: http://www.doingbusiness.org/rankings
- The World Bank (2018). Enterprise Survey. Available at: http://www.enterprisesurveys.org/ The World Bank (2018). LPI – Logistic Performance Index. Available at: https://lpi.worldbank.org/international/global?sort=desc&order=LPI%20Score#datatable
- The World Bank (2018). The World Bank In Mozambique. Available at: http://www.worldbank.org/en/country/mozambique
- The World Bank (2018). World Development Indicator Database. Available at: http://databank.worldbank.org/data/source/world-development-indicators
- Times Higher Education World University Rankings (21 Apr. 2016). Best universities in Africa. Available at: https://www.timeshighereducation.com/world-university-rankings/besthttps://www.timeshighereducation.com/world-university-rankings/best-universities-in-africa-2016universities-in-africa-2016
- Tom Alberts, Berhanu Abegaz, Peter Coughlin, Gunnar Jehrlander, Else Skjønsberg, David Wield and Salomão Manhiça (2003). Sida' Support to the University Eduardo Mondlane, Mozambique. Available at: https://www.sida.se/contentassets/6c776505d5394f2fb136f738460cb239/13795.pdf
- UK Department for International Trade (2018). Doing business in Mozambique: Mozambique trade and export guide. Available at: https://www.gov.uk/government/publications/exporting-tohttps://www.gov.uk/government/publications/exporting-to-mozambique/doing-business-in-mozambique-mozambique-trade-and-export-guidemozambique/doing-business-in-mozambique-mozambique-trade-and-export-guide
- UNCTAD (2017). World Investment Report 2017: Investment And The Digital Economy. Available at: http://unctad.org/en/PublicationsLibrary/wir2017_en.pdf UNCTADstat (2018). General profile: Mozambique. Available at: http://unctadstat.unctad.org/

CountryProfile/GeneralProfile/en-GB/508/index.html UNESCO (2010). World Data on Education – Mozambique. Available at: http://www.ibe.unesco.org/fileadmin/user_upload/Publications/WDE/2010/pdfhttp://www.ibe.unesco.org/fileadmin/user_upload/Publications/WDE/2010/pdf-versions/Mozambique.pdfversions/Mozambique.pdf

- UNESCO (2015). UNESCO Science Report: towards 2030. Available at: http://unesdoc.unesco.org/images/0023/002354/235406e.pdf
- UNESCO (2018). Country profile: Mozambique. Available at: http://uis.unesco.org/en/country/mz
- UNESCO (2018). Global Education Monitoring (GEM) Report 2017–2018. Available at: https://en.unesco.org/gem-report/
- UNICEF (2015). Migration Profile – Mozambique. Available at: https://esa.un.org/miggmgprofiles/indicators/files/Mozambique.pdf
- uniRank (2018). Top Universities in Mozambique – 2018 Mozambican University Ranking. Available at: https://www.4icu.org/mz/
- UNITED NATIONS (2018). UN Comtrade Database. Available at: https://comtrade.un.org/data/da
- WIPO – World Intellectual Property Organization (2018). Directory of Technology and Innovation Support Centers. Available at: http://www.wipo.int/tisc/en/search/
- World Economic Forum (2018). Global Energy Architecture Performance Index Report 2017. Available at: http://www3.weforum.org/docs/WEF_Energy_Architecture_Performance_Index_2017.pdf
- World Economic Forum (2018). The Global Competitiveness Report 2017–2018. Available at: https://www.weforum.org/reports/the-global-competitiveness-report-2017-2018