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Celebrating the 1st African Standards Day

Jointly organized by, the ***African Organization for Standardization*** (ARSO) and the ***Standards and Quality Agency*** (ANOR) at the Hilton Hotel in Yaoundé, Cameroon.

Theme: "***Celebrating Standardization as a Strategic Resource for Africa's Economic Integration.***"

Technological and Industrial Development of Africa: ***The Role of Standards***

By

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Yaoundé, 19 June 2013

This paper has been prepared for ARSO and ANOR. I am grateful to *Hormogène Nsengimana,* Secretary General of ARSO and *Booto à Ngon Charles*, General Manager of ANOR for their guidance. I am also grateful to *Mama Ndjana Serge Abissama Onana* and *Nenkam Serge Rodrigue* for their review. I am particularly grateful to *Armel Fabrice Fosse* and *Marthe Nnoko* for the English version.

Contents

1. Basic Data

This paper is presented on 19 June 2013 to commemorate the 1st ***African Standards Day*** on the theme "*Celebrating Standardisation as a Strategic Resource to Africa's economic integration"*. This celebration consolidates the 36th anniversary of the ***African Organisation for Standardisation (ARSO)***. This Pan African event is one of the pivotal items of the 19th General Assembly of ARSO, jointly organised by ARSO and ANOR (*Standards and Quality Agency)* at *Hilton Hotel*, Yaoundé – Cameroon from 17 to 21 June 2013.

The organisers of the 1st ***African Standards Day*** asked me to present, under the sub theme "*Role of Standards in African Development"*, a paper titled: "***Technological and Industrial Development of Africa: The Role of Standards***". In the current Pan African context dominated by the issue of the structural transformation of Africa's economy through robust and accelerated industrialization, *the operational and systemic role of standards and associated technologies* needs to be better clarified, positioned and actively utilised in order to quickly and continuously boost the continent's technological accumulation and absorptive capacity, backbone of an effective and efficient industrial strategy.

In this respect, this paper is organized in five parts: *(i) an overview of Africa's technological and industrial development; (ii) identification of the main benchmarks for a new strategy for Africa's accelerated industrialisation; (iii) clarification of the role of the policy on technology and standards in Africa's new industrialisation policy; (iv) the practical case of project, programme and portfolio management technologies and (v) conclusion and recommendations to ARSO, ANOR and other Pan African institutions and governments of the member States of the African Union.*

2. Overview of Africa's Technological and Industrial Development

Africa's technological and industrial development can be summarised into four (4) main points: *(i) reminder of the role of industry as a driver of prosperity in modern nations;(ii) identifying the main phases of Africa's industrialization; (iii) evaluation of the industrial performances of Africa and (iv) comparative evaluation of African productivity and its components.*

2.1. Industry, main Driver of the Prosperity of Nations

Industry is all activities which ensure that scientific and technical results can be used to produce goods and services that the world's society needs. Industry must be able to continuously absorb knowledge acquired (*scientific, technical and technological*) and meet demand which is increasingly greedy in goods and services produced. Practically, the scientific and technical results are used through technology.

Whether technology is *hard* or *soft*, codified or tacit, it is the main determining factor in the industrial production of a company at the microeconomic level and of a country at the macroeconomic level. Countries very far from the world technological frontier (like most African States) are least advanced. They are characterized by low income and are economically poor. In contrast, countries closer to or on the technological frontier are distinguished by their high industrialization and high income. They are economically rich. Any country that wants to be a prosperous nation and in sustainable economic and social progress, must bank on an industrial strategy centred on robust technological mastery, resting on operational benchmarks inspired by regional and international best practices.

For several years now, the definition of economist Clark (1960), which segments the productive system into primary, secondary and tertiary sectors, has become obsolete in determining industrial dynamics. Modern industry covers a dominant part of economic activity. Mentioning some industrial sectors should be convincing enough: manufacturing industry, information and communication

industry, tourist industry, culture industry, construction industry, energy industry, posts industry, agro industry, etc.

In spite of this sectorial diversification of modern industry, one thing remains constant: the manufacturing industry plays a dominant role (*technological innovations, knock-on effects and synergy effects)* in the dynamic of the structural and infrastructural transformation of an economy and its exports[1]. This transformation is materialized by the changes in the technological nature, category and intensity (low, medium and high), which are reflected on the manufactured goods produced and the related services elaborated.

The real economic growth and prosperity of a country are fundamentally determined by a constant rise in the productivity of its economy. *Productivity*, whether it is defined as GDP per capita or output per worker, has three complementary but unequally important components: *physical capital productivity, human capital productivity* and *total factor productivity (TFP)* or the efficiency of productive methods used, that is, *technology.* The dynamic of the structural and infrastructural transformation of the economy is reflected in the shift from low productivity and low technological intensity production activities to high productivity and high technological intensity production activities. This change in structure is also manifested through a significant mutation of the sectorial component of the gross domestic product (GDP) specifically, a major shift in the employment and production from the primary sector to the secondary and/or tertiary sector. The main driver, in this transformation process centred on perpetually increasing productivity, is *technological change or progress*.

2.2. The Main Phases of Africa's Industrialization

Despite the timing gaps per country and regions, there is consensus that since independence, Africa has undergone three main phases in its industrial development[2]: *(i) industrialization by import-substitution, (ii) industrialization by structural adjustment programmes (SAPs) and (iii) industrialization by poverty reduction strategies (PRSPs).*

Phase One: ***Industrialization by Import Substitution (IIS)***. The policy model of industrialization by the replacement of importations was used in Africa from the independence period in the late 1950s and early 1960s till the late 1970s and early 1980s (twenty years). *Coupled with the inherited colonial productive system mainly based on the exportation of primary agricultural and mining products*, the IIS model was based on an interventionist and developer State using the legal or rigid planning for the selection and execution of industrial investments (public and mixed economy corporations). The said investments were supposed to ensure the domestic production of already imported consumer goods with a perspective of improving in range and production stage to intermediary goods and equipment products. Since importations and the domestic market were reference targets, industrial policy instruments and measures were reflected as trade protectionism (*tariff and non tariff barriers*), negligence of the exportation of manufactured goods and the granting of various incentives and other benefits in terms of taxation, direct financing and subsidised interest rates to local businesses.

Since the exportation of manufactured goods was implicitly neglected, towards the end of the 70s, the unsustainable nature of the industrialization by import substitution model resulted in a severe lack of currency and, consequently, serious balance of payments problems.

Phase Two: ***Industrialization by Structural Adjustment Programmes (SAPs).*** The phase of industrialization by SAPs spans from the early 1980s to the late 1990s (twenty years). As a counter proposal to the "*Lagos Plan of Action for the Economic Development of Africa, 1980-2000*" which the

[1]**United Nations** (UNCTAD and UNIDO), *Economic Development in Africa, Report 2011*, Fostering Industrial Development in Africa in the New Global Environment, page 10.
[2]**United Nations**, *Report 2011 cited above and* **Economic Commission for Africa & African Union**, *Economic Report on Africa 2013 – Making the Most of Africa's Commodities: Industrializing for Growth, Jobs and Economic Transformation.*

OAU adopted in April 1980 in implementation of the Monrovia Declaration adopted in July 1981, the World Bank had published in 1981 the *Berg Report* titled "*Accelerated Development in Sub-Saharan Africa: A Plan for Action*" thus recommending SAPs as reference model. This report had been presented in September 1980 during the *Breton Woods* institutions joint annual meeting following the G7's approval of the World Bank's Structural Adjustment Loan during its summit in Venice (Italy) from 22 to 23 June 1980, as a major financial innovation. Contrarily to African leaders who were convinced of State driven industrialization, Breton Woods institutions were against the importance placed on industry, trade protectionism and State intervention. Instead, they had been privileging agriculture, openness, and markets. Faced with difficulties in balance of payments, several African countries were forced to implement SAPs. SAPs translated notably in the breaking up of IIS instruments and measures, the liberalisation of economies, the closing and privatisation of enterprises, the weakening and reduction of the role of States, placing the market at the heart of national economic systems with a marginalisation of social sectors.

The unsustainable nature of the SAP model was translated by the lack of qualitative structural transformation of the economies and the diversification of exports. Accordingly, around the late 1990s, State debt overload problems became recurrent and unsustainable. *The productive system based on the exportation of raw agricultural and mining products remained predominant.*

Phase Three: ***Industrialization by Poverty Reduction Strategy Papers (PRSP)***. Industrialization through PRSPs began in 2000 and is still going on today. The heavily indebted poor countries (HIPC) initiative was initially launched in 1996 and was strengthened in 1999. In this framework and motivated by G7 countries, the IMF and the World Bank imposed, from the start of the year 2000, the approach of poverty reduction strategy papers as a requirement to benefit from the initiative. By late January 2013, *thirty three (33) African countries were committed in the HIPC initiative process.* Since 2000, the PRSP has become a reference model for public policy formulation and implementation in several African countries. Social sectors came back to a good position. Agriculture and associated industries regained a better place in recent years. However, industry was still marginalised or played an unessential role. Productive systems in most African countries mainly focus on the production and exportation of primary agricultural and mining products.

2.3. Evaluation of Africa's Industrial Performances

Table 1 below (page 6), from the UNIDO-UNCTAD 2011 report[3], recapitulates the statistics of the compared contribution of Africa's industry to GDP from 1970 to 2008. It can be noted that Africa, lagging as per the performances of developing countries, has suffered severe deindustrialization especially during the SAP and PRSP phases from 1980 to 2008. The share of the manufacturing industry dropped from 11.92% in 1980 to 10.49% in 2008 as against 17.26% and 23.73% for developing countries.

The deindustrialization of Africa is coupled with the positive economic growth observed since the 2000s. As the figure 1 below (page 6) demonstrates, this growth is mainly driven by the commodities price boom underpinned by strong demand from China and India.

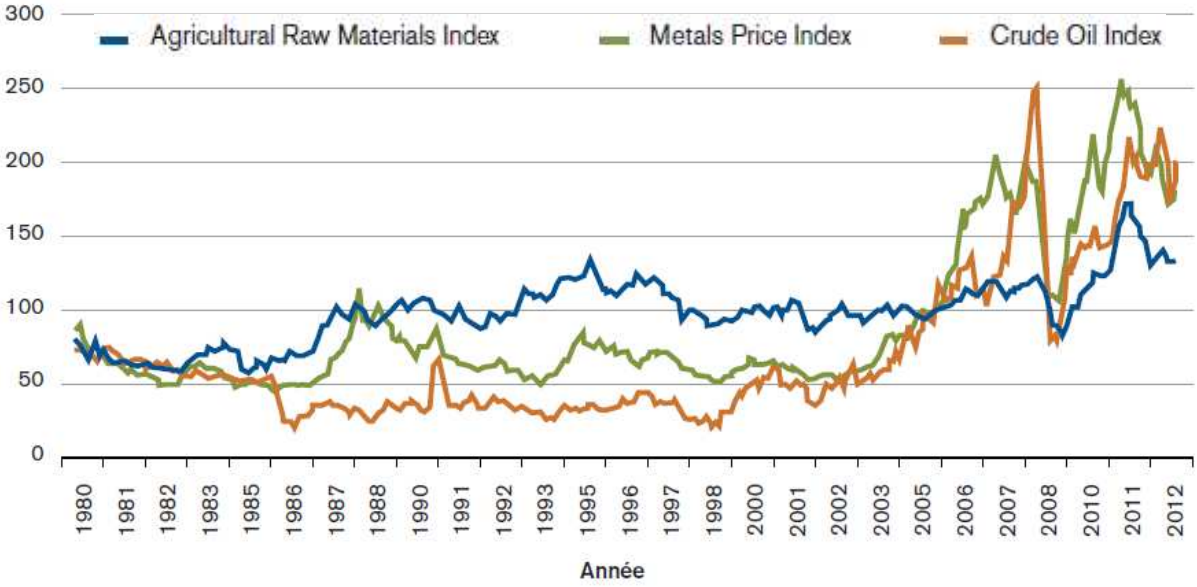
[3] **United Nations** (UNCTAD and UNIDO), *Economic Development in Africa, Report 2011*, Fostering Industrial Development in Africa in the New Global Environment

Table 1: Contribution of Industry to GDP for the 1970-2008 Period

	% share of GDP	1970	1980	1990	2000	2005	2008
World	Industry	36.9	38.1	33.3	29.1	28.8	30.1
	Manufacturing	26.7	24.4	21.7	19.2	17.8	18.1
	Mining & utilities	3.9	7.1	5.2	4.5	5.5	6.2
Developing economies	Industry	27.3	41.1	36.8	36.3	38.9	40.2
	Manufacturing	17.6	20.2	22.4	22.6	23.3	23.7
	Mining & utilities	5.7	14.7	8.9	8.3	10.1	10.9
African developing economies	Industry	13.1	35.6	35.2	35.5	38.8	40.7
	Manufacturing	6.3	11.9	15.3	12.8	11.6	10.5
	Mining & utilities	4.8	19.3	15.2	18.4	23.0	25.8
Eastern Africa	Industry	3.1	7.8	20.6	18.6	20.6	20.3
	Manufacturing	1.7	4.9	13.4	10.4	10.3	9.7
	Mining & utilities	0.8	1.5	3.3	3.1	3.6	3.7
Middle Africa	Industry	34.2	38.4	34.1	50.4	57.9	59.8
	Manufacturing	10.3	11.8	11.2	8.2	7.3	6.4
	Mining & utilities	19.1	21.2	18.9	39.3	47.9	50.5
Northern Africa	Industry	34.2	50.0	37.4	37.8	45.0	46.0
	Manufacturing	13.6	9.7	13.4	12.8	11.3	10.7
	Mining & utilities	15.7	33.0	17.2	19.5	28.2	29.8
Southern Africa	Industry	38.2	48.2	40.6	32.7	31.7	34.5
	Manufacturing	22.0	20.9	22.9	18.4	17.9	18.2
	Mining & utilities	12.0	24.0	14.3	11.7	11.2	13.1
Western Africa	Industry	26.7	43.3	34.5	39.8	36.7	37.4
	Manufacturing	13.3	16.8	13.1	7.8	6.0	5.0
	Mining & utilities	7.7	21.3	18.8	29.3	27.7	29.6

Source: UNCTAD/UNIDO, Economic Development in Africa, Report 2011, page 15.

Figure 1: Commodities Price Index, January 1980-January 2011



Source: ECA-AU 2013 Report, page 85.

2.4. Comparative Evaluation of African Productivity

In the observed deindustrialization in Africa and underlying economic growth rate, it is essential to evaluate productivity performances by separating *(i) the productivity of capital, (ii) the productivity of labour and (iii) the total factor productivity (TFP)* representing technology. Table 2 below recounts the evolution of productivity in 84 countries worldwide, with 19 of them from Sub-Saharan Africa over a 40 year period (1960 – 2003)[4].

Table 2: Sources of Economic Growth, 1960-2000

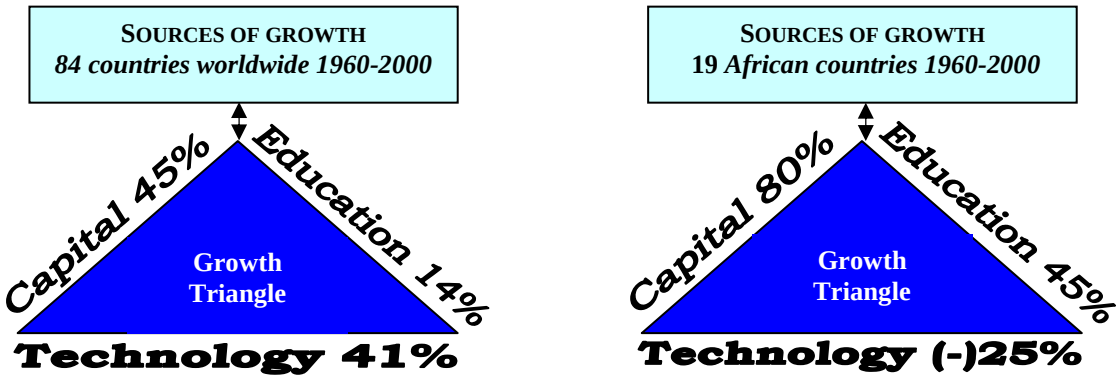
Region / Period	Production	Output per Worker	Contribution of:		
			Physical Capital	Education	Total Factor Productivity
In Percentage					
World (84 countries)					
1960-1970	5.1	3.5	1.2	0.3	1.9
1970-1980	3.9	1.9	1.1	0.5	0.3
1980-1990	3.5	1.8	0.8	0.3	0.8
1990-2000	3.3	1.9	0.9	0.3	0.8
1960-2000	4.0	2.3	1.0	0.3	0.9
Sub-Saharan Africa (19 countries)					
1960-1970	5.2	2.8	0.7	0.2	1.9
1970-1980	3.6	1.0	1.3	0.1	-0.3
1980-1990	1.7	-1.1	-0.1	0.4	-1.4
1990-2000	2.3	-0.2	-0.1	0.4	-0.5
1960-2000	3.2	0.6	0.5	0.3	-0.1
Contribution of Factors in Proportions (%)					
World (84 countries)					
1960-1970		100	35	10	55
1970-1980		100	58	26	16
1980-1990		100	46	18	46
1990-2000		100	45	15	40
1960-2000		100	45	14	41
Sub-Saharan Africa (19 countries)					
1960-1970		100	25	7	68
1970-1980		100	126	8	-34
1980-1990		-100	-9	36	-127
1990-2000		-100	-50	200	-250
1960-2000		100	80	45	-25

Source: *Bosworth Barry and Collins M. Susan., 2003*

This statistical data (*despite the error margin*) clearly show that the growth models used in Sub-Saharan Africa since the 1970s are extremely imbalanced and evidently contrary to those corresponding with the pursuit of economic and social progress. In the 84 countries selected around the world, *total factor productivity or technology* contributed to 41% of economic growth. *Contrarily, in the 19 countries south of the Sahara, the technological deficit reduced economic growth by 25%, that is insufficient productive efficiency to the tune of 66% as compared with global trends (see figure 2 below).*

[4]Results in percentage are drawn from **Bosworth Barry and Collins M. Susan**., 2003 (September 22,) "***The Empirics of Growth: An Update***", Brookings Institution, Washington, D.C. (USA).
The 19 African countries are: *South Africa, Cameroon, Cote d'Ivoire, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mauritius, Mozambique, Nigeria, Uganda, Rwanda, Senegal, Sierra Leone, Tanzania, Zambia and Zimbabwe.*

Figure 2: Sources of Economic Growth, 1960-2000



It can be broadly noted that the imbalance and inadequacy of economic growth models in Sub-Saharan Africa have been considerably worsening. From 1970 to 1980, the first decade of imbalance, the technological deficit reduced economic growth by 34% as against a predominant contribution of 68% from 1960 to 1970. From 1980 to 1990, the shortage of the technology factor reduced economic growth by 127% and this negative contribution culminated to 250% between 1990 and 2000. In compliance with this trend, the situation should not be reversed in the 2000-2010 decade as indicated by the contribution of the manufacturing sector to Africa's GDP which dropped from 12.81% in 2000 to 10.49% in 2008. Technology is lacking in economic growth models in Africa and is in correlation with the movement of deindustrialization in the continent.

Empirical studies show that it is the differences in factor productivity growth in general (*discrepancies in technology development*) that primarily justify the differences in economic growth between countries worldwide. The study of *Easterly* and *Levine* (2001)[5] is an interesting illustration of this observation: "*TFP-growth differentials account for the bulk of cross-country growth differences. For instance, Klenow and Rodriguez-Clare (1997) estimate that, differences in TFP growth account for about 90% of the variation in growth rates of output per worker across a sample of 98 countries over the period 1960-1995 after accounting for human capital accumulation. Similarly, using the newly constructed capital stock series from disaggregated investment data from the Penn-World Tables and estimates of growth rate human capital from Benhalib and Spiegel (1994), we also find that differences in TFP-growth account for about 90% of cross-country differences in real per capita GDP growth over the period 1960-1992*".

Having identified the main source of the structural imbalance of economic growth models in Africa, African leaders should be aware and act accordingly by placing as priority of priorities the technological catching-up within the framework of an accelerated industrialization strategy for the continent.

3. The Main benchmarks for a New Strategy for Africa's Accelerated Industrialisation

Mindful of the observed trend of deindustrialization, Pan African institutions, specifically the African Union, the African Development Bank and the NEPAD Planning and Coordinating Agency, from the late 2000s, have undertaken various initiatives. These aim the formulation and implementation of a new strategy for the accelerated industrialization of Africa and for the structural and infrastructural transformation of the continent's economy.

Under this framework, seven (7) main benchmarks can be identified:

[5] **William Easterly and Ross Levine**, *"It's Not Factor Accumulation: Stylized Facts and Growth Models"*, *World Bank Economic Review 15 (2), March 2001.*

(i) the urgent need for structural transformation in African economies;
(ii) the Action Plan for Accelerated Industrial Development of Africa (AIDA);
(iii) Africa's Science and Technology Consolidated Plan of Action (PAC);
(iv) the Africa Mining Vision 2050;
(v) the Programme for Infrastructure Development in Africa (PIDA);
(vi) the UNIDO-UNCTAD 2011 and ECA-AU 2013 Reports; and
*(vii) the p*rimacy of industrialization and articulation of *the public policies of each African country, at both continental and regional levels.*

3.1. The Urgent Need for Structural Transformation in African Economies

The currently prevailing economic growth model in Africa is imbalanced and mainly driven by the commodities price boom linked with high demand from the new economic powers in Asia. The model is vulnerable and out of phase with Africa's pressing needs. This economic growth rate is not generating the volume of jobs that Africa needs to sustainably and substantially reduce unemployment and alleviate poverty. An estimated 7 to 10 million African youths enter the job market every year. The high demand for jobs stemming from this demographical dynamic in Africa requires a productive system which is diversified and in perpetual structural and infrastructural transformation.

Development of industry in general and the manufacturing industry in particular will have to play a predominant role (technological *innovations, knock-on effects, synergy effects*) in the dynamic of structural and infrastructural transformation of African economies through accelerated technological changes visible through the production and exportation of manufactured goods in Africa and the world.

This paper will highlight four (4) structural and infrastructural transformation initiatives of Africa's economy from the perspective of their operational feasibility and sustainable success.

3.2. Action Plan for Accelerated Industrial Development of Africa (AIDA)

Formulated under the framework of the Conference of African Ministers of Industry (CAMI) with the support of UNIDO *(United Nations Industrial Development Organization), the Action Plan for Accelerated Industrial Development of Africa (AIDA)*[6] was approved by African Union Heads of State and Government in February 2008. AIDA defines critical priorities for action at the national, regional, continental and international levels for coherent industrial development of Africa. Concretely speaking, the AIDA implementation strategy is the operational structuring of structural transformation initiatives of Africa's economy organised into ***seven (7) programmes and project portfolios (modules) having a total of twenty (20) programmes and fifty-two (52) projects***. The table 3 below shows the statistical distribution of these initiatives to be governed and managed in the short, medium and long terms.

Table 3: Portfolios of Programmes and Projects of AIDA

Portfolio	**Number of Programmes**	**Number of Projects**
1. Industrial Policy and Institutional Orientation	2	5
2. Updating Production and Trade Capacities	3	6
3. Promoting Infrastructure and Energy for Industrial Development	4	5
4. Building Competence for Industrial Development	2	6
5. Industrial Innovation Systems, Research and Development and Technological Development	2	8
6. Financing and Resources Mobilising	4	13
7. Sustainable Development	3	9
Total	**20**	**52**

[6] The *Action Plan for Accelerated Industrial Development of Africa* and the *Strategy for the Implementation of the Plan of Action for the Accelerated Industrial Development of Africa* are available on the African Union website: www.au.int.

From the perspective of operational feasibility, the review of AIDA and its implementation strategy dated September 2008 highlights the absence of a really credible institutional governance and management mechanism for the seven (7) portfolios of programmes and projects which guarantees the successful initiation, planning and execution of each project under the best conditions of scope, schedule, cost and quality.

It is only in November 2012, that is, almost five (5) years after the adoption of AIDA that the CAMI Bureau approved the idea of establishing an AIDA Implementation and Coordination Unit within the African Union Commission.

3.3. Africa's Science and Technology Consolidated Plan of Action

Africa's Science and Technology Consolidated Plan of Action (CPA)[7] was approved by African Union Heads of State and Government in 2006. The CPA was formulated under the framework of the *African Ministerial Council on Science and Technology* (AMCOST) by the NEPAD Secretariat with the support of the *South African Department of Science and Technology (DST)* and the United Nations Education, Science and Culture Organization (UNESCO). The CPA outlines critical action priorities at the national, regional, continental and international levels to develop and use science and technology in the socio-economic transformation of the continent and its integration in the global economy. It is built on three interlinked conceptual pillars. These are: *(a) capacity building; (b) knowledge production and (c) technological innovations.*

Concretely, the CPA is an operational structuring of initiatives for developing science and technology organised in ***five (5) portfolios of programmes and projects (modules) with a total of eighteen (18) programmes and forty-three (43) projects***. The table below shows the statistical distribution of these initiatives to be governed and managed in the short, medium and long terms.

Table 4: Portfolios of Programmes and Projects of CPA

Portfolio	Number of Programmes	Number of Projects
1. Biodiversity, Biotechnology and Indigenous Knowledge	3	8
2. Energy, Water and Desertification	3	7
3. Materials Sciences, Laser Manufacturing, Post Harvest Technologies	4	8
4. Information and Communication Technologies and Space science and Technologies	2	5
5. Improving policy conditions and strengthening innovation mechanisms	6	15
Total	**18**	**43**

Added to concerns about the effectiveness and efficiency of the institutional system of CPA governance and management adopted in 2006, it appears that the issue of its conceptual and operational relationship with the *Action Plan for Accelerated Industrial Development of Africa* (AIDA) adopted in 2008 has not been tackled.

3.4. The African Mining Vision 2050

The African Mining Vision 2050 (AMV)[8] was developed within the framework of the African Union Conference of Ministers in charge of Mining Resource Development with the support of the United Nations Economic Commission for Africa (ECA). The AMV was approved by African Union Heads of State and Government in February 2009. The AMV implementation action plan was approved by African Union Heads of State and Government in 2011.

[7] *Africa's Science and Technology Consolidated Plan of Action* (CPA) is available on the NEPAD website: www.nepadst.org.

[8] *The African Mining Vision 2050* and *The AMV implementation action plan* are available on the Africa Union website: www.au.int.

The AMV defines critical priorities for action at the national, regional, continental and international levels. It aims at using Africa's natural resource sector to contribute in the structural transformation of the continent by accelerating industrialization, diversifying production and its integration in the global economy. In concrete terms, the AMV and its action plan consists of the operational structuring of extractive industries development initiatives organised in ***nine (9) portfolios of programmes and projects (modules) with a total of eleven (11) programmes, of which the projects have not yet been identified***. The table below presents the statistical distribution of these initiatives to be governed and managed in the short, medium and long terms.

Table 5: Portfolios of Programmes and Projects of AMV

Portfolio	Number of Programmes	Number of Projects
1. Mining Revenue and Mineral Rents Management	2	
2. Geological and Mining Information Systems	1	
3. Building Human and Institutional Capacities	1	
4. Artisanal and Small Scale Mining	1	
5. Mineral Sector Governance	2	
6. Research and Development	1	
7. Environmental and Social Issues	1	
8. Linkages and Diversification	1	
9. Mobilising of Mining and Infrastructure Investment	1	
Total	**11**	

The institutional system of governance and management of portfolios, programmes and projects is to be formulated and established for the structural transformation of the mining industry to become reality. To this end, an African Mineral Development Centre is being created to serve as an AMV management agency. This institution's business plan was published in August 2012[9].

3.5. The Programme for Infrastructure Development in Africa (PIDA)

After its introduction in July 2010 and its formulation by the African Union Commission, in partnership with the African Development Bank (AfDB), the NEPAD Planning and Coordinating Agency and the Economic Commission for Africa, the launching of the *Programme for Infrastructure Development in Africa (PIDA)*[10] was approved by African Union Heads of State and Government in February 2012.

PIDA defines critical priorities for action at the national, regional, continental and international levels to accelerate the integration and structural transformation of Africa's economy and to integrate it in the global economy through integrated regional and continental infrastructure networks. PIDA was formulated with short term goals to be achieved by 2020, middle term goals to be achieved by 2030 and long term goals to be achieved by 2040. *PIDA is estimated to cost over 360 billion USD by 2040.*

The PIDA priority action plan (PAP) by 2020 is estimated at close to 68 billion USD and concretely consists in the operational structuring of infrastructure development initiatives organised in ***five portfolios of programmes and projects (sectors) with a total of twenty-seven (27) programmes and twenty-four (24) projects***. The table 6 below presents the statistical distribution of these initiatives to be governed and managed by 2020 under the PAP.

[9] "*The African Minerals Development Centre, Business Plan, August, 2012*" is available online on the African Union website: www.au.int

[10] The *Programme for Infrastructure Development in Africa (PIDA)* is available online on the websites of the African Union (www.au.int) and the African Development Bank (www.afdb.org).

Table 6: Portfolios of Programmes and Projects of PIDA

Portfolio	Number of Programmes	Number of Projects
1. Energy	-	15
2. Transport	24	-
3. Trans-boundary Water Resources	-	9
4. Information and Communication Technologies	3	-
Total	**27**	**24**

PIDA is governed and managed under the framework of an *Institutional Architecture for Infrastructure Development for Africa* (IAIDA). The main PIDA governance and management institutions include AUC, AfDB and NPCA which is the main executing body.

3.6. UNIDO-UNCTAD 2011 and ECA-AU 2013 Reports

The recurring underscoring of the urgent need for the structural and infrastructural transformation of Africa's economy specifically through accelerated industrialization (*the Action Plan for Accelerated Industrial Development of Africa was adopted by AU Heads of State and Government in February 2008*) led the main United Nations economic institutions to produce public reports useful for debate on the issue of the New Industrial Strategy/Policy in Africa. Two (2) main reports fall within this framework: (i) the UNIDO-UNCTAD Report 2011 and (ii) the ECA-AU 2013 Report.

3.6.1. UNIDO-UNCTAD Report 2011

In July 2011, the *United Nations Conference on Trade and Development* (UNCTAD) and the *United Nations Industrial Development Organisation* (UNIDO) jointly published the *2011 Report on Economic Development in Africa*, titled "***Fostering Industrial Development in Africa in the New Global Environment***"[11]. In terms of applied policy evaluation, this United Nations report observes the deindustrialization in Africa with SAPs as well as PRSPs. UNCTAD and UNIDO call for and recommend the formulation and implementation of a new industrial policy in Africa (*industrial diagnosis and strategy formulation, principles, sectors, instruments, financing, complementary policies and the inclusion of the new international environment).*

3.6.2. ECA-AU 2013 Report

The theme of the joint publication by the United Nations Economic Commission for Africa (ECA) and the African Union Commission of the Economic Report on Africa 2013 is: "*Making the Most of Africa's Commodities:* ***Industrializing for Growth, Jobs and Economic Transformation***"[12]. The ECA-AUC Report, like the UNCTAD-UNIDO Report, observes the deindustrialization in Africa over the last three decades. This deindustrialization has led to increasing marginalization of Africa in the world economy. This report recommends a resource- or commodity-based industrialization approach.

3.7. Primacy of Industrialization and Articulation of Public Policies

With the painful observation of the deindustrialisation of Africa during the last three (3) decades, the imperative and urgent need for a new strategy for the industrialization of Africa is undeniable. The crucial issue arising in Africa today is the strategic and operational approach of a new effective and efficient policy of industrialization. This is the initiation of the fourth phase of industrialization in Africa.

[11] The *UNCTAD and UNIDO 2011 Report on Economic Development in Africa* is available on the UNCTAD website: www.unctad.org

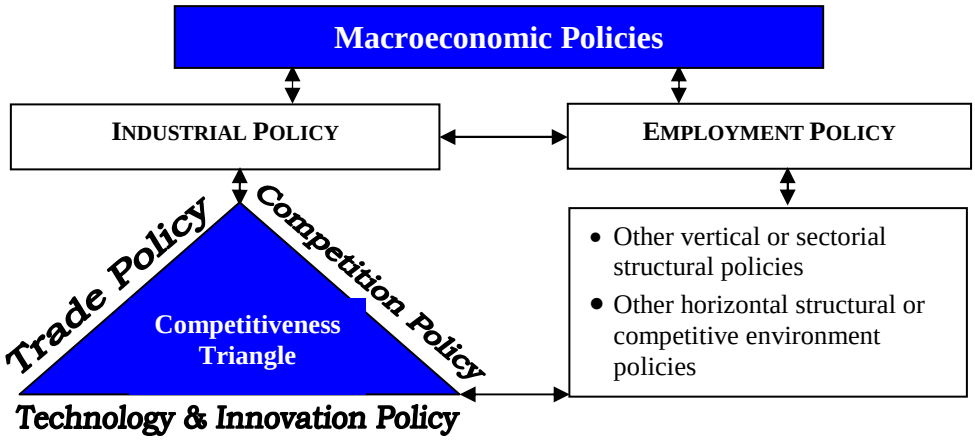
[12] The *Economic Report on Africa 2013* by ECA and AUC is available on the ECA website: www.uneca.org

3.7.1. How to Articulate the New Industrial Policy with all other Public Policies?

For example, the *Action Plan for Accelerated Industrial Development in Africa (AIDA)* was approved in February 2008 and the AIDA implementation strategy was adopted in September 2008 with a total of twenty (20) programmes and fifty two (52) projects. As of date, more than five (5) years later, the balance sheet of effective execution of AIDA programmes and projects is not as good as it could have been. Moreover, *Africa's Science and Technology Consolidated Plan of Action (CPA)* approved in 2006 with a total of eighteen (18) programmes and forty-three (43) projects has no formal linkage with AIDA. However, the CPA must be a major component of PIDA.

In a perspective of a structural and infrastructural transformation of the African economy through accelerated industrialisation, the figure 3 below defines the articulation of economic policies which the Governments of *African States* should incorporate in their strategic and operational processes and procedures.

Figure 3: Adequate Articulation of Economic Policies



In terms of economic policies, keep in mind this fundamental lessons learned that a country far from the technological frontier (e.g. Cameroon) should not implement the same policies like one close to or on the technological frontier (e.g. United-States). Most African countries are very far from the technology frontier and cannot be satisfied with just applying horizontal or competitive environment policies without coupling them with aggressive industrial policies with selective and incentive interventions. Therefore, African public policies should be based on a clear and explicit affirmation of industrialization translated by the primacy of industrial development goals at every stage of the State's critical decision-making path.

The primacy of industrial policy supposes a clear and well understood subordination of every other structural socio-economic policies. Among these structural policies, discrimination (without being positive or negative) must be undertaken. ***The three (3) public policies forming the triangle of competitiveness and supporting an effective and efficient industrial policy*** *are: (i) the technology, standards and innovation policy, (ii) the competition policy and (iii) the trade policy.* Also, the underlying policy to the industrial policy is employment one which aims at acting on job creation levels and reducing unemployment. Policies on education and vocational training,, and infrastructure (energy, transport, information & communication, etc.) must all be subordinate to the industrial policy in coherence with the employment policy. Placed above structural policies are macroeconomic policies. Without prejudice of maintaining macroeconomic stability (internal and external balances), monetary and budgetary policies must absolutely accommodate industrial policy goals.

It is consistent with this articulation of the industrial policy and other public policies that the specific role of technology, standards and innovation is discussed in terms of the contribution to the accelerated industrialization of Africa.

3.7.2. Practically Speaking, How will the New Industrial policy be Articulated with other Public Policies?

This major question comes to the issue of transition from the phase of *industrialization by PRSPs* that has shown its limits in a fourth phase that can be *industrialization by technological development*. This fourth phase of Africa's real and accelerated industrialization can only be sustainably and irreversibly undertaken by technology development following the phasing described in Section 4.3. (*Critical role of technological accumulation and absorptive capacity*). It is to place technology at the centre of the continent's industrial approach.

The recommendations of the 2011 UNCTAD-UNIDO and 2013 AUC-ECA reports specifically address the immediate impulse of a new industrial policy in Africa and can be easily integrated in this phase of industrialization by technological development. The new industrial policy must help Africa get out of the severe de-industrialization observed.

However, in the current formulation and implementation practice of public policies in Africa, it is *the PRSP approach of the International Monetary Fund (IMF) and the World Bank which is in force in most countries*. According to IMF data for January 2013[13], thirty-three (33) African countries are or were in the process of the HIPC initiative with twenty-nine (29) countries having reached the completion point, one (1) country having reached the decision point and three (3) countries that have not yet reached the decision point. All these countries have necessarily adopted the PRSP approach. In addition, several other African countries that use the so-called concessional financing and other instruments of the IMF and the World Bank are obliged to apply the PRSP approach.

Thus, in the reality of African public policies, there is an opposition of industrialization approaches between the IMF and the World Bank on the one hand, with their PRSP approach, non-financial agencies of United Nations (*UNCTAD, UNIDO and ECA*) and the other hand, relied on by the African Union Commission to initiate a new industrialization strategy of the continent. In this opposition of approaches, the balance of forces on the ground favours the couple IMF-World Bank, which has a greater financial intervention capacity.

In this context, the impulse, initiation and effectiveness of a new strategy of accelerated industrialization of Africa, are determined by the expression, the structure and the affirmation of *a real pan-African political leadership supported by Heads of State and Government themselves, based on the technocratic capacity of their own government institutions in the Member States*. It is neither the *Bretton Woods* institutions (IMF, World Bank), nor other United Nations agencies which should be the basic institutional backbone for Africa's industrialization.

4. The Role of Technology and Standards in Africa's New Industrialization Strategy

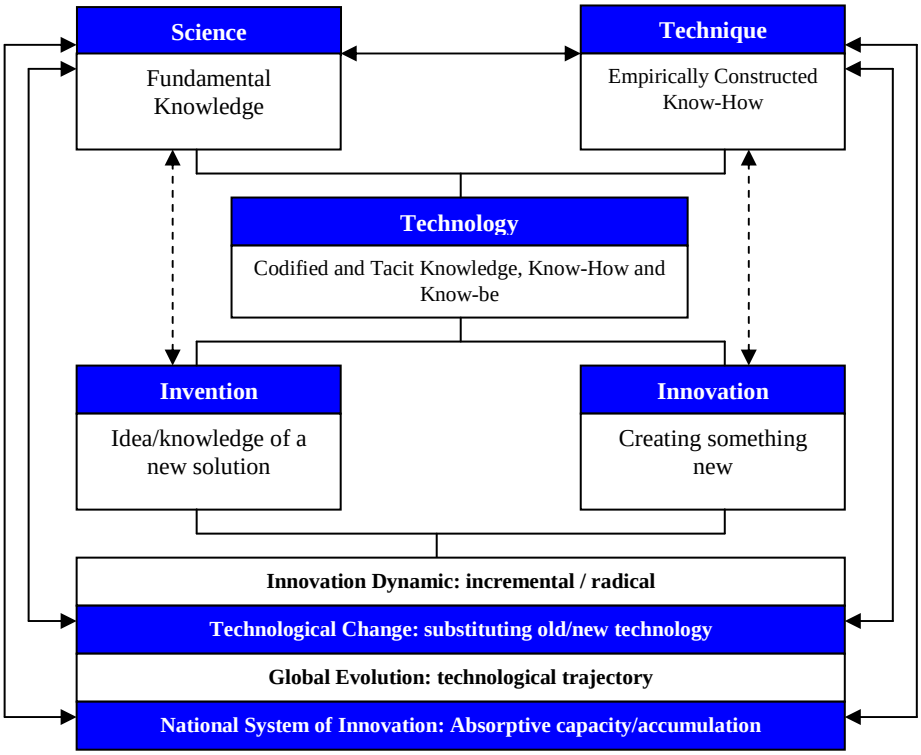
Manufactured goods are ranked by technological intensity: low technology goods, medium technology goods and high technology goods. Technology, standards and innovation policy is central to every credible, pertinent and operational industrialization strategy. With the perspective of a new strategy for Africa's industrialization, this paper reviews the role of technologies and standards in four (4) main points: *(i) technology: what is it about? (ii) the relationship between technologies and standards; (iii) the critical role of technological accumulation and absorptive capacity; (iv) the proactive policy for technological infrastructure and quality infrastructure.*

[13] International Monetary Fund, **Factsheet**, "*Debt Relief Under the Heavily Indebted Poor Countries (HIPC) Initiative"*, available only on the IMF website (www.imf.org).

4.1. Technology: What is it about?

Technology is an asset or intangible property or even an intangible asset acquired and managed with much caution depending on its lifespan which can be more or less long. This immaterial good is represented by *operational knowledge (knowledge and know-how)*, that is, one that is specifically dedicated to solving concrete, generic or repetitive problems and finally meeting the real needs of mankind or society.

Figure 4: Dynamic of Technologies



Technology represents the combination of codified or explicit knowledge, know-how and/or tacit or implicit know-how likely to be mobilised in a conception and execution aimed specifically at solving a problem in order to meet a generic or recurring need in society. Codified or explicit technological knowledge is formalized in the form of inductions, standards, procedures, rules and blueprints that can be transmitted or reproduced in print (paper) or digital (CD-ROM, cassette, file) form. Tacit or implicit technological knowledge is informal, borne by humans and transmitted through practices on the field or on the job, from one person to another, through trade guilds. Each technology is characterised by two or a combination of codified knowledge and tacit knowledge. When the codification level is high, this *technology is termed hard*. When the tacitness level is high, it is termed *soft technology*. As figure 4 above shows, technology is clearly different from similar concepts contributing to the dynamic of technological change: science, technique, invention and innovation.

Science concerns learning or fundamental knowledge from basic research activities. It aims at highlighting basic relations and mechanisms characterising the world we live in; its physical, biological, chemical, medical, economic, geographical, sociological, environmental, etc. aspects. Technique concerns progressively and empirically developed know-how in the concrete activity or action process involving a dynamic of experimentation and experience accumulation. *Technology pulls specific knowledge from both science and technique while being distinct from them*. Invention concerns the formulation of new ideas in solving generic problems of society. Innovation on its part consecrates the effective execution of the novelty in order to meet a societal need. It is the achievement of the change which can be on the good or service, or on the manufacturing or

presentation process, or on other aspects of internal or external activity. Consequently, figure 4 above clears the way to the conception of knowledge-applying models and technical rationale models which must be authentically adapted to the organisational capacities of each country undertaking the dynamic of developing technologies.

Research and Technology. Considering the schematic structure of the dynamic of technologies above (Figure 4), it is important to mention the relationship between research and technology. Fundamental research and/or research and development (R&D) contribute to the dynamic of technologies. At the level of stakeholders, research is the business of scientists while technology is the business of entrepreneurs or industrialists. The issues of scientific and technical research are different from technological research problems. Thus, fundamental or scientific and technical research is mainly developed by public research institutions, universities and similar entities. Technological research is broadly developed by companies through various operational modalities. To accelerate the technological development of a country, States must not only finance fundamental research, but must especially provide substantial financial and institutional support to research and acquiring technologies directly to benefit companies and the economy.

There are four phases to **the life cycle of a technology**: emergence, growth, maturity and decline (see diagram below). This life cycle is determined by the process of innovation associated with the technology or aiming at meeting the same need.

Figure 5: Life Cycle of a Technology

1 – Emergence phase of the technology
2 – Development *(growth)* **phase of the technology**
3 – Maturity phase of the technology
4 – Obsolete (*decline*) phase of the technology

The life cycle of a technology is marked by incremental or progressive and cumulative innovations which enable the trajectory of the given technology to be traced until its maturity phase. *The decline of the technology or its obsolescence* happens as soon as there is a radical or revolutionary innovation leading to the emergence of a new technology and creating a technological break in the sector concerned. This dynamic of technological change demands that enterprises and States have a robust approach in the management of key or critical technologies for the development of the technological trajectory of each enterprise and each nation. At the centre of technological portfolio management is the Innovation System which underpins and conditions the dynamic of technological change. Figure 6 below summarises the elements to be taken into account in managing the technological portfolio of an enterprise or a nation.

The Enterprise System of Innovation and the National System of Innovation. At the enterprise level, the optimal management of a technological portfolio enabling the construction of a sustainable competitive advantage depends on the quality of the System of Innovation in place. The main determining factor of the quality or adequacy of this system of innovation in the enterprise is the technological accumulation and absorptive capacity. This technological capacity of the enterprise can only be appropriately developed if the innovation context is favourable at the national and international levels. The national context which is likely to encourage technological development taking into account international possibilities should include infrastructure and institutions providing appropriate accompanying incentives in the areas of *science, technology and standards* on the one hand, and in the areas of entrepreneurship, investment and industrial production activities on the other hand. This national context made up of infrastructure, institutions and incentives forms the National System of Innovation which supports the national technological accumulation and absorptive capacity. The primary determining factor of this technological accumulation and absorptive capacity is human capital that is qualified or able to internalize knowledge or own it and use it with skill, flexibility and adaptation, whether they fall under *hard* or *soft* technologies.

Figure 6: Managing a Technologies Portfolio

1 – Observing, identifying and evaluating alternative technologies
2 – Selecting the most robust and relevant technologies
3 – Acquiring and mastering selected technologies
4 – Managing underlying R&D activities
5 – Technology watch, adaptation and updating activities
6 – Terminating obsolete or declining technologies

Acquiring and Selling Technology. Technology is an intangible property or asset which is produced, bought or sold like any other good. It is a strategic asset with acquisition or selling operations that must be done with caution and following adequate legal procedures sometimes commensurate with industrial stakes. Technology is materialized by intellectual property rights, specifically copyrights (*notably on standards and computer software*) and industrial property rights. The main industrial property rights concerned by technology are: *(i) patents of invention (ii) manufacturing, trade and service models; (iii) designs and models; (iv) unpublished know-how, unpatentable technological knowledge and manufacturing secrets (confidential technological knowledge)*. Just like every good, technology has a lifespan with two aspects: economic life and legal life. The legal life of technology is a function of the type of intellectual property right. For example, the life of a patented invention universally converges around 20 years. After this period, the rights fall under the public domain or become State property. The economic life of the technology is very important because it is a product of the life cycle of the technology, summarized into four phases: emergence, growth, maturity and obsolescence. The price of technologies on the market incorporates these two factors of its life (economic and legal). Technologies are very costly in the emergence and growth phases. They become more affordable in the maturity phase and, finally, are cheap in the decline or obsolescence phase. This is the same when they fall under the public domain with the exception of technologies that remain critical or vital beyond their legal protection period.

Measures of Technology. Given that technology is an intangible asset, it is only partially possible to quantify it. Technology is measured using three types of data: (i) research and development (R&D) expenditures, (ii) patents and (iii) total factor productivity (TFP). R&D expenditures under the framework of innovation activities are a measure of the input of the technology, even if they do not concern the technology alone or do not systematically lead to the creation of a new technology. The second measure is made of the number of patents registered or obtained. It is a measure of output. In the case of patents, it is generally only a minority of patents that are actually exploited or transformed into technological creations or improvements through innovation. Also, several innovations are not patented and are maintained as manufacturing secrets or confidential know-how. Total factor productivity (TFP) is the third indicator in measuring technology. It is an output measure. The fundamental idea behind TFP is derived from the accounting of production which outlines that if capital and labour are subtracted from the contributing of factors, the remainder is determined by the technology factor. Thus in the **Cobb-Douglas** production function $\mathbf{Y = AK^{\alpha}L^{(1-\alpha)}}$, A represents TFP while K represents capital and L, labour. This measure of technology is very important for the productive performance and prosperity of a nation.

4.2. Relationship between Technologies and Standards

According to the *International Standards Organisation (ISO)*, a standard (voluntary) is a document established by consensus and approved by a recognized body that provides or codifies requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose. The voluntary standard differs from the mandatory standard which can be either a law or regulation, or a treaty or convention.

Life Cycle of a Standard and Life Cycle of a Technology. A standard has four phases in its life cycle: development, publication, revision and cancellation (see Figure 7 below). This life cycle is determined by the innovation process associated with technologies used in the area concerned to meet the same need. This life cycle is in high correlation and alignment with the life cycle of technology. Indeed, for each technology, there are several associated standards. Therefore, the standard acts as a major instrument codifying the technology for its dissemination in both local and international markets.

Figure 7: Life Cycle of a Standard

1 – Standard development phase
2 – Standard publication phase
3 – Standard revision phase
4 – Standard cancellation phase

Standards Portfolio Management and Technologies Portfolio Management. The management of the standards portfolio is directly linked to the management of the technological portfolio of the company. At the enterprise level, the optimal management of the innovation system is conditioned by the portfolio of required technologies as well as by the associated standards. The main determining factor, the technological accumulation and absorptive capacity, is confirmed with two (2) variables: technologies and associated or required standards, to utilize them adequately. At the national level, it is the National Innovation System, notably made up of *technological infrastructure and quality infrastructure*, incentive institutions and instruments that are supporting the national technological accumulation and absorptive capacity.

Figure 8: Managing a Standards Portfolio

1 – Observing, identifying and evaluating alternative standards
2 – Selecting the most robust and relevant standards
3 – Acquiring and mastering selected standards
4 – Managing underlying standardisation activities
5 – Standards watch, adaptation and updating activities
6 – Terminating cancelled or obsolete standards

Acquiring and Selling Standards in comparison with Technologies. Standard like technology is information good materialized by intellectual property rights and more specifically copyrights. In its global and operational vision, technology incorporates the standard for its application. Standards acquisition or selling operations are done with caution and adequate legal procedures. In terms of cost, standards are much less costly than technologies which are materialised by industrial property rights. Since standards represent the codification of state-of-the-art or the technological standard in force in a sector or trade, they ensure an easier and broader dissemination of technologies for use by the largest possible number of enterprises.

Measuring Standards in comparison with Technologies. Like technologies, standards are measured using three (3) types of data: *(i) standardization expenditures, (ii) published standards and (iii) total factor productivity (TFP).* These three indicators provide the level of technological and standards development of an enterprise, a country or a continent. Standardisation expenditures are done with the participation of stakeholders interested in standardization activities ensuring the codification of the state-of-the-art or the standard technology which translates current technological solution in the concerned sector.

The second measure is made of the number of published and implemented standards. Table 7 in page 19 shows the number of standards published in Africa and the world. ***Africa's standards deficit is the corollary of the technological deficit***. Similarly to technologies, total factor productivity (TFP) is the

third indicator in measuring standards. This main economic performance indicator is common to standards and technologies. It measures the economic impact of technologies and associated standards. Table 8 below summarises the estimates of economic impact of standards in several countries[14].

Table 7: Portfolio of published standards

ARSO MEMBER STATE		Number of stanadrds
1.	Burkina Faso*	
2.	Benin*	
3.	Cameroon	400
4.	Cote d'Ivoire*	
5.	Congo Brazzaville*	
6.	Democratic Republic of Congo*	
7.	Egypt	8 000
8.	Ethiopia	6 000
9.	Gabon	300
10.	Ghana	5 000
11.	Guinea Bissau*	
12.	Guinea*	
13.	Kenya	6 100
14.	Liberia*	
15.	Libyan Arab Jamahiriya*	
16.	Madagascar*	
17.	Malawi	2 200
18.	Mauritius	500
19.	Namibia	250
20.	Niger*	
21.	Nigeria	4 500
22.	Rwanda	1 200
23.	Senegal (2011)	346
24.	Seychelles*	
25.	Sierra Leone*	
26.	Sudan*	
27.	South Africa	7 600
28.	Swaziland	50
29.	Tanzania	2 000
30.	Togo*	
31.	Tunisia	13 000
32.	Uganda	1 500
33.	Zambia	2 500
34.	Zimbabwe	1 500

Continental & Regional level		
	ARSO	802
	EAC	1 250
	COMESA	370
	SADC	80

International level	
ISO	19 573

* Number of standards not known

Source: ARSO (www.orso-oran.org) & ISO (www.iso.org)

[14] ***Knut Blind, Andre Jungmittag et Axel Mangelsdorf***, "*The Economic Benefits of Standardization: An update of the study carried out by DIN in 2000*", DIN (German Institute for Standardization), June 2011.

Table 8: Impact of Standards on Economic Growth

N°	Country	Publisher Organisation	Time frame	Growth rate of GDP	Contribution of standards
1.	Germany	DIN (2000)	1960 - 1996	3.3%	**0.9%**
		DIN (2011)	2002 - 2006		**0.72%**
2.	France	AFNOR (2009)	1950 - 2007	3.4%	**0.8%**
3.	United Kingdom	DTI (2005)	1948 - 2002	2.5%	**0.3%**
4.	Canada	Standards Council of Canada (2007)	1981 - 2004	2.7%	**0.2%**
5.	Australia	Standards Australia (2006)	1962 - 2003	3.6%	**0.8%**

Source: DIN (German Institute for Standardization), June 2011

Table 9: Contribution to Growth of various Production Factors, in %

	1961–1965	1966–1970	1971–1975	1976–1980	1981–1985	1986–1990	1992*–1996	1997–2001	2002–2006
Capital	2.30%	1.70%	1.60%	1.10%	0.90%	0.90%	0.90%	0.50%	0.30%
Labour	0.70%	0.10%	−0.50%	0.60%	−0.40%	1.20%	−0.70%	0.60%	−0.30%
Patents	0.50%	0.50%	−0.60%	0.60%	1.00%	0.00%	−0.70%	−0.60%	−0.60%
Licences	0.90%	0.80%	0.90%	0.30%	0.50%	2.00%	1.70%	0.10%	0.50%
Standards	0.40%	0.60%	1.80%	1.20%	0.70%	−0.02%	0.70%	0.80%	0.70%
Special factors	0.01%	0.01%	−0.70%	−0.20%	−1.30%	0.01%	0.01%	−1.10%	1.10%

* There is no reliable data for 1991 due to German reunification.

Source: DIN (German Institute for Standardization), June 2011

When *total factor productivity* (TFP) is broken down, two main variables appear: (i) productivity derived from patents and licences representing technologies and (ii) productivity derived from standards representing the diffusion of technologies. Table 9 above shows the comparative analysis for the case of the German economy. *It is therefore clear that the standards variable has a substantial socio-economic impact on the pace of production, industrial in this case, and consequently the economic growth and prosperity of a country.*

4.3. The Critical Role of Technological Accumulation and Absorptive Capacity

Technological absorptive capacity represents the capacity of economic units like enterprises and States to absorb (learn) internalize or own and efficiently use technological knowledge that is potentially available and accessible locally and worldwide. Technological accumulation capacity has a broader meaning. It refers to the capacity of economic units to not only absorb, internalize and use technological knowledge created by others, but also create their own technological knowledge

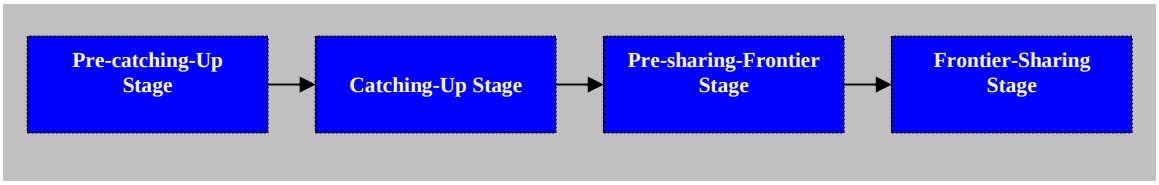
themselves, and efficiently use all of this knowledge in their productive activities. Absorptive capacity is a subset or component of an enterprise's or country's technological accumulation capacity.

It should be noted that the technological accumulation and absorptive capacity of a country is not just the sum of the technological accumulation and absorptive capacity of the country's enterprises. In addition to enterprises which should each place priority in establishing and developing their technological accumulation and absorptive capacity (*manufacturing plants, laboratories, equipments, scientists, engineers, technicians, professionals, etc.*) as the microeconomic foundation of industrial development, the State must guarantee the creation and development of industrial infrastructure which can absorb, acquire, internalize, disseminate and promote technological knowledge and innovations at the national level. This essential infrastructure is broken down into two (2) interdependent aspects: *Technological Infrastructure* and *Quality Infrastructure*. **Technologic al Infrastructure** is notably represented by: *public and private research institutes; universities; engineering and technical schools, intellectual property bodies and technological information bodies.* **Quality infrastructure** is in this case represented by *standardization bodies, metrology bodies and conformity assessment bodies* (Testing and calibration laboratories; management system certification bodies-QMS and EMS; persons certification bodies; products, services and systems certification bodies; inspection bodies).

The main operational determinant of this technological accumulation and absorptive capacity is invariably human capital. It is as valid for stakeholders in enterprises as it is for non-enterprises, hence the importance of explicit and specifically adequate profiling of the education policy with measured support from technology and industrial policies.

The mere presence of these two groups of stakeholders, enterprises and actors of industrial infrastructure, can not trigger a strong positive dynamic of technological accumulation and absorption for rapid economic progress and prosperity. It is crucial to have a supply of adequate incentives to investment and production as necessary supporting conditions. This is the function of public institutions which formulate and implement public policies including the industrial policy supported by the technology, standards and innovation policy, the competition policy, the trade policy, etc. This is the trio, *(i) enterprises, (ii) industrial infrastructure and (iii) investment and production incentive organizations* which are the backbone of the National Innovation System.

The nature of the technological and industrial trajectory of a country indicates whether it is on the path to impoverishment and economic and social regression or if it is getting richer with economic and social progress. The strength of technological change which builds up the technological and industrial trajectory of a nation is mainly determined by the strength of its technological accumulation and absorptive capacity. The following diagram outlines the four stages of technological development specified by **Criscuolo** and **Narula**[15] in terms of capacity to accumulate technological knowledge.

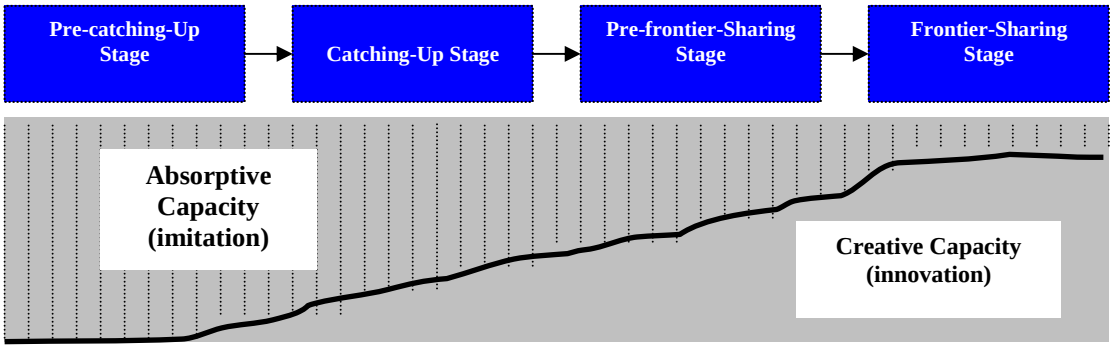


A country's technological accumulation and absorptive capacity is a function of the level of industrial development on the one hand and its distance or remoteness from the technological frontier. *The technological frontier represents all production methods which at any given time are the best references of productive efficiency, or are the most cost-effective and the most productive in the world.*

[15] **Paola Criscuolo & Rajneesh Narula**, "*A novel approach to national technological accumulation and absorptive capacity: Aggregating Cohen and Levinthal*", MERIT-Infonomics Research Memorandum Series, 2002-016.

The catching-up dynamic of each lagging country (*technological catching-up phase*) is expressed in terms of the speed of absorption and accumulation of technology as compared with leading countries (*technological frontier-sharing stage)* at the technological frontier in each sector of economic activity. As illustrated in the figure 10 below, the level of absorption capacity or technological imitation progressively reduces as the country converges or gets closer to the technological frontier, by upgrading from the dynamic of technological accumulation to its capacity for technological creation through innovation.

Figure 10: Evolution of the Technological Accumulation and Absorptive Capacity



Given that a country's technological accumulation and absorptive capacity is a function of its distance from the technological frontier and of its level of economic development, the crucial issue arising is that of the role that Africa Union and each of its members-States have to play to ensure that at each stage, the necessary changes can be made for the continent and African countries to converge and catch-up. Thenceforth, it is axiomatic to affirm that public policies, particularly the industrial policy should necessarily differ in the function of the levels of technological development of each country. This is the problem of organization and industrial development that the African Union and each of its member States must solve in order to guarantee their nation's progress and prosperity.

To provide Africa with an adequate industrial and economic organization for the current level of technological development of the continent (*technological pre-catching-up stage*), the African Union and each of its member States must efficiently absorb, internalize, own and use the **appropriate technologies and associated standards available in African, and especially international, markets**. It is the technological accumulation and absorptive capacity of the African Union, of each Regional Economic Community and of each Member State that are concerned with an appropriate engineering of public policies and particularly industrialization policies. *Hence the strong recommendation for proactive policy of Industrial Infrastructure development, broken down into Technological Infrastructure and Quality Infrastructure.*

4.4. Proactive Policy for Technological Infrastructure and Quality Infrastructure

For the African Union, Regional Communities and especially member States, proactive policy consists in urgent and massive investment for accelerated development of Industrial Infrastructure in its two (2) interdependent aspects; (i) Technological Infrastructure and (ii) Quality Infrastructure.

The public investment to be made for the accelerated development of technological infrastructure (*notably public and private research institutes; universities; engineering and technical schools; intellectual property organizations and technology and innovation information organizations*) should initially stress on reducing the technology gap especially on the establishment of organizations supplying information on technologies and innovations (*international analysis, identification of key technologies by priority sector, indication of conditions for acquisition, owners contacts, etc.*) and on intellectual property organisations likely to facilitate operations on industrial property titles.

Public investments to develop quality infrastructure (standardization bodies, metrology bodies and conformity assessment bodies: *testing and calibration laboratories; management system certification bodies-QMS and EMS; persons certification bodies; products, services and systems certification bodies; inspection bodies)* should primarily target the reduction of the current standards deficit (*goods and services standards, management systems standards, professional standards, conformity assessment standards, metrology standards*) in connection with technologies identified as key for Africa, Regions or States. Conformity assessment should also be a priority.

5. Practical Case of Project, Programme and Portfolio Management

Every real initiative for the structural and infrastructural transformation of the economy and the African society will come in the form of projects, programmes or programme and project portfolios. To succeed in this structural and infrastructural transformation, acquiring and mastering *project, programme and portfolio management technologies* is a key prerequisite. It is in this context that these *soft* technologies are key and priority technologies for African Union, its institutions and members States.

This practical case of key technologies to be acquired and controlled by every public and private organizations (*continental and regional pan African institutions, State governments, administrations, enterprises, bodies, etc.*) in charge of leading structural and infrastructural transformation initiatives is organized in four (4) points: *(i) identifying Africa's project, programme and portfolio management technologies needs; (ii) identifying accessible project, programme and portfolio management technologies; (iii) analyzing Africa's technological deficit in project, programme and portfolio management; and (iv) a proposed solution to upgrade Africa's technological capacities in project, programme and portfolio management.*

5.1. Africa's Project, Programme and Portfolio Management Technologies Needs

Africa has considerable project, programme and portfolio management technologies needs. The size of these needs can be evaluated using two (2) concrete cases: (i) pan African initiatives for the structural and infrastructural transformation of the economy and (ii) public finance reforms through the introduction of programmes-budgets in several African States.

5.1.1. Pan African Initiatives for the Structural and Infrastructural Transformation of the Economy

As an illustration, four (4) initiatives for structural and infrastructural transformation of Africa's economy were covered in point 3 of this paper. The table 11 below presents a statistical summary of the number of portfolios, programmes and projects for which successful implementation conditions *in fine* the success of the said initiatives. For these four (4) continental initiatives only, there are twenty five (25) programme and project portfolios, seventy six (76) programmes and one hundred and nineteen (119) projects to be governed and managed. By broadening to all initiatives at the continental, regional and national levels, these figures can reach several thousands.

Table 11: Portfolios, Programmes and Projects of some African Initiatives

African Initiative	Number of Portfolios	Number of Programmes	Number of Projects
1. Action Plan for Accelerated Industrial Development of Africa (AIDA)	7	20	52
2. Africa's Science and Technology Consolidated Plan of Action (CPA)	5	18	43
3. Africa Mining Vision 2050	9	11	-
4. Programme for Infrastructure Development in Africa (PIDA)	4	27	24
Total	**25**	**76**	**119**

5.1.2. Public Finance Reforms through the Introduction of Programmes-Budgets in several African States

In several African States, public finance reforms aim at increasing the effectiveness and efficiency of public expenditures. In this respect, these reforms ensure the adoption of several results-based public management operational modalities. It was in the framework of results-based public management that the classifying of public expenditures by programme (programme-budget) is introduced in State budget management (*planning, adopting, executing and auditing the finance laws*). In this context, it is necessary to acquire and master programme and project management technologies in order to succeed with the reforms introducing programmes-budgets in Africa. For example, Cameroon introduced programme-budgeting with Law No. 2007/6 of 26 December 2007 relating to Financial Regime of the State. The programme-budget became operational from 1 January 2013.

5.2. Accessible Project, Programme and Portfolio Management Technologies

Project, programme and portfolio management technologies are in fact *soft* technologies codified by standardisation. They are international standards or internationally recognised national standards including as the case may be operational specifications in the form of best practiced methodologies and/or application guides. There are three (3) identified groups of standards shown below in tables 12, 13 and 14: *(i) project management standards; (ii) programme management standards and (iii) programme and project portfolio management standards.*

Table 12: Project Management Standards

Standard	Standardisation Body
1.ISO 21500:2012, Guidance on Project Management	ISO – International Standards Organisation
2. Guide to the Project Management Body of Knowledge (PMBOK® Guide),Fifth Edition, 2012	Project Management Institute (PMI) & American National Standard Institute (ANSI)
3. PRojects IN Controlled Environments (PRINCE2)	Office of Government Commerce (OGC)
4. ICB IPMA Competence Baseline, Version 3.0	International Project Management Association (IPMA)

Table 13: Programme Management Standards

Standard	Standardisation Body
1. Standard for Program Management, Third Edition, 2012	Project Management Institute (PMI) & American National Standard Institute (ANSI) - USA
2. Managing Successful Programmes Manual - 4th Edition, 2011	Office of Government Commerce (OGC) - UK

Table 14: Programme and Project Portfolio Management Standards

Standard	Standardisation Body
1. Standard for Portfolio Management, Third Edition, 2012	Project Management Institute (PMI) & American National Standard Institute (ANSI) - USA
2. Management of Portfolios (MoP™)	Office of Government Commerce (OGC) - UK

5.3. Africa's Technological Gap in Project, Programme and Portfolio Management

Africa's technological gap or delay in project, programme and portfolio management can be analysed using two practical indicators in the sector: (i) participation of African countries in international standardization activities at ISO and (ii) the number of chapters of the Project Management Institute (PMI) in Africa.

5.3.1. Participation of African Countries in International Standardization Activities at ISO

By 31 December 2012, ISO had **44 African members** out of its 164 members worldwide. The 44 African members of ISO are further classified into 22 member bodies and 22 correspondent members. The table below details the two (2) categories of African members of ISO.

Member Bodies

N°	Country	Body
1.	Algeria	IANOR
2.	Botswana	BOBS
3.	Cameroon	ANOR
4.	Congo, the Democratic Republic of the	OCC
5.	Côte d'Ivoire	CODINORM
6.	Egypt	EOS
7.	Ethiopia	ESA
8.	Gabon	ANTT
9.	Ghana	GSA
10.	Kenya	KEBS
11.	Libya	LNCSM
12.	Mali	AMANORM
13.	Mauritius	MSB
14.	Morocco	IMANOR
15.	Namibia	NSI
16.	Nigeria	SON
17.	Senegal	ASN
18.	South Africa	SABS
19.	Sudan	SSMO
20.	Tanzania, United Republic of	TBS
21.	Tunisia	INNORPI
22.	Zimbabwe	SAZ

Correspondent Members

N°	Country	Body
1.	Angola	IANORQ
2.	Benin	ABENOR
3.	Burkina Faso	FASONORM
4.	Burundi	BBN
5.	Congo, Republic of the	ACONOR
6.	Erithrea	ESI
7.	Gambia	TGSB
8.	Guinea	IGNM
9.	Lesotho	LSQAS
10.	Liberia	LDS
11.	Madagascar	BNM
12.	Malawi	MBS
13.	Mauritania	DNPQ
14.	Mozambique	INNOQ
15.	Niger	DNPQM
16.	Rwanda	RBS
17.	Seychelles	SBS
18.	Sierra Leone	SLSB
19.	Swaziland	SWASA
20.	Togo	CSN
21.	Uganda	UNBS
22.	Zambia	ZABS

Source: ISO, 2012 Annual Report (www.iso.org).

However, only five (5) countries (see the list below) out of the 44 African members of ISO are registered in the technical committee *ISO/TC 258 which develops project, programme and portfolio management standards.* African members had the same level of participation in ISO/PC 236 which developed the international standard *ISO 21500:2012 Guidance on Project Management* published in September 2012.

Participant Members

N°	Country	Body
1.	Cameroon	ANOR
2.	Egypt	EOS
3.	Morocco	IMANOR
4.	South Africa	SABS

Observers

N°	Country	Body
1.	Ouganda	UNBS

Source : ISO, www.iso.org.

5.3.2. Number of Project Management Institute Chapters in Africa

Project Management Institute (PMI)[16] is a standard body specialised in project, programme and portfolio management, based in the United States but open to the world (*with over 412 000 members by 30 April 2013*) which was accredited by ANSI for the development of standards in this sector. In addition to standards, PMI offers certification programmes especially in project and programme management. PMI *as of 30 April 2013 had a total of 267 chapters in 83 countries in the five continents, thereby making up an international professional network for standardization, standards diffusion and conformity assessment in project, programme and portfolio management.*

In this vast network, Africa is only represented by 6 PMI chapters in the countries listed below:

PMI Chapters

N°	Country
1.	Cameroon
2.	Ghana
3.	Kenya
4.	Morocco
5.	Nigeria
6.	South Africa

Source : PMI, www.pmi.org.

5.4. How to Upgrade Africa's Technological Capacities in Project, Programme and Portfolio Management

African standardisation bodies and all African institutions, governments and other partners who are really committed to the structural and infrastructural transformation of African economies can undertake three (3) main initiatives to stimulate an progressive upgrading of Africa's technological capacities in project, programme and portfolio management: *(i) adopting ISO 21500:2012 Guidance on Project Management; (ii) participating in ISO/TC 258 technical committee work and (iii) concrete incentive actions encouraging the certification of African professionals and experts.*

5.4.1. Adopting ISO 21500:2012 Guidance on Project Management

For every permanent African member body or correspondent member of ISO (*As of 31 December 2012, ISO had* ***44 African members***), the adoption of international standard *ISO 21500:2012 Guidance on Project Management* as a voluntary national standard seems appropriate. By adopting the ISO standard as a national standard, every African standardization body will be free to opt for a better dissemination strategy by setting a purchase price that is as accessible as possible. In comparison, the ISO price for a copy of standard 21500:2012 is 140 Swiss francs (CHF), that is, 75 600 CFAF with 1 CHF = 540 FCFA.

5.4.2. Participating in ISO/TC 258 Technical Committee Activities

Greater participation of African countries in international standardization activities of the *Technical Committee ISO/ TC 258 on project, program and portfolio management* is highly recommended. The ISO international standards on project, programme and portfolio management are currently under development. Instead of only six (6) countries currently involved in this particular ISO/TC, a more substantial number of African countries is needed and required.

[16] Project Management Institute website: www.pmi.org

5.4.3. Encouraging the Certification of African Professionals and Experts

Project, programme and portfolio technologies are *soft* technologies for which the codification or standardization falls under the category of professional standards. The optimal and efficient use of *soft* technologies is conditioned by the use or involvement of professionals with the appropriate related expertise and skills. Conformity assessment (*Personnel certification programmes*) is thus performed on the said professionals to certify that they have the required knowledge and skills for the proper application of standards.

It is in this context that a number of specialized international organizations offer certification programmes for professionals in reference to **project management standards** [PMI - *Body of Knowledge Guide PMI Project Management (PMBOK ® Guide)*, OGC - *PRojects IN Controlled Environments (PRINCE2)* and IPMA - *ICB IPMA Competence Baseline Version 3.0*), to **programme management standards** [PMI - *Standard for program Management, Third Edition* and OGC - *Managing Successful Programmes Manual - 4th Edition*] and to **portfolio management standards** [PMI - *Standard for Portfolio Management, Third Edition* and OGC - *Management of Portfolios (MoP ™)*].

To have an adequate and growing number of professionals and experts who can successfully manage multiple initiatives for the structural and infrastructural transformation of Africa's economy, *our recommendation to African standards organizations, the Pan-African continental and regional institutions, State governments and key partners is to take appropriate measures to develop the certification of African professionals and experts in project, programme and portfolio management.*

6. Conclusion and Recommendations

In conclusion, it is clearly ascertainable that Africa has experienced a severe deindustrialization in recent decades, especially during the phases of SAPs and PRSPs from 1980 to this day, under the domination of models and approaches of the IMF and the World Bank. Investment in appropriate technologies and associated standards has been severely lacking (*negative total factors productivity*) in economic growth models in Africa. This chronic technological gap is highly correlated with the structural movement of deindustrialization of the continent.

It is common like everywhere else that industrial development in general and manufacturing industry in particular are expected to play a leading role (*technological acquisition and master, technological innovations, spillover effects, synergies*) in the dynamics of the structural and infrastructural transformation of African economies through rapid technological change expressed in the production and exportation of manufactured goods in Africa and the world.

From the perspective of structural and infrastructural transformation of the African economy through accelerated industrialization, three (3) recommendations are made to the African Union Commission, the Pan-African and regional institutions, the governments of the member States and other stakeholders.

Recommendation 1. The public policies of each African State should be organized around a clear and explicit affirmation of the accelerated industrialization resulting in *the primacy of industrial and technological development objectives* at all stages of the critical path of the decision-making chain of the State Government. The primacy of industrial policy requires a clear and well understood subordination of all other socio-economic and structural policies of the State. Without prejudice to the pursuit of macroeconomic stability, *monetary and fiscal policies must be absolutely accommodating to the industrial and technological development goals*. It consists in placing technology at the centre of the industrialization approach of the continent. We must move from the phase of *industrialization through PRSPs* to a fourth phase of *industrialization through technological development*.

Given that the current context of public policies in Africa is dominated by the PRSP approach, *a real pan-African political leadership is required from the Heads of State and Government themselves based on their own technocratic capacity of government institutions to effectively promote a new strategy for the accelerated industrialization of Africa*. It is neither the *Bretton Woods* institutions (*IMF, World Bank*), nor other agencies of the United Nations that should be the basic institutional backbone for Africa's industrialization.

Recommendation 2. Under the new industrialization strategy of Africa, each Member State needs a proactive policy to develop an appropriate industrial infrastructure which is consistent with key challenges. Proactive policy consists in urgent and massive investment for accelerated development of *industrial infrastructure* in its two (2) interdependent and complementary aspects; (i) Technological Infrastructure and (ii) Quality Infrastructure.

Recommendation 3. All initiatives of structural and infrastructural transformation of the African economy and society will take the operational forms of projects, programmes and programme & project portfolio. To achieve this structural and infrastructural transformation, acquisition and mastery of *project, programme and portfolio management technologies* constitute a prerequisite that seems inevitable and indispensable. It is in this context that these *soft* technologies are priority and *key technologies*.

To drive a progressive and sustainable upgrading of African technological capacities in project, programme and portfolio management, three (3) major initiatives can be undertaken: *(i) adopting ISO 21500:2012 Guidance on Project Management; (ii) participating in ISO/TC 258 technical committee activities and (iii) concrete incentive actions encouraging the certification of African professionals and experts.*