UNESCO 6TH AFRICA ENGINEERING WEEK AND 4TH AFRICA ENGINEERING CONFERENCE
15th – 21st September, 2019

Engineering Numbers & Needs in the SADC Region

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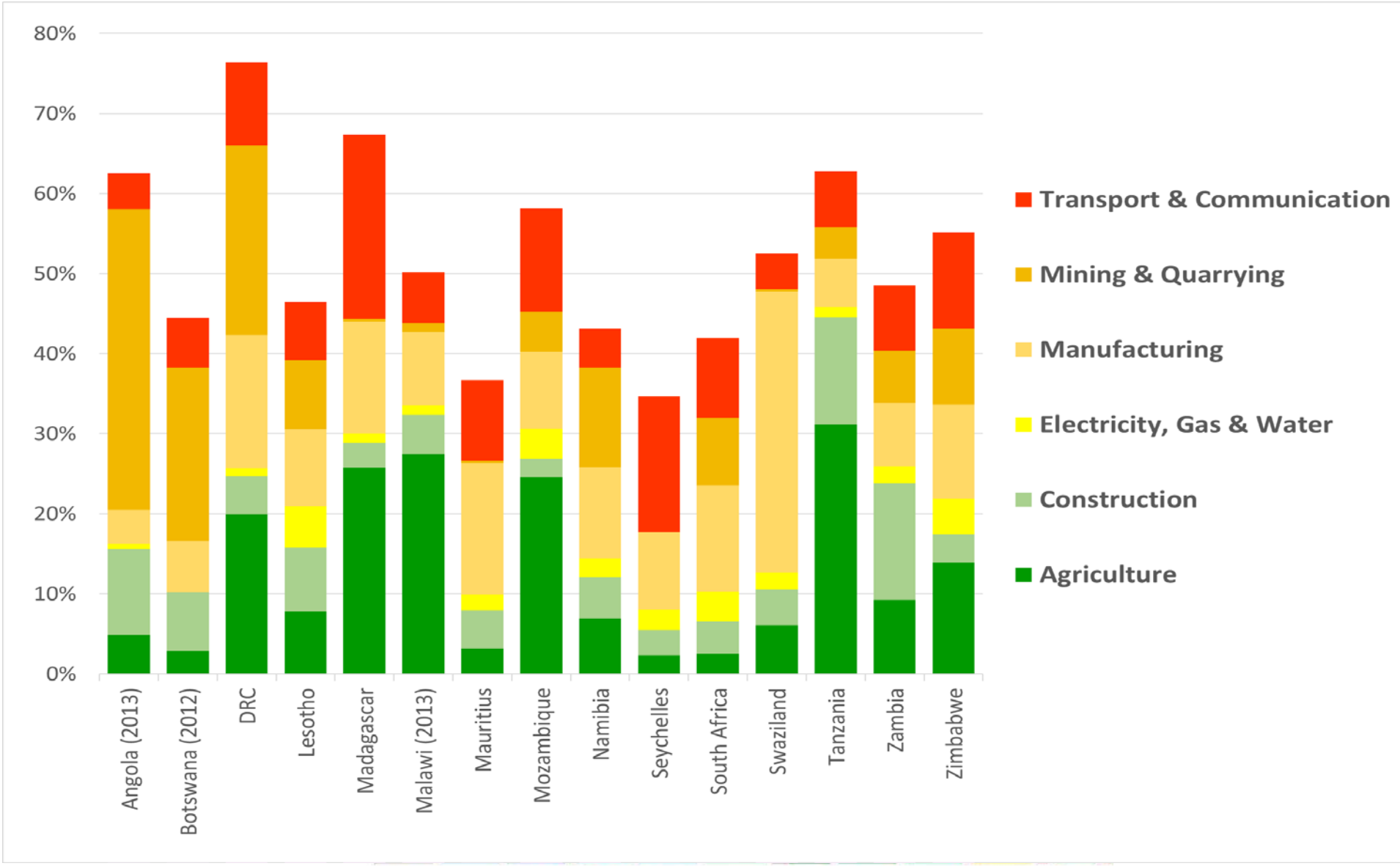
DATE : 18th & 19th September, 2019

Avani Victoria Falls Resort, Livingstone, Zambia

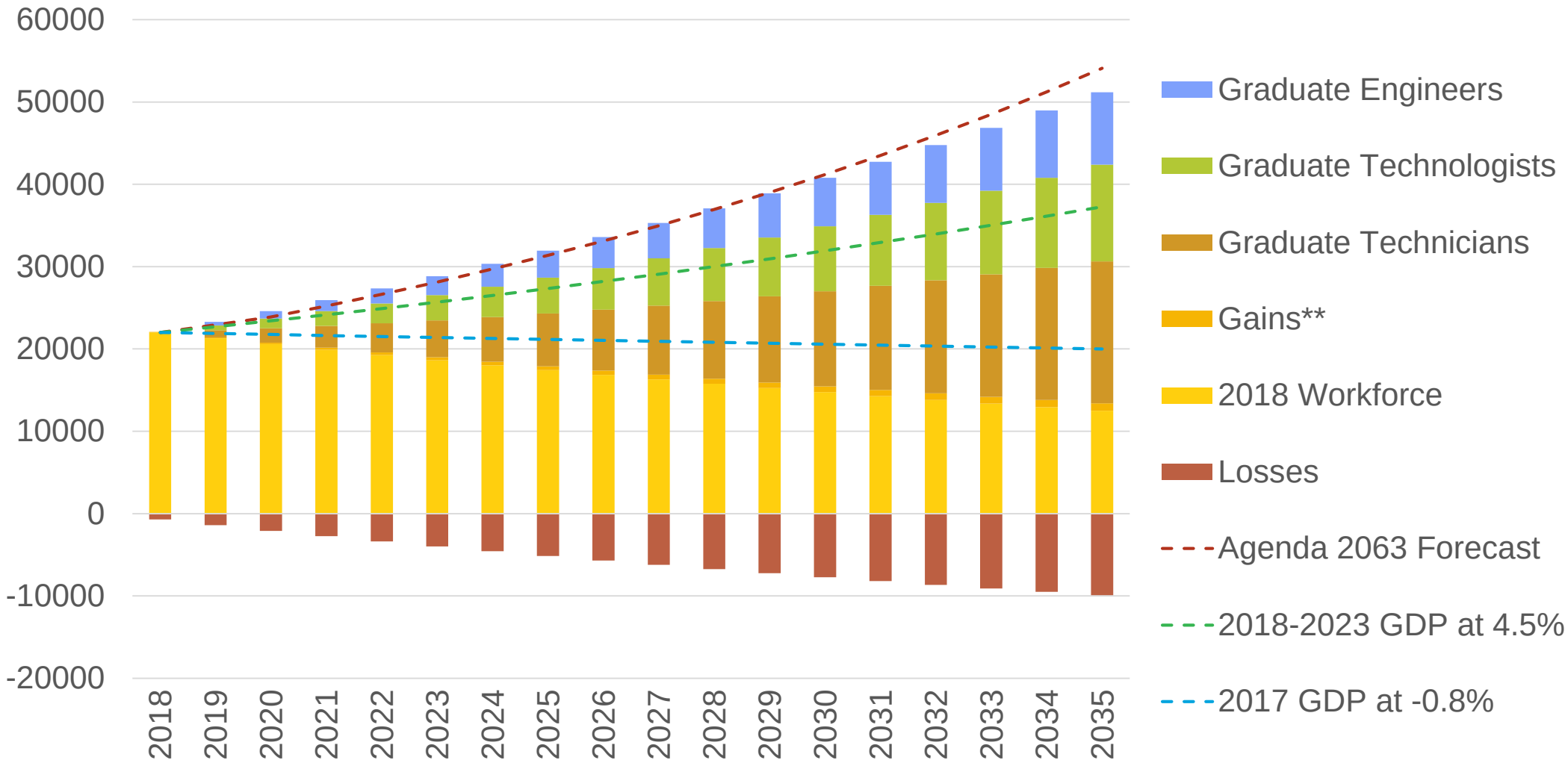
Why the study?

- **Industrialisation:** Do we have adequate engineering capacity to support the **Industrialisation Strategy (2015-2063)**?
- **Economic and social infrastructure:** Do we have adequate engineering capacity to develop, upgrade, operate and maintain economic and social infrastructure to support the **Strategy**?
- **Engineering students and graduates:** Are they being adequately educated and trained?
- **Engineering experts:** Are we developing engineering experts and are we using their expertise to develop skills, and carry out long-term planning?
- **Gaps and recommendations:** Where are the gaps and what policies and programmes are required?

Engineering sectors' contribution to GDP



The flow of skills



Elements of the study

- Determine **numbers** in the workforce
- Determine **needs** based on current workload, demands of policies and planned projects
- Determine **inflows** from higher education and immigration
- Determine the **outflows** e.g. emigration, retirement etc
- Identify **successful initiatives** in place and understand lessons learned
- Determine **gaps** and how to address them by following existing successful models, and/or developing innovative solutions

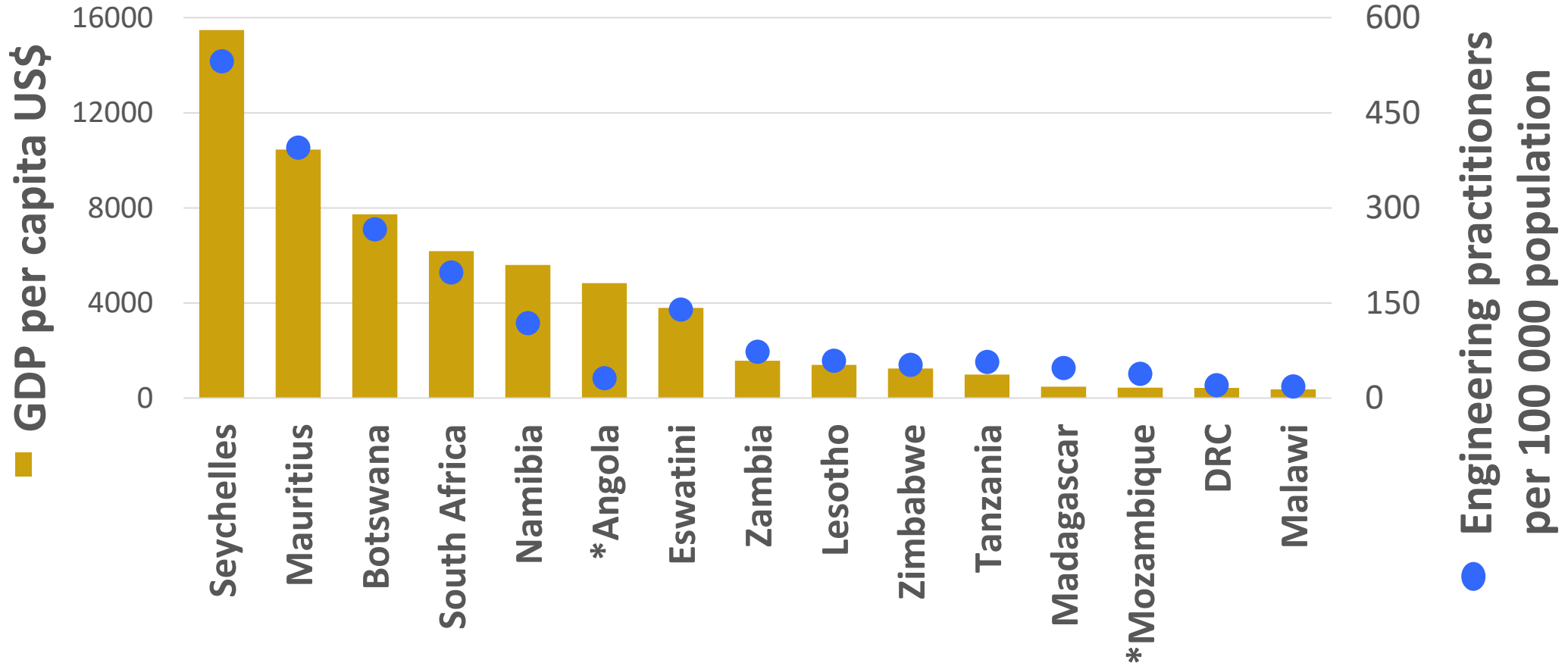
The numbers

CATEGORY	NUMBER	TOTAL IN THE WORKFORCE	REGISTERED		GRADUATES		GRADUATES AS A % OF THE WORKFORCE
			REGISTERED	% REGISTERED	IN 2015*	% FEMALE	
Engineers		114 579	34 722	30%	9 875	22.0%	9%
Technologists and technicians**		114 281	12 746	11%	15 607	24.7%	14%
TOTAL		228 860	47 468	21%	25 482	23.7%	11%

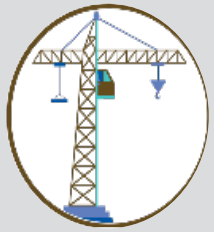
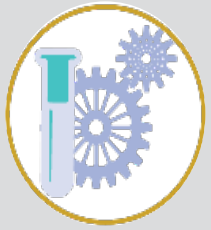
*** Totals are understated as graduation data from some countries is incomplete – see Figure 23**
**** Technologist and technician categories are not recognised in all countries – see Table 24**

- **68 engineering practitioners per 100,000 population in SADC – ranging from 531 to 18**
- **850 engineering practitioners per 100,000 population in the USA**
- **1 160 engineering practitioners per 100,000 population in the UK**

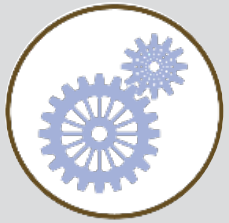
Ratios per Member State



% engineering practitioners per sector

4%	3%	10%	11%	27%
Academia	Agriculture	Consulting	Contracting	Government
				
ICT	Manufacturing	Mining, Oil & Gas	Misc. & NGO	
				
6%	26%	7%	6%	

% engineering practitioners per discipline

5%	7%	32%
Agriculture	**Chemical**	**Civil**
		
		
Electrical, Electronics, Systems & Telecommunications	**Mechanical, Mechatronics, Aeronautical, Marine & Industrial**	**Mining, Quarrying, Metallurgy & Oil and Gas**
27%	**24%**	**5%**

Challenges

Schooling – lack of teachers, resources and poor maths and science passes

Higher education – under-resourced, too many entering, graduate number and calibre challenges

Graduate training – unemployed graduates and limited investment in graduate training

Professional development – little investment in growing experts

Investment – lack of investment in infrastructure development and maintenance

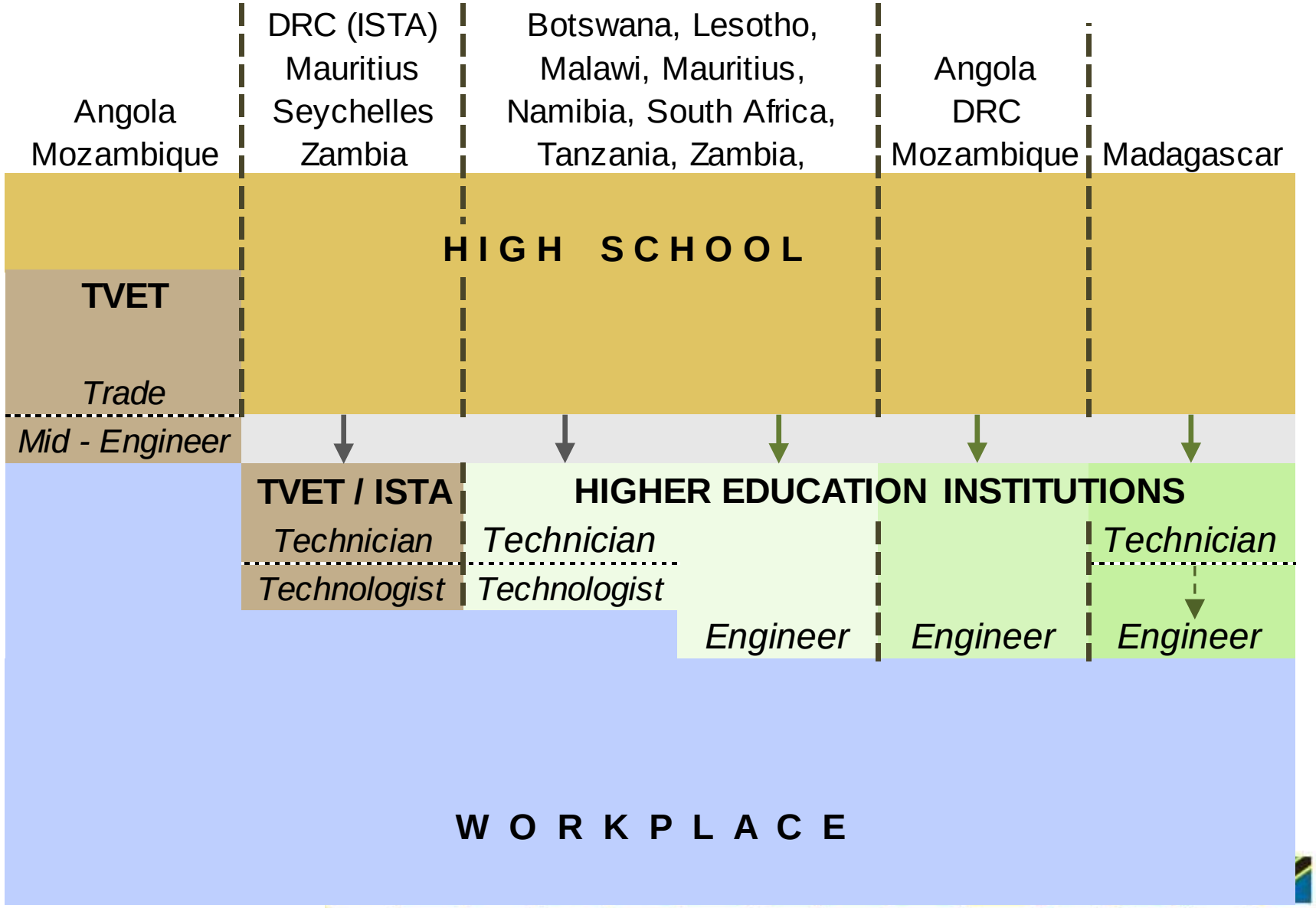
Public sector – technical capacity significantly reduced over the years

Use of service providers – often used to the exclusion of local skills, goods and services

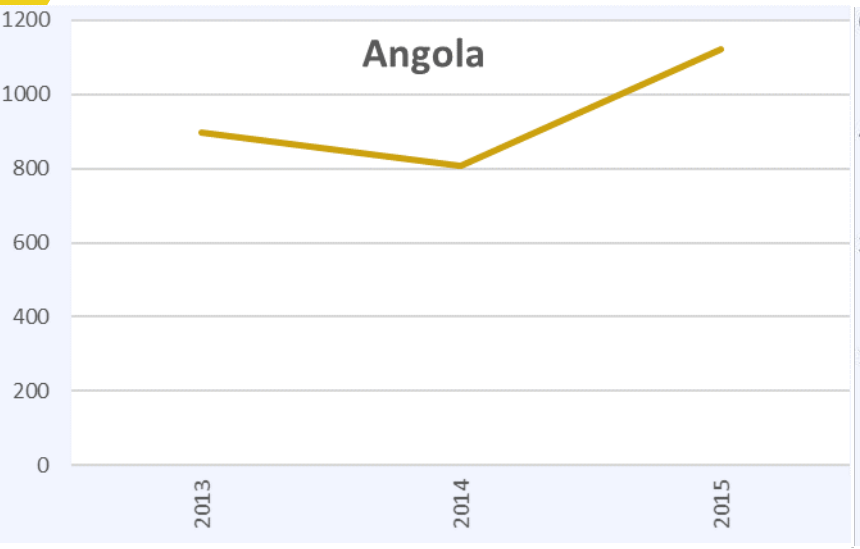
Agriculture and rural development – limited investment to assist and grow smallholders and rural communities

Higher education – different models

Education Level	
School	**SADCQF**
8	
9	1
10	2
11	3
12	4
13	5
Tertiary	
Under-graduate	6
	7
	8
Master's	9
Doctorate	10



Graduation trends 2005-2015



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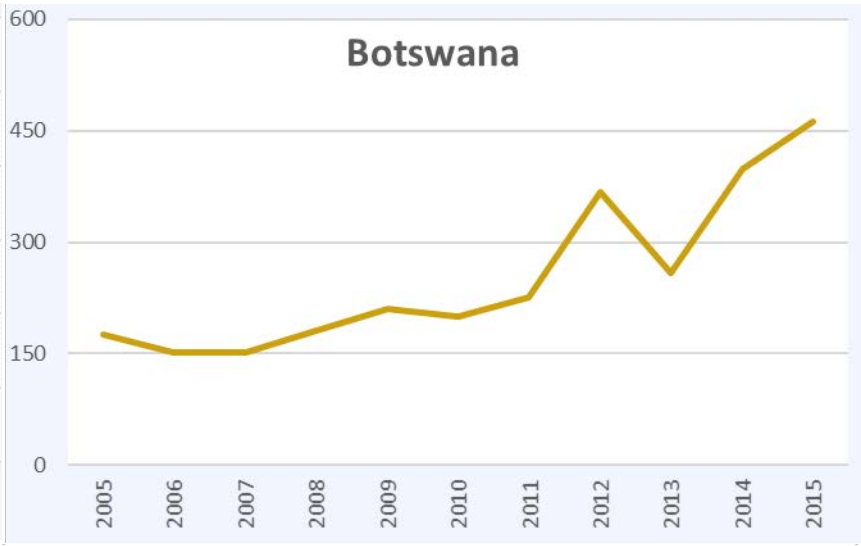

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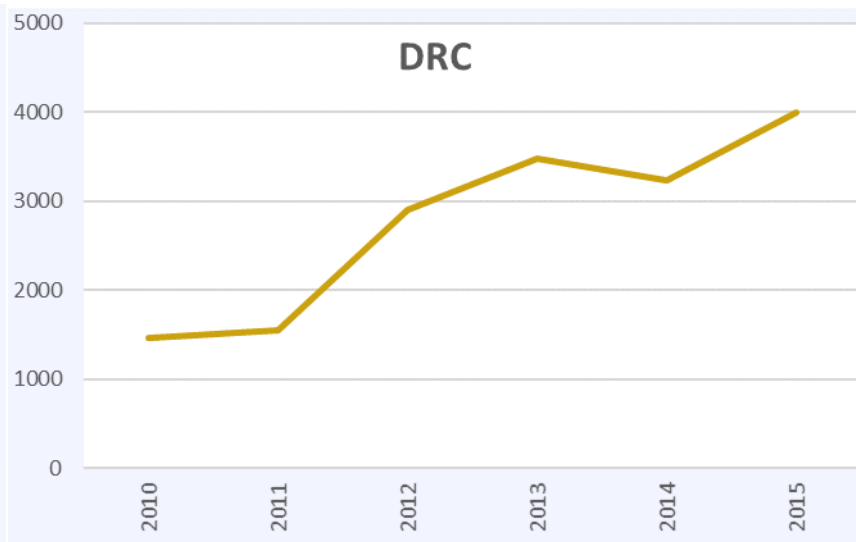

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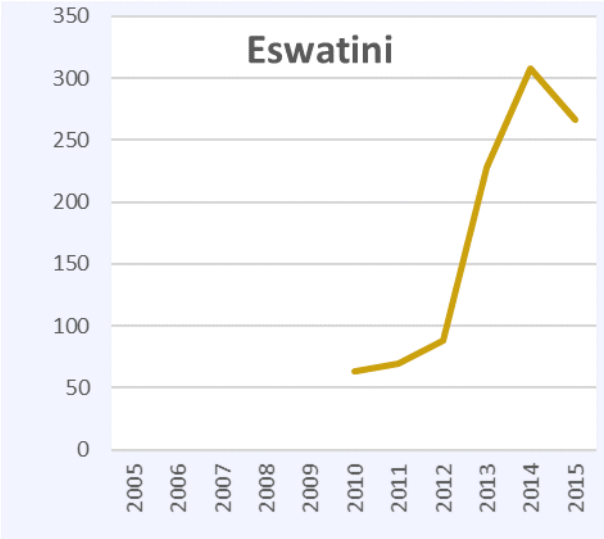

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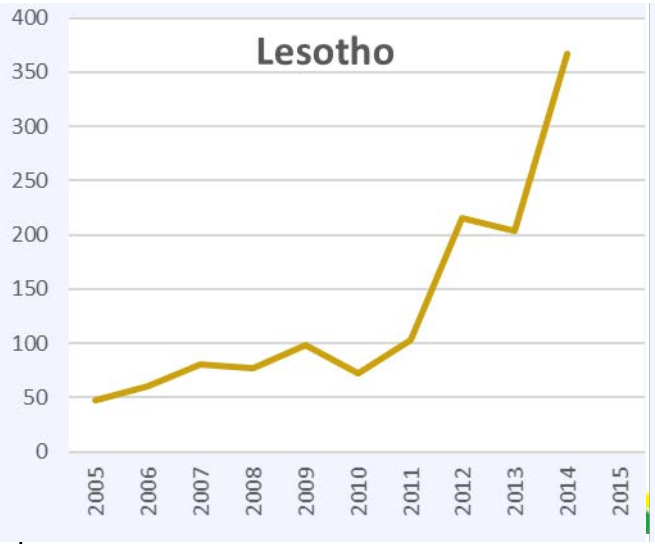

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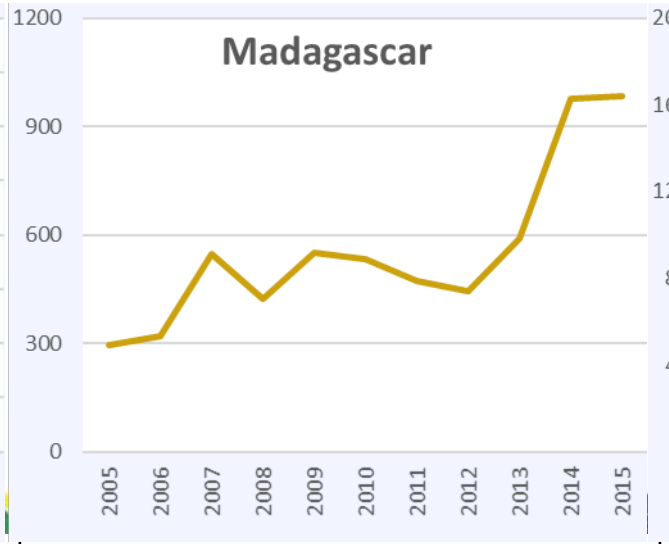

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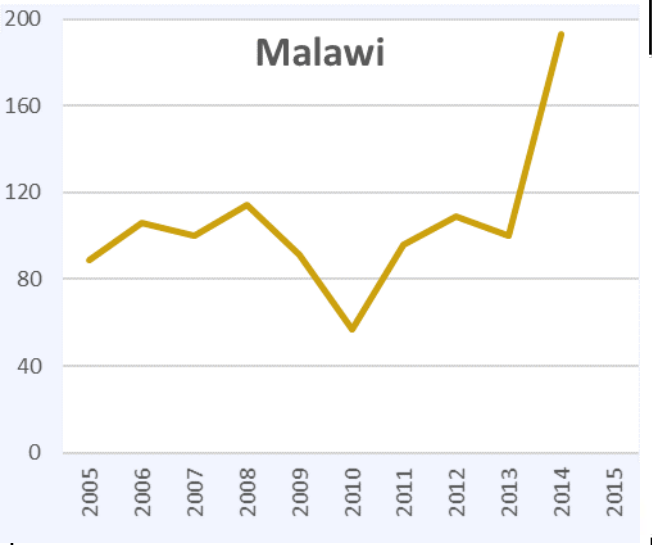

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Qualifications framework and accreditation

Policy

Recommend adoption of the graduate attributes as defined by the IEA in the:

- Washington
- Sydney
- Dublin Accords

for engineer, technologist and technician qualifications

Activity

Form a working committee under the TCCA to:

- Set the level of technician, technologist and engineer qualifications on the SADCQF
- Determine the approach to accreditation, suggest not restructuring all qualifications but aligning graduate attributes per category
- Determine a method of assessing institutions who wish to achieve the IEA standards
- Develop milestones for institutions to achieve over a 10- or 15-year period to achieve the required standards to become signatories
- Review and align where necessary, technician qualifications required per discipline and country

Graduate development

Policy

- Recommend that all countries develop and support graduate training programmes

Activity

Form working group from successful programmes to document and share best practice and consolidate guidelines for the region – must include:

- Suggested activities per discipline and developing a training plan in the workplace and for groups
- Degree of complexity of work required per category of registration
- Guidelines for mentors (internal and external) and supervisors
- Suggested reporting methods
- Methods of assessing progress
- Guidelines for secondments
- Suggested methods of funding such programmes

Registration numbers

COUNTRY	CATEGORY								METRICS		
	GRADUATE/CANDIDATE-IN-TRAINING				PROFESSIONAL				COMPARISONS		%
	Engineer	Technologist	Technician	Certificated	Engineer	Technologist	Technician	Certificated	Total professional	Engineering workforce	% professionally registered
Angola	506	-	-	-	3 337	-	-	-	3 337	9 000	37.1%
Botswana *	1 542	297	1 201	-	1 272	123	357	6	1758	6 000	29.3%
Eswatini	12	3	17	2	36	6	6	-	48	1 600	3.0%
Madagascar	-	-	-	-	765	-	-	-	765	11 000	7.0%
Malawi	-	-	-	-	706	423 TE	163	-	1 292	3 200	40.4%
Mauritius	-	-	-	-	851	-	-	-	851	5 000	17.0%
Mozambique	1 225	-	-	-	1 868	-	-	-	1 868	11 000	17.0%
Namibia	452	321 IE	197	-	506	201 IE	102	-	809	2 800	28.9%
South Africa	7 749	4 385	6 674	281	15 862	5 513	3 921	966	26 262	110 000	23.9%
Tanzania	9 428	661	-	-	5 699	409	-	-	6 108	30 000	20.4%
Zambia	-	-	-	-	2 066	566	483	-	3 115	12 000	26.0%
Zimbabwe	-	-	-	-	1 754		473	-	2 227	7 600	29.3%
TOTAL	**20 914**	**5 667**	**8 089**	**283**	**34 722**	**7 241**	**5 505**	**972**	**48 440**	**209 200**	**23.15%**

*Candidates includes those in the Registered, but not Professional categories

Registration alignment

Policy

- Recommend adoption of the IEA registration standards, initially for engineers and in time for other categories

Activity

Form a working committee under the TCCA to agree on:

- Functionality to be covered per body and develop framework for Engineering Profession Acts
- Who should be registered and the definition of engineering work
- Minimum period of graduate training and guidelines on activities to be covered
- Methods of assessment and reviewing professional registration applications
- CPD requirements and period and approach to renewing registration

Developing tomorrows' leaders

- **Graduates** – development to professional registration required
- **Independent practitioners** – grow in leadership, expertise and complexity and range of work
- **Team leader** – develop to manage teams in area of practice
- **Technical manager** – develop to manage teams, budgets, corporate responsibilities, stakeholder engagement, and be recognised as an expert in area of practice
- **General manager** – develop to be technical director or general manager, and have a national and international profile

Recommendations

- **Support ongoing development** including CPD, post-graduate and management studies and linking mid-career staff to serve as understudies to international experts

Public sector capacity challenges

- Most Ministries report **vacancies** – low salaries, and in some cases a moratorium on appointments are a challenge in terms of filling vacancies
- Public sector staffing **reducing**, while number of graduates continue to increase
- In some countries, **only registered** personnel can be employed, so no opportunity to develop graduates
- No capacity to plan or manage **service providers**, who have free rein which impacts on the quality delivered and final cost
- No authority to make **decisions** w.r.t. suppliers, service providers, appointment of staff and decisions by non-technical staff often limited or inappropriate
- '**Savings**' **cost** countries significantly in terms of neglect of infrastructure

Recommendations

- Appoint **experienced** engineering professionals into d**ecision-making** posts
- Appoint **graduates** and train them through the ranks to develop as infrastructure leaders of tomorrow

Alignment of service provider conditions

Policy

- Recommend alignment of approaches and threshold below which only local service providers can be used

Activity

Set up sub-committee under TNF to work on aligning:

- Criteria for classifying contractors and limits to be set on the size of projects on which international and SADC contractors may be appointed
- International service provider conditions – include that designs must be checked and approved by local engineers and calculations and operating manuals must be provided in the local official language
- Conditions for graduates, technicians and trades to be trained in a structured manner on all contracts and for training to be monitored
- Requirement for use of local labour and materials
- Turnkey projects conditions to include for local supervision to ensure enforcement of quality delivery

Numbers & Needs

Numbers influence by:

- Level of investment
- Levels of service
- AIDI
- Manufacturing level of technology
- Commitment to higher education
- Commitment to strengthening the public sector

Africa Infrastructure Development Index (AIDI): extent, type & condition of services

COUNTRY	RATING 2018	AIDI 2003	AIDI 2018	% INCREASE	WSS	ICT	ELECTRICITY	TRANSPORT
Angola	29	7.3	19.04	161%	40.14	11.78	6.4	1.87
Botswana	10	24.73	36.79	49%	80.82	30.63	21.51	22.28
DRC	50	4.02	8.15	103%	31.93	6.99	1.85	1.64
Eswatini	17	13.22	25.76	95%	61.6	18.32	5.78	8.36
Lesotho	35	12.83	16.01	25%	54.56	16.35	4.11	7.41
Madagascar	46	3.14	10.73	242%	23.42	6.45	0.95	3.01
Malawi	25	11.51	21.02	83%	65.84	7.02	2	4.83
Mauritius	5	42.1	76.79	82%	97.51	58.67	39.86	38.39
Mozambique	44	5.88	12.49	112%	27.11	11.18	12.04	2.02
Namibia	13	24.72	28.65	16%	63.34	22.09	10.54	15.49
Seychelles	1	47.43	94.32	99%	96.87	59.78	63.81	50.32
South Africa	4	46.07	78.53	70%	79.99	76.94	74.86	21.91
Tanzania	43	5.17	12.54	143%	28.16	10.43	1.82	3.27
Zambia	23	14.42	22.29	55%	48.74	14.93	14.08	4.71
Zimbabwe	19	22.48	24.52	9%	53.97	16.36	10.38	11.69

Summary of recommendations

- Expand school support to include **online learning**
- **Rationalise** the number of higher education institutions offering engineering
- Align and **accredit** engineering qualifications considering international standards
- Institutionalise **graduate training**
- Align **registration processes** considering international standards
- Align **service provider** and **construction council** conditions
- **Re-populate** public sector structures with experienced engineering capacity
- **Invest** in agriculture and in particular support of smallholders
- **Invest** in rural development and services to rural communities
- **Invest** in infrastructure, operations and maintenance to support the growth of manufacturing and mining
- **Invest** in data collection and system developments
- **Engage** with the profession **-** A *National Engineering Advisory Team (NEAT)*