SADC Engineering Numbers and Needs Study

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science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

saice professional development & projects t/a civils masakheni

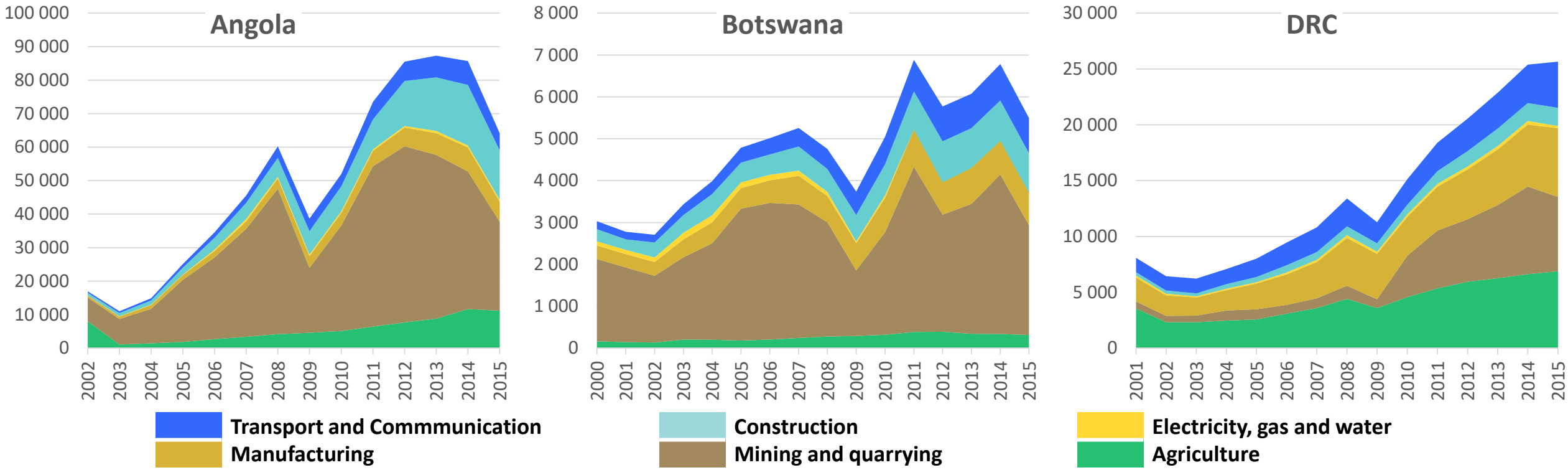
PART 1
CONTEXT

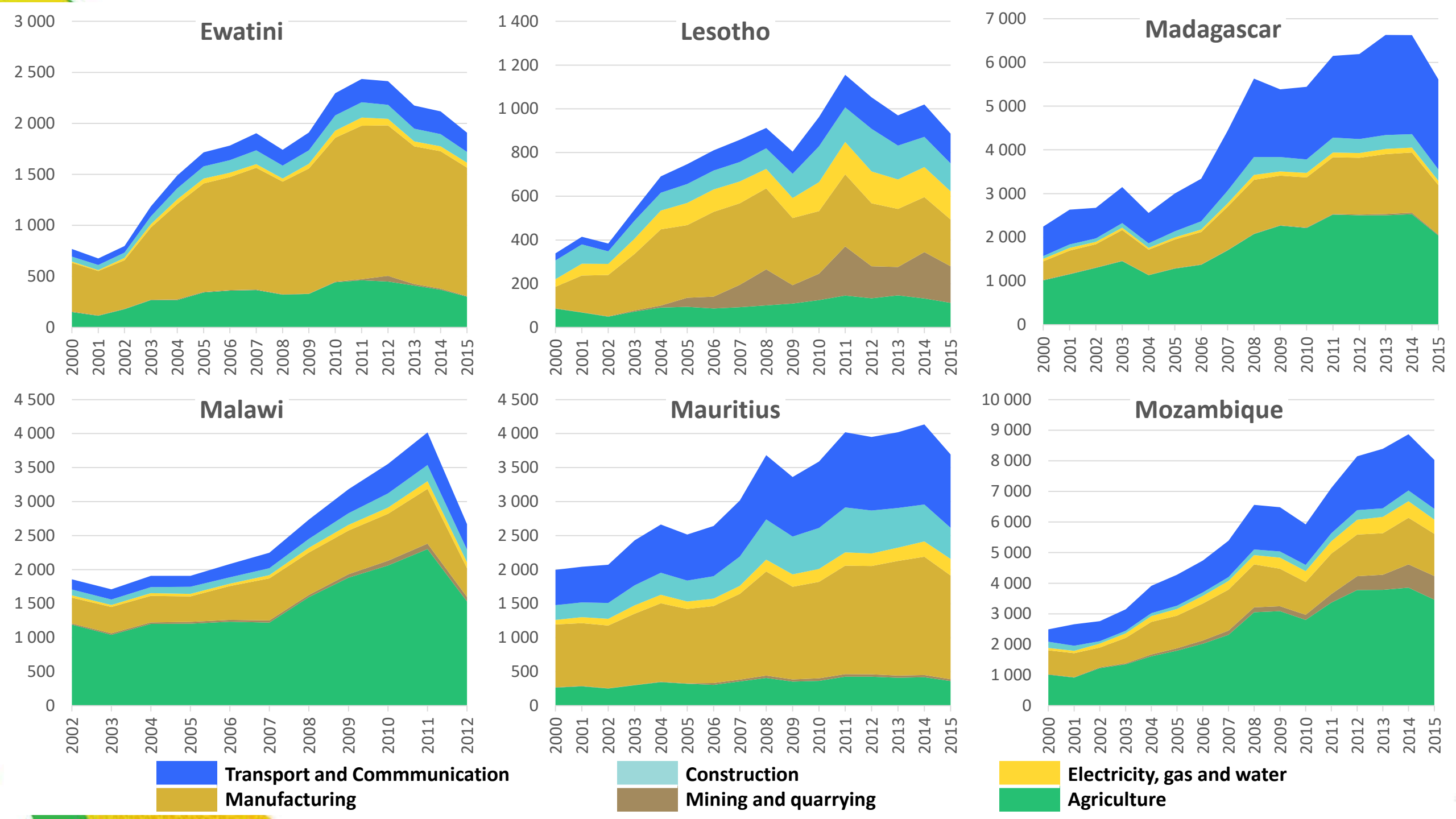
Why the study?

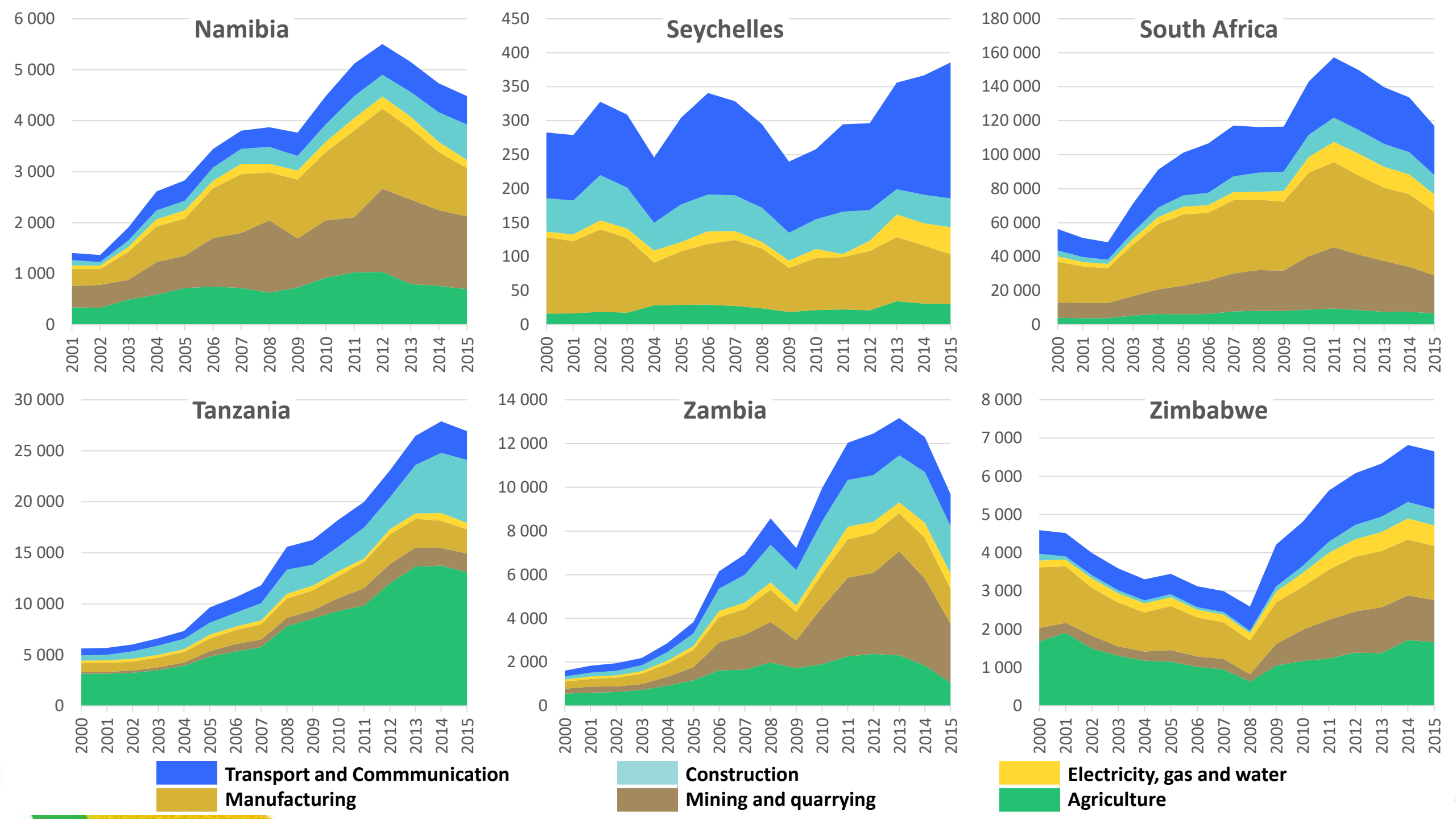
- **Industrialisation:** Do we have adequate engineer, technologist and technician capacity to support the **Industrialisation Strategy (2015-2063)**?
- **Economic and social infrastructure:** Do we have adequate engineering capacity to develop, upgrade, operate and maintain economic and social infrastructure to support the Industrialisation Strategy (2015-2063)?
- **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 need to be included in SADC Master Plan on Infrastructure Development, Protocol on Education and Training and the Protocol on Science, Technology and Innovation?

GDP contributions per sector (m US$)

- Note different mix of GPD contributions per country
- Must determine which engineers need to be strengthened to expand or improve efficiency per sector



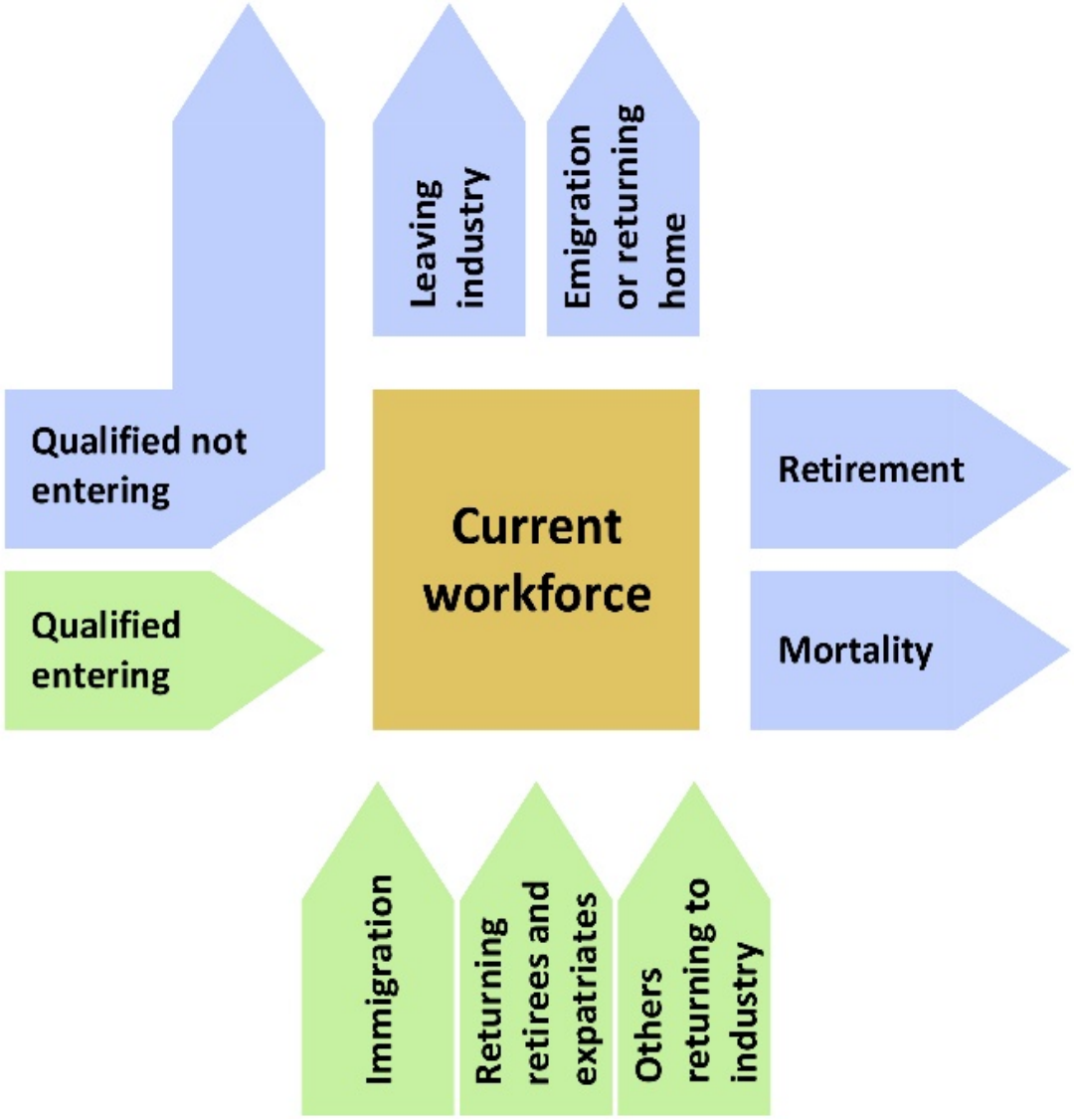

Ewatini
Lesotho
Madagascar
Malawi
Mauritius
Mozambique
Transport and Commmunication
Manufacturing
Construction
Mining and quarrying
Electricity, gas and water
Agriculture


Namibia
Seychelles
South Africa
Tanzania
Zambia
Zimbabwe
Transport and Commmunication
Manufacturing
Construction
Mining and quarrying
Electricity, gas and water
Agriculture

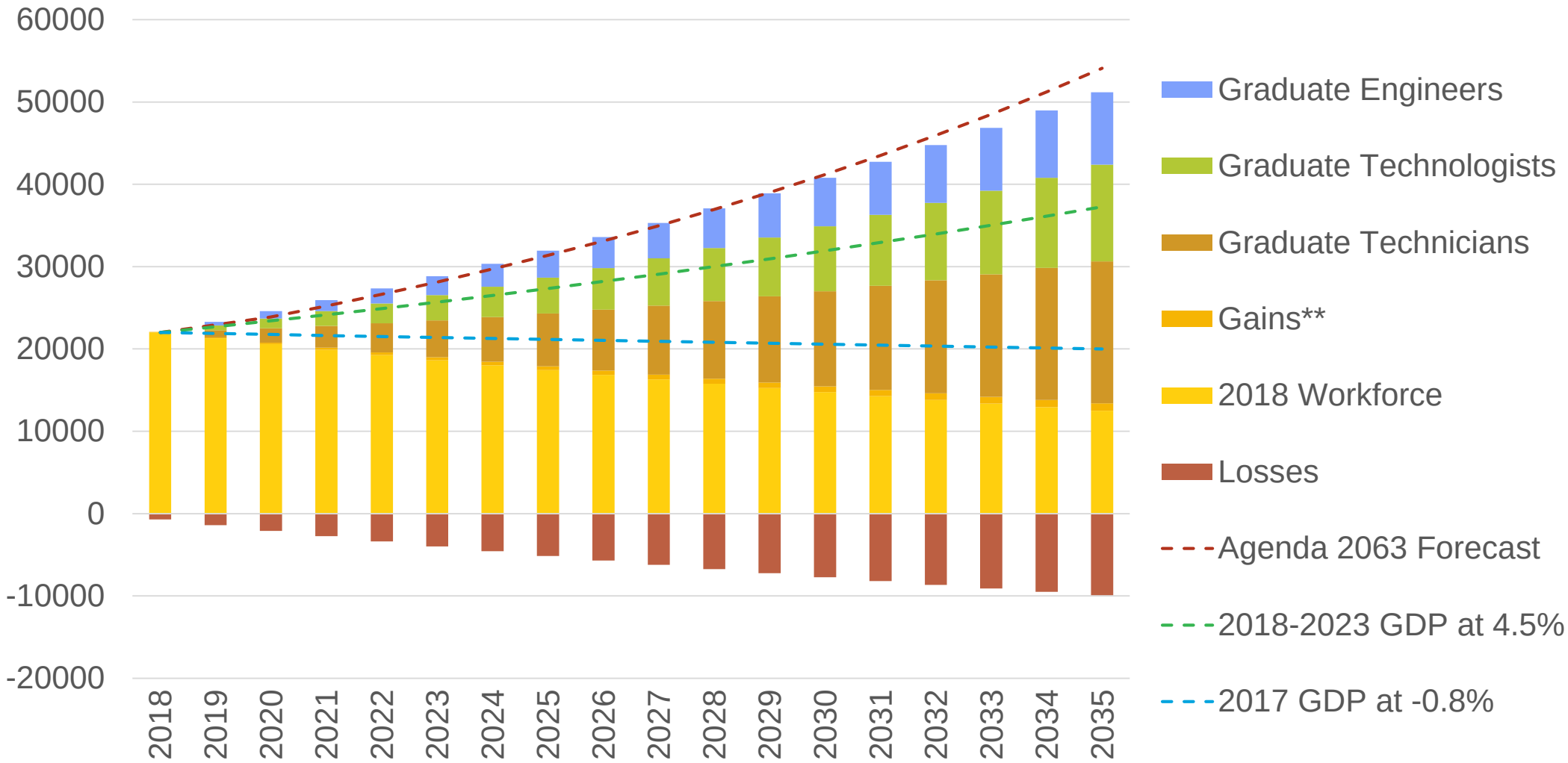
The flow of skills

Need to determine flow factors

- Growth rate
- Graduation rate
- Migration rate
- Retirement
- Mortality
- Re-entry into industry



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
- 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

Carried out extensive desktop research, made many calls, had many Skype sessions and visited all countries

INSTITUTIONS AND COUNTRY VISITS

Institutions/organisations consulted

- Higher education
- Ministries
  - Public works
  - Transport
  - Water and sanitation
  - Energy
  - Agriculture
  - Mining
  - Communications
  - Local government where separate
- Professional and industry bodies and employers
  - Engineering Voluntary Associations
  - Registering Bodies
  - Construction Councils
  - Manufacturing Associations
  - Chambers of Mining

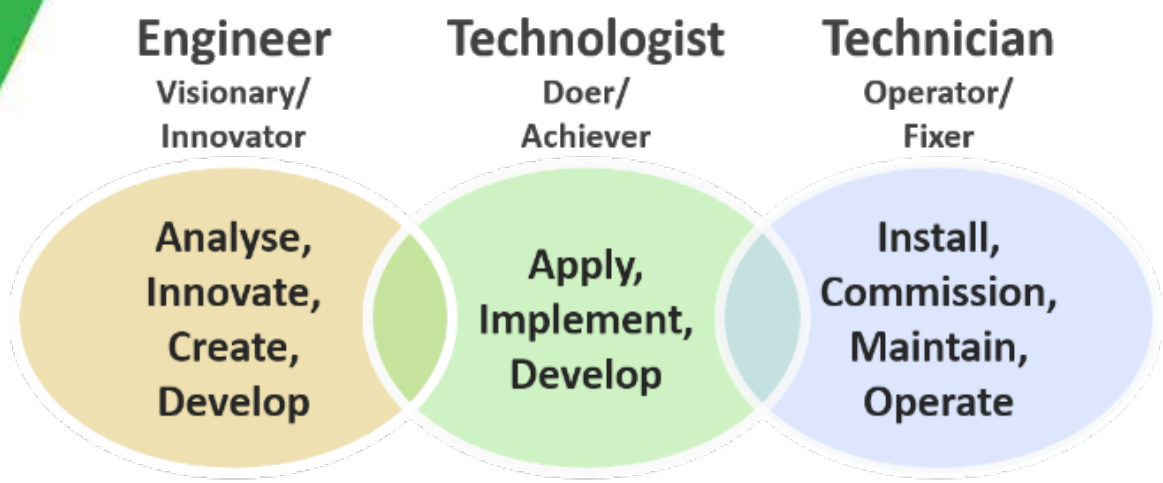
Country visits and engagements

Angola	April 2018 and follow up input and validation by OEA, meetings with representatives in SA in July 2017
Botswana	August 2017, August 2018, meetings with representatives in Ethiopia in April 2017 and in SA in October 2017
DRC	January to February 2018 and follow up with Association of Engineers of DRC Origin in South Africa (AEDOSA) in November 2018
Eswatini	May 2017, June 2017, meetings with representatives in Ethiopia in April 2017 plus validation workshop
Lesotho	March 2018 and ongoing engagement with several ministries and LHDA
Madagascar	September 2017 and Malagasy professionals in SA in December 2017 and April 2018
Malawi	October 2017, November 2017, meetings with representatives in SA in October 2017, January and December 2018
Mauritius	July 2018, meetings with representatives in Ethiopia in April 2017, SA in July 2017, October 2017 and April 2018
Mozambique	August 2017, June 2018 plus validation workshop
Namibia	August 2017, April 2018, July 2018, meetings with representatives in SA in October 2017 plus validation workshop
Seychelles	September 2017 and many meetings with NISTI representatives in SA in June 2017, July 2017, February 2018, June 2018 and final input from surveys and NISTI in December 2018
South Africa	Address many conferences, and engage with many government departments and parastatals, consulting, contracting, mining and manufacturing associations and carry out many online surveys throughout the period plus validation workshop
Tanzania	May 2017, May to June 2018, meetings with representatives in SA in May 2017 and December 2017 plus validation workshop
Zambia	March 2018, meetings with representatives in SA in October 2017 plus validation workshop
Zimbabwe	March 2018, meetings with representatives in Ethiopia in April 2017 and SA in October 2017 plus validation workshop

THE SCOPE,
STANDARDS AND NUMBERS

Engineering categories and disciplines

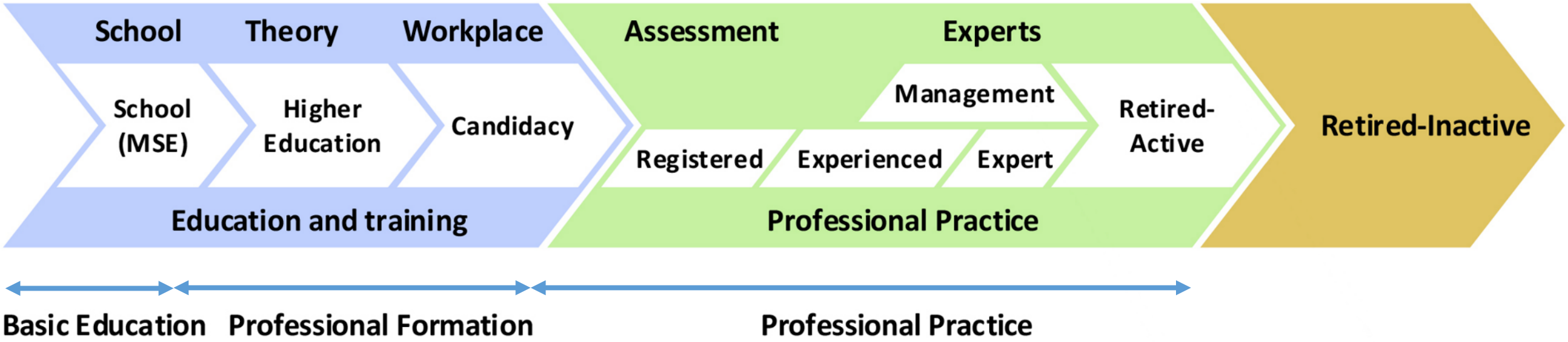
- Engineers
- Engineering technologists (incorporated engineers)
- Engineering technicians



Different education and training but of equal value in the team

- Agricultural engineering
- Chemical engineering
- Civil engineering
- Electrical, electronic, systems and telecommunications engineering
- Industrial engineering
- Mechanical engineering
- Metallurgical engineering
- Mining engineering

The engineering career path



The SADCQF

- The Technical Committee on Certification and Accreditation (TCCA)
- The SADCQF
  - **Level 4** – **school leavers**
  - **Level 5** – certificate: **mid-level engineers** (Angola & Mozambique)
  - **Level 6** – diploma: **technician**
  - **Level 7** – higher or advanced diploma or BTech: **technologist**
  - **Level 8** – degree: **engineer**
  - **Level 9** – Masters
  - **Level 10 –** PhD

International standards – qualifications

International Engineering Alliance (IEA) define desired graduate attributes

- Washington Accord
- Sydney Accord
- Dublin Accord

European Network for Accreditation of Engineering Education (ENAEE)

- EUR-ACE

Conseil Africain Et Malgache Pour L'enseignement Supérieur (CAMES) (African and Malagasy Council for Higher Education)

- General accreditation

World Federation of Engineering Organisations (WFEO)

- IEA standards adopted and recommended by WFEO for engineering qualifications

International Standards – registration

International Engineering Alliance (IEA)

- International Professional Engineers Agreement (IPEA)
- International Engineering Technologists Agreement (IETA)
- Agreement for International Engineering Technicians (AIET)
- APEC agreement which is in place between a number of Asia-Pacific Economic Cooperation countries for the purposes of recognising ‘substantial equivalence’ of professional competence in engineering.
- The International Register

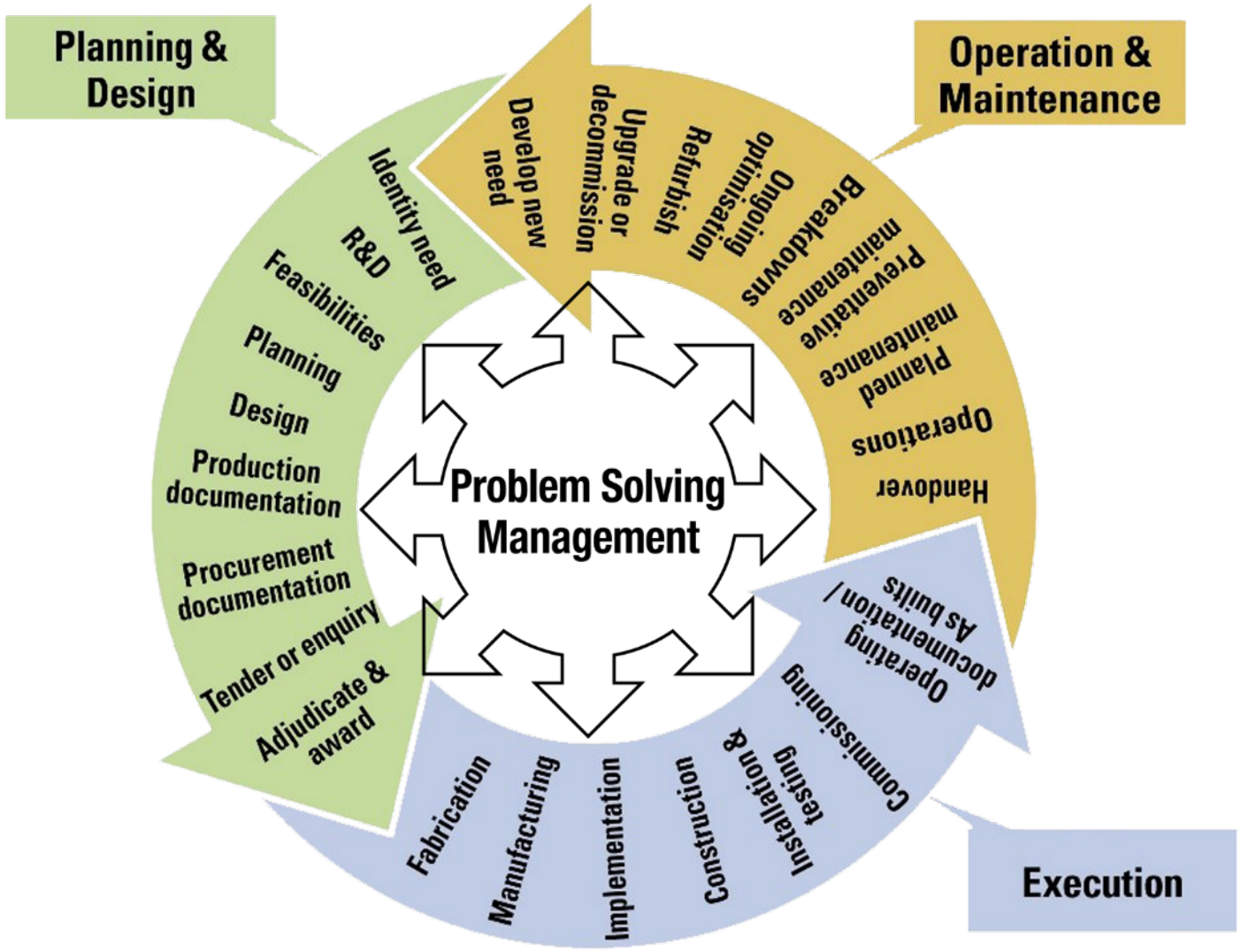
European Federation of National Engineering Associations (FEANI)

- EUR-ING

World Federation of Engineering Organisations (WFEO)

- IEA standards adopted and recommended by WFEO for professional registration

Engineering activities



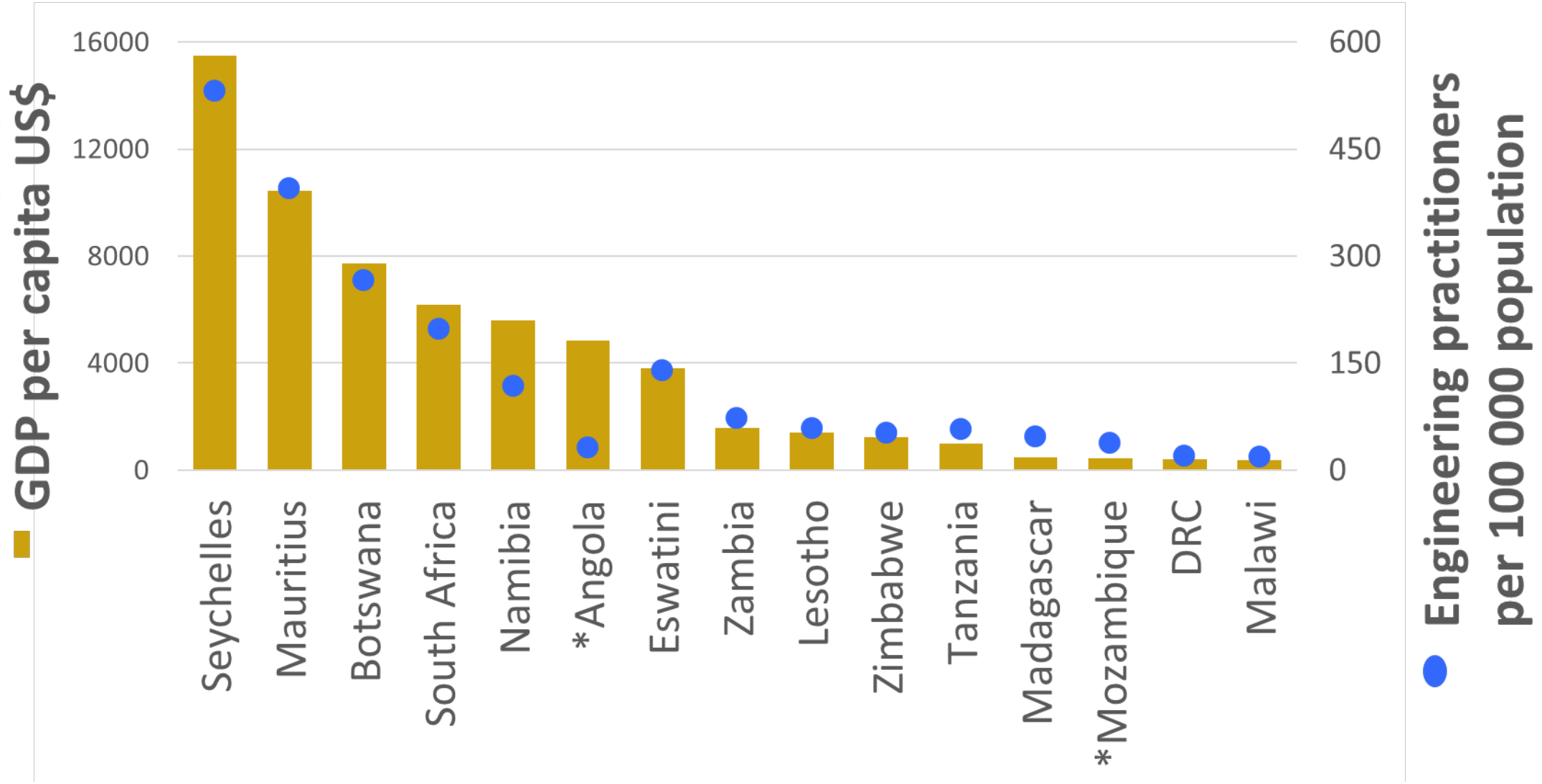
The engineering numbers

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%

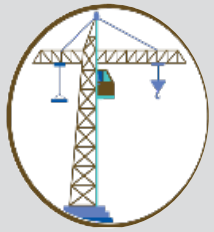
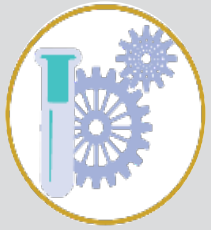
* Totals are understated as graduation data from some countries is incomplete – see Figure 23
** Technologist and technician categories are not recognised in all countries – see Table 24

- 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

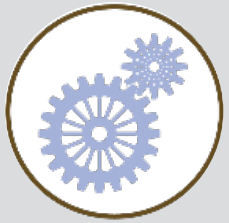
Ratios per Member State



% 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%**

Gender

AGE GROUP	Angola	Botswana	Eswatini	Madagascar	Malawi	Mauritius	Mozambique	Namibia	South Africa	Zimbabwe
25-34	10.0%	15.4%	17.6%	40.6%	10.9%	23.5%	14.9%	21.3%	19.1%	10.0%
35-49	9.5%	8.7%	10.3%	20.6%	6.2%	9.2%	10.5%	15.1%	9.1%	6.1%
50+	7.5%	5.0%	0.0%	20.3%	2.6%	1.3%	5.9%	3.6%	1.8%	3.1%
TOTAL	**8.8%**	**9.9%**	**8.2%**	**23.2%**	**6.2%**	**8.7%**	**10.6%**	**14.3%**	**10.4%**	**6.2%**
Source	OEA	ERB	AESAP	OIM	MIE	CRPE	OrdEM	ECN	VAs	ZIE

PART 2

FINDINGS AND RECOMMENDATIONS

Challenges

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

Higher education – under-resourced, too many entering, graduate number and calibre challenges, no alignment

Graduate training – unemployed graduates and limited investment in graduate training

Professional registration – approaches, categories and standards vary

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

Schooling

- In several countries inadequate numbers of school leavers satisfy engineering qualification entrance criteria
- Too many being accepted who do not meet the minimum requirements and cannot cope with engineering studies
- Maths and science education inadequate
- Career guidance inadequate – students choosing engineering to access bursaries without understanding what they are going to study

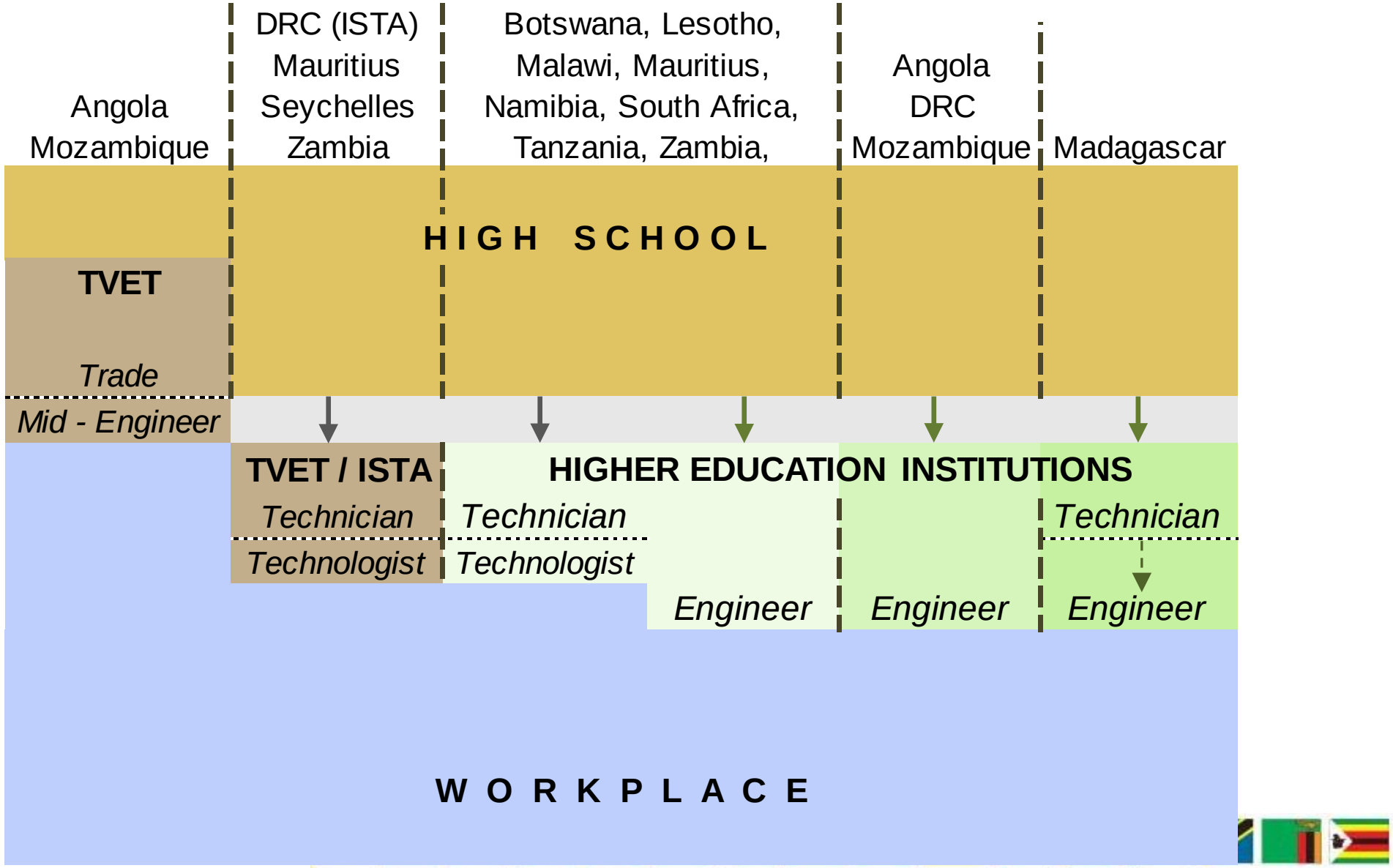
Schooling

Recommendations

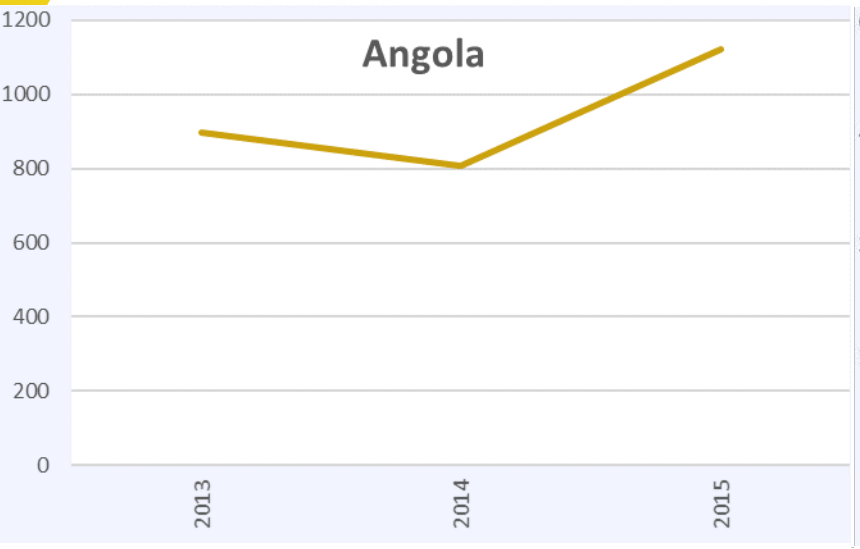
- **Teachers** – Many more teachers needed, particularly in maths and science
- **Technology** – Consider technology to expand teaching capacity rather than wait for enough teachers to be trained
- **Support** – Identify high aptitude learners and place in stronger schools
- **Career guidance** – regional material and work with VAs and ministries to distribute?
- **Women** – the need to attract women must be addressed – female chapters in institutions need to be supported to carry out career guidance and awareness

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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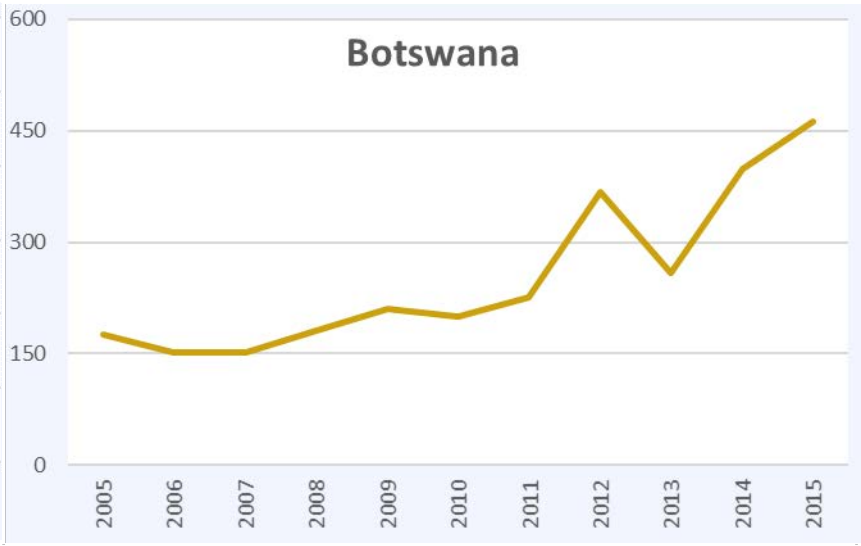

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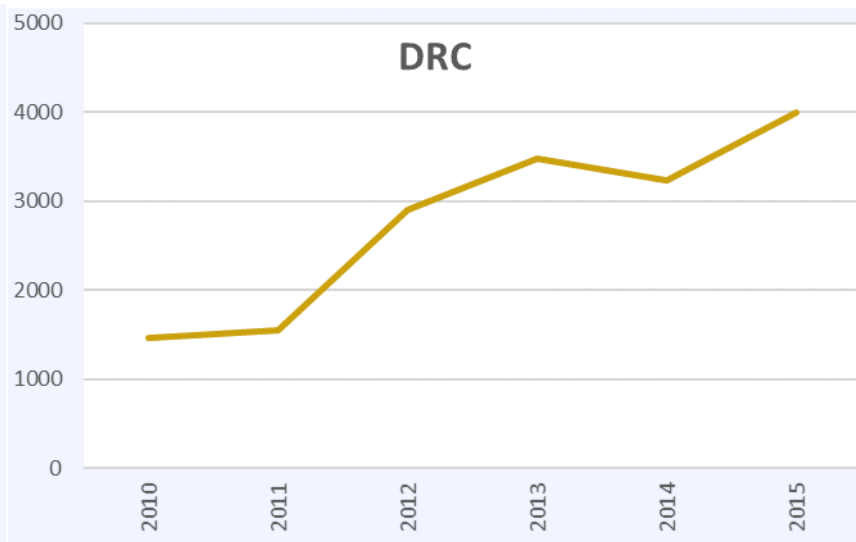

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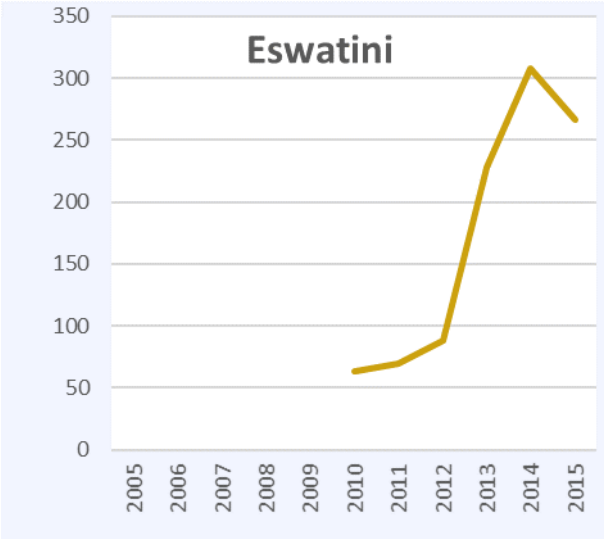

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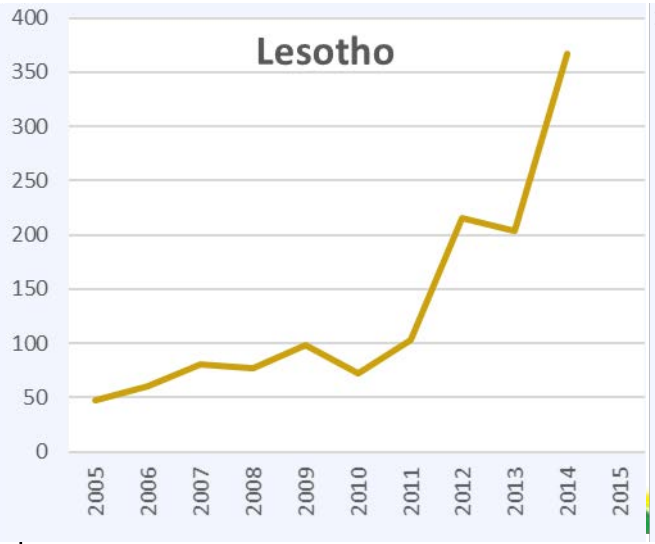

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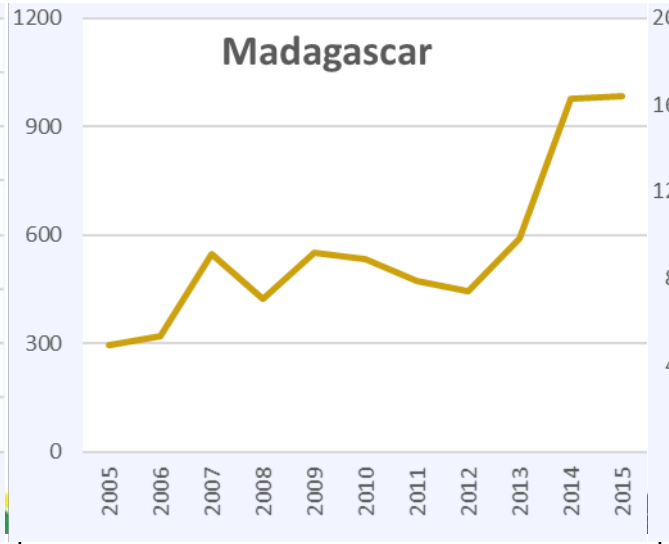

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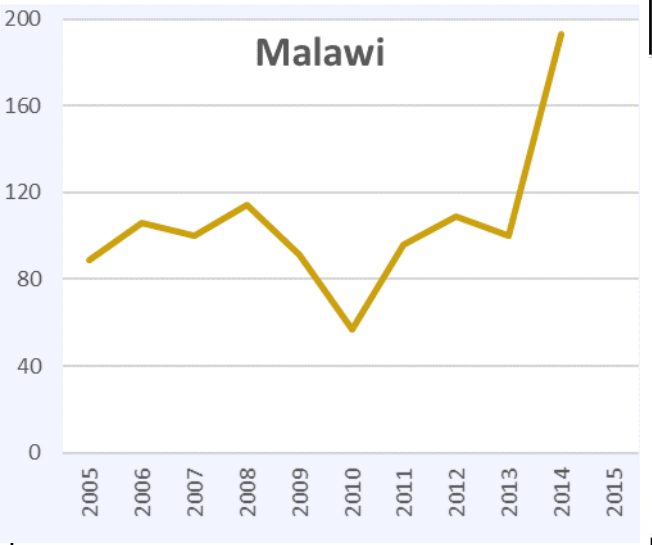

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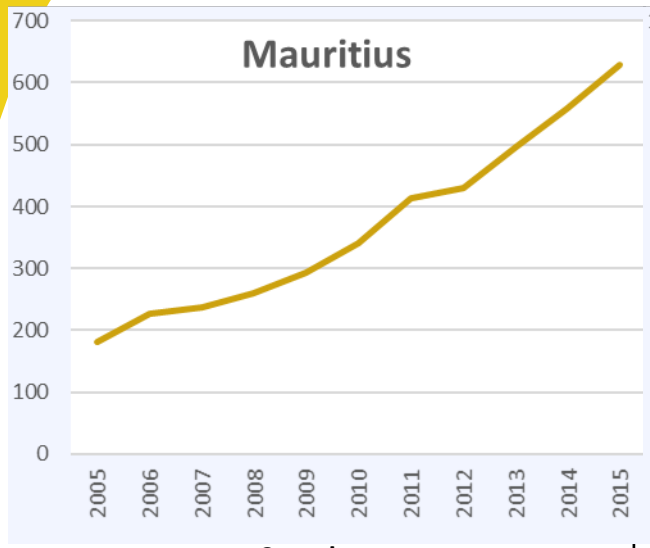

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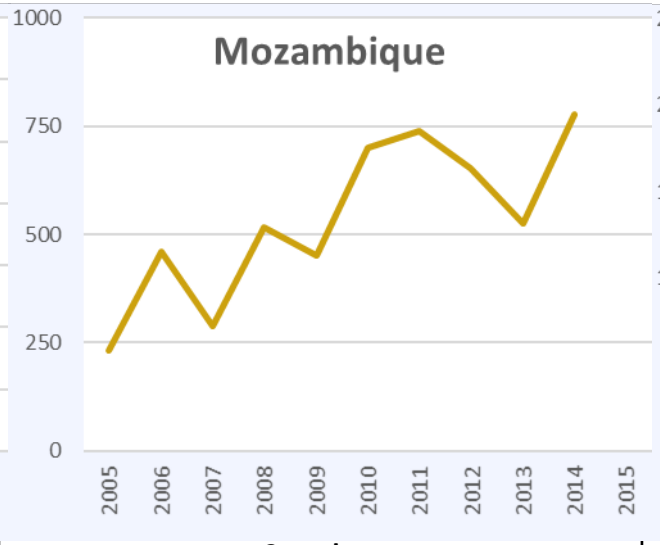

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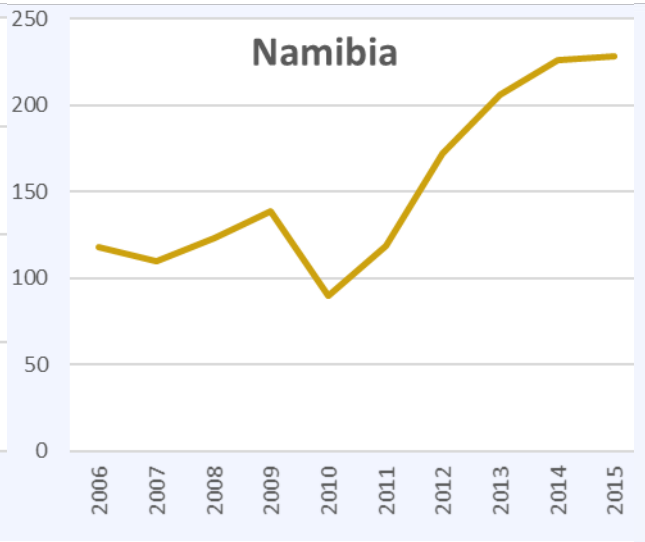

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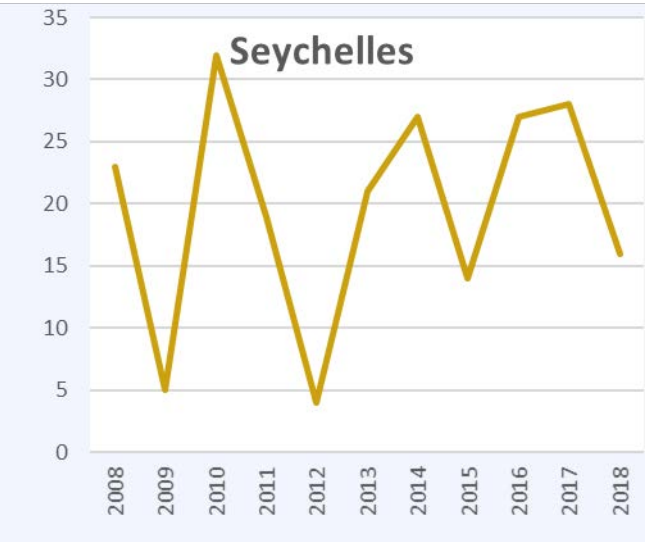

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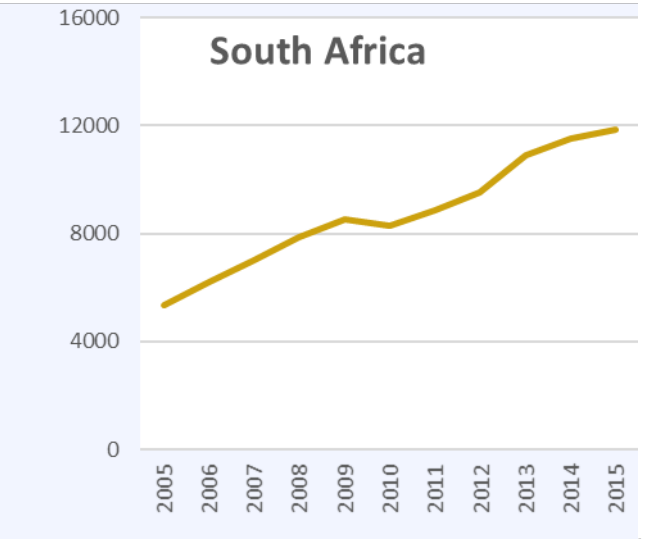

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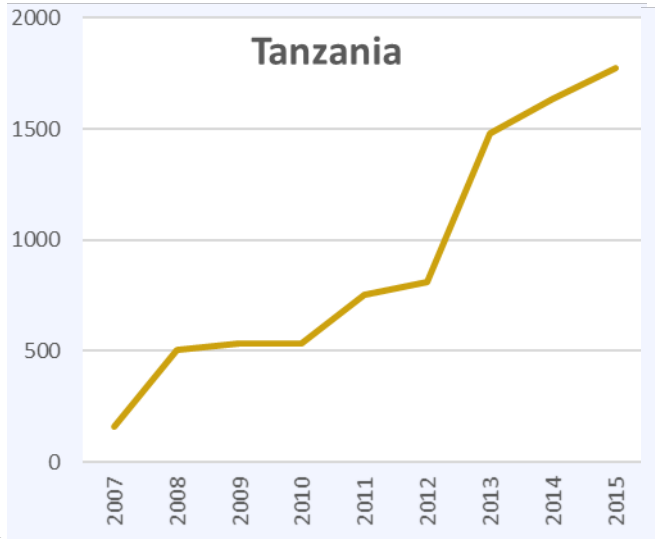

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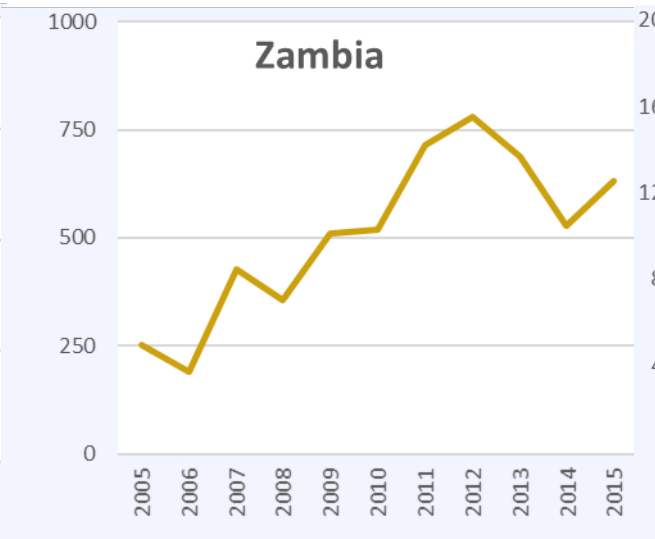

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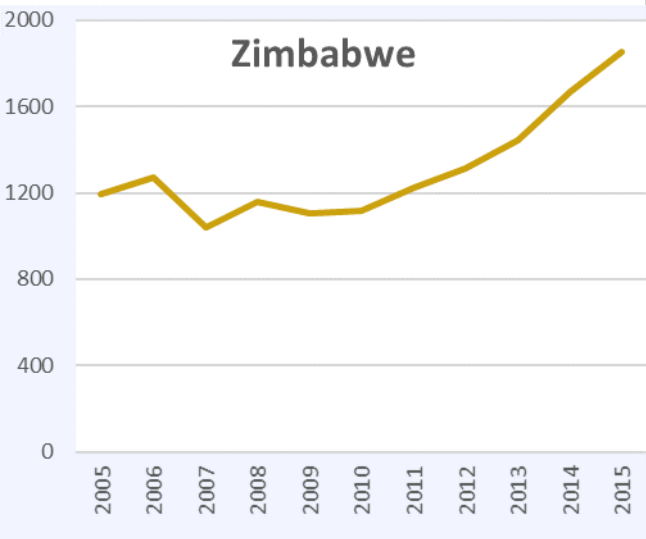

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Higher education – many new universities

- In most countries, the number of universities has gone from one or two established universities to 10 or more
- In some countries, colleges have become polytechnics and polytechnics have become universities, so many engineers are being trained but no longer enough technicians
- The number and limited resources and poor quality of graduates has become a problem in terms of employability

Level & complexity of qualifications inconsistent

- **Recognition** of qualifications around the region challenging
- Some qualifications **not sufficiently complex** to be recognised by neighbouring states
- Technician qualifications **at different levels** – some at 'A' level and others above 'A' level. Which should they be and what content?
- More **applied approaches** suggested for technician training
- Consider using guidelines from the **International Engineering Alliance** for all qualifications

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

- Industry expects graduates to be experienced
- Limited workplace training programmes
- Too many graduates to train - challenge for seniors to spend enough time with graduates
- Funding and programmes needed
- Need group approaches to training graduates in the workplace, supervised by experienced professionals

Ongoing training must be institutionalised – not ad hoc programmes

Apprentice and graduate training to become part of all public sector tenders

Need to share best practice

- **Tanzania** – Structured Engineers Apprenticeship Programme (SEAP, 2003)
- **Mauritius** – government funded two years after graduation (only introduced 2016)
- **South Africa** – training of graduates and apprentices to be quoted as part of all public sector projects (introduced 2013, slow take up)
- **Angola** – oil industry to train as part of their licences with government
- **Mozambique** – private university (ISTUC) offering employability workshops ($25 – 24 hours applied problem solving, great improvement in employment)
- **Electricity parastatals** – generally still developing graduates, but very procedural

Need more problem solving, challenging approaches to development!

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

Functionality per registering body

- No alignment between registration requirements - some compulsory, others voluntary, some only public sector, others not public sector, some academics, others not academics
- Different periods of training and workplace training methods
- Different outcomes measured and assessment methods
- Range of functionality covered by professional bodies varies:
  - Accreditation of qualifications
  - Requirements for CPD
  - Support for RPL and reviewing foreign qualifications
  - Appointment of councils and ministerial roles
  - Malpractice
  - Recognition of Voluntary Associations

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

Appointing professional service providers

- Registration of contractors and consultants inconsistent
- Some countries have Construction Councils and others not
- Construction Councils or Boards consider professionals available, capital, premises, equipment and machinery etc – but varies
- No training or use of local labour and materials enforced in contracts
- No project size limit set in terms of international or SADC contractors and trade liberalisation, but local SMMEs need to be protected

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

Industrialisation

Industrialisation and investment policies to include:

- Use of local skills
- Use of local materials and resources
- Development of local manufacturers
- Development of local markets
- Training of locals on all projects

Need to consider criteria to be included in all developments

Investment needed

- Infrastructure
- Maintenance
- Manufacturing
- Staffing
- Research and new technologies
- Appropriate solutions, and with the right conditions
- Agriculture
- Rural development
- Data collection and management

Targets and skills

- Big targets will require both short- and long-term skills
- Construction technicians and engineers needed
- Construction may require international expertise initially, but training must take place on ALL contracts
- Where sub-contractors used to expand capacity, sub-contracting staff must ALSO be trained and monitored
- Maintenance once built IS critical – need to expand maintenance teams and budgets – training needed here but only when funds have been committed!

Numbers and 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

Levels of service

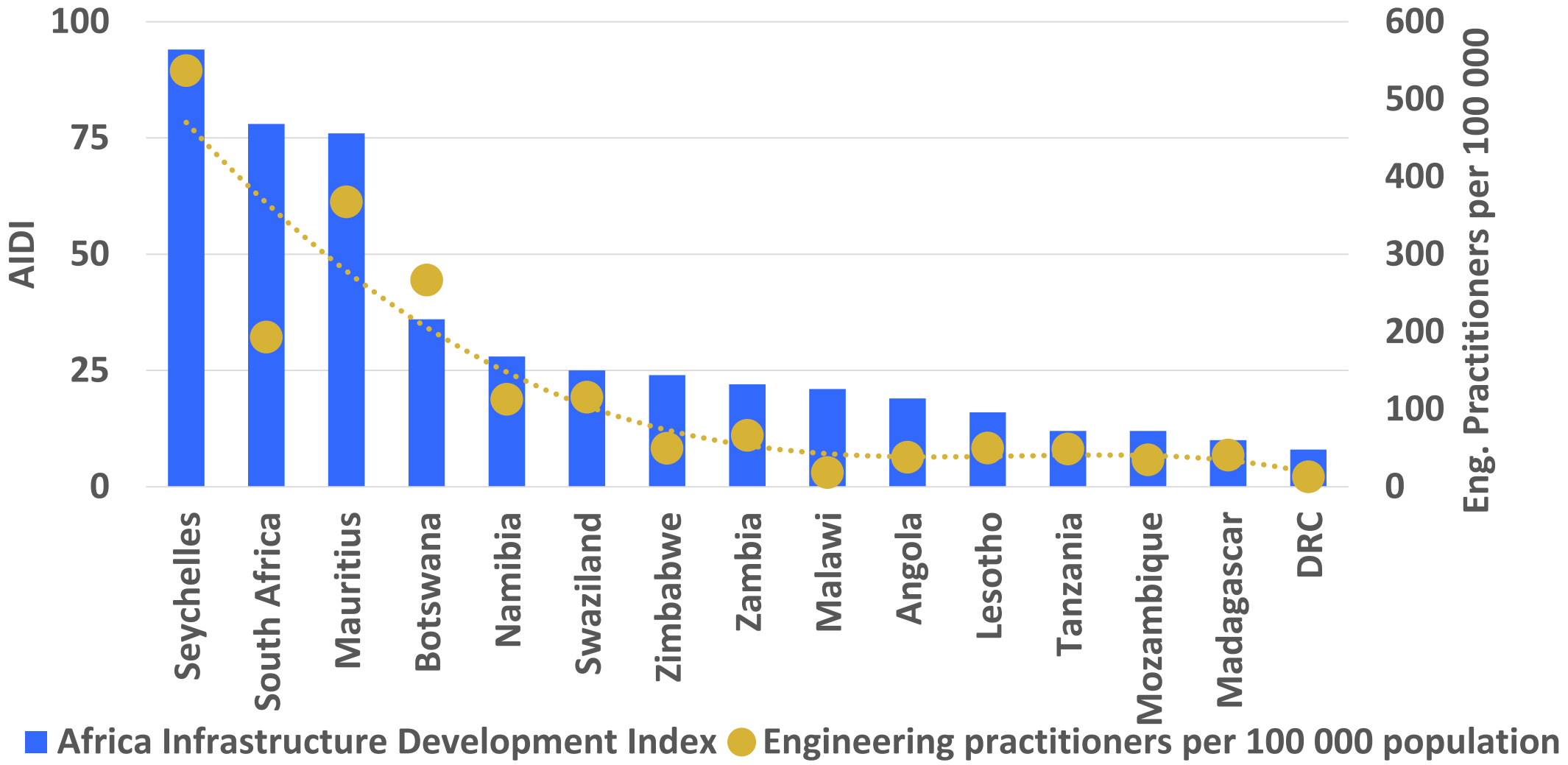
SERVICE TYPE	MINIMUM SERVICE	LEVEL 1 (BASIC)	LEVEL 2 (INTERMEDIATE)	LEVEL 3 (FULL)
	Increasing number and levels of skills needed			
Water	6 kl of drinking water per month, delivered to within 200 m of each household	Communal standpipes (from wells or boreholes)	Yard taps, yard tanks	In-house water
Sanitation	VIP latrine or better	VIP Latrine	Loflos or septic tanks	Full water borne
Electricity	50 kWh per month, delivered to each household. Street lights- one for every 4 stands or high mast lighting for dense settlements	5-8 A or non-grid Electricity	20 A	60A
Roads	Residential roads should provide all-weather access to within 500 m of dwelling	Graded	Gravel	Paved/tarred & kerbs
Stormwater Drainage		Open earth-lined channel	Open lined Channel	Piped Systems
Solid waste Disposal	Refuse into a street container within 200 m per household. Weekly collection	Communal (residents)	Communal (contractors)	Kerbside

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

Rate out of 54 – lowest = Somalia

AIDI to engineering practitioner per 100 000 population



Manufacturing: hi-, med- & low- tech

COUNTRY	LOW TECH					MEDIUM TECH			HIGH TECH					TOTAL		
	Food & beverages	Tobacco products	Textiles	Wearing apparel, leather, footwear	Wood, paper, printing, furniture	Petroleum, rubber, plastics	Non-metallic minerals	Metals & metal products	Chemicals & chemical products	Machinery & equipment	Electrpical equipment	Medical & precision instruments	Motor vehicles & other transport equipment	Low tech	Medium tech	High tech
Angola	16		1		2		72	3	3		1		1	20	76	4
Botswana	26		3						5	15				61	13	26
DRC	47				11				11					77	8	15
Eswatini	84		3	4	3	2	2	2	1	0	1		1	92	5	3
Lesotho	72		14						6					91	2	7
Madagascar	18	16	32		2		25	2	5					68	27	5
Malawi	47	25	2	1	5	3	5	3	8				1	80	11	9
Mauritius	31		36			8	3	2	8		0			75	16	10
Mozambique	37	7	2		1	1	6	42	2					48	49	2
Namibia	51		4	1	11	2	3	24	5					66	29	5
Seychelles	71	3					8							85	13	2
South Africa	26		3		18	11	3	9	11	9	2	1	7	47	23	30
Tanzania	61	9	4			4	7							84	15	2
Zambia	63		6		18	5	1	2	5					88	8	5
Zimbabwe	27		3	4	17		20	20	3				6	51	40	9

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)*

PART 3

COUNTRY REPORTS AND RECOMMENDATIONS

ANGOLA

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - Consider **using the IEA standards for accreditation of engineering qualifications** and provide funding to increase lecturing capacity and expand resources
  - **Align** public and private institution qualifications
  - **Rationalise** the number of institutions offering engineering qualifications
  - Review supply and demand for **chemical** engineering graduates and increase if necessary
- **Graduate training**
  - **Expand** successful **graduate training** programmes to all ministries
  - Fund graduate training in the private sector through incentives and linking to public sector projects
- **Registration**
  - Introduce rigorous **registration process,** rather than only certifying graduates
  - Include training, use of local material, skills and standards in **contractor** regulations
- **Public sector**
  - Increase **tariffs** where appropriate and address operations, **maintenance** and upgrading of infrastructure
  - Continue to **expand** economic and social infrastructure

BOTSWANA

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - Provide funding to increase lecturing capacity and expand resources to **support institutions** in working **towards IEA standards**
  - Review the range of engineering qualifications offered to ensure that they **match the need** and registration requirements, ensure number of mechanical graduates match demand
- **Graduate training**
  - Expand successful **graduate training** programmes to all ministries
  - Fund graduate training in the private sector through incentives and linking to public sector projects
- **Registration**
  - Ensure **complexity** measured by ERB matches that attributes recommended by the IEA
  - Set up a **registration council for contractors** – classify companies based on skills, capital, equipment, size of projects completed and include training, use of local material, skills and standards in regulations

DRC

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - Consider using the **IEA standards for accreditation** of engineering qualifications and provide funding to increase lecturing capacity and expand resources
  - **Rationalise** the number of institutions offering engineering qualifications
- **Graduate training**
  - Develop **graduate training** programmes in the public sector
  - Fund graduate training in the private sector through incentives and linking to public sector projects
- **Registration**
  - Set up and support **professional registration process** following finalisation of ONICIV Bill, December 2018
  - Set up a **registration council for contractors** – classify companies based on skills, capital, equipment, size of projects completed and include training, use of local material, skills and standards in regulations
- **Public sector**
  - **Invest** in economic and social infrastructure and maintenance
  - Review **procurement** conditions to ring-fence more work for **local consultants and contractors**
  - Promote, and **subsidise** if necessary, local contracting companies to acquire plant and construction equipment

ESWATINI

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - Consider using the **IEA standards for accreditation** of engineering qualifications and provide funding to increase lecturing capacity and expand resources
  - **Rationalise** the **number** being trained **to match the needs**
  - Offer **top-up** training for civil and mechanical engineering graduates of the past in construction and maintenance management
  - Make **bursaries** available to complete studies in engineering disciplines not taught in Eswatini
- **Graduate training**
  - Develop **graduate training** programmes in the public sector
  - Fund graduate training in the private sector through incentives and linking to public sector projects
- **Registration**
  - Support the role out of the **professional registration process** following finalisation of 2015 Bill
  - Rebuild **Voluntary Association capacity**
  - Include training, use of local material, skills and standards in **contractor** regulations
- **Public sector**
  - **Invest** in economic and social infrastructure and maintenance
  - Increase tariffs where appropriate and address operations, maintenance and upgrading of infrastructure

LESOTHO

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - Work towards using the **IEA standards for accreditation** of engineering qualifications and provide funding to increase lecturing capacity and expand resources
  - **Rationalise** the **number** being trained **to match the needs**
  - **Fund** the delivery of qualifications in **disciplines not currently available locally**
  - Work towards **expanding NUL** to offer all disciplines not available in the country
- **Graduate training**
  - Develop **graduate training** programmes in the public sector and in particular **mount large structured programmes on LHWP Phase II**
  - Fund graduate training in the private sector through incentives and linking to public sector projects
- **Registration**
  - Approve Bill and set up and support **professional registration process**
  - Set up a **registration council for contractors** – classify companies based on skills, capital, equipment, size of projects completed and include training, use of local material, skills and standards in regulations
- **Public sector**
  - Increase **tariffs** where appropriate and address operations, maintenance and upgrading of infrastructure
  - Continue to **expand** economic and social infrastructure
  - Fill **vacant** posts and ensure that engineering professionals are employed in senior decision-making posts.
  - Engineering sector to contribute towards preparing the **National Manpower Development Plan**

MADAGASCAR

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - Consider using the **IEA standards for accreditation** of engineering qualifications and provide funding to increase lecturing capacity and expand resources
  - **Rationalise** the number of institutions offering engineering qualifications
- **Graduate training**
  - Develop **graduate training** programmes in the public sector
  - Fund graduate training in the private sector through incentives and linking to public sector projects
- **Registration**
  - Introduce rigorous competence-based professional **registration process,** rather than certifying professionals after one year of experience
  - Set up a **registration council for contractors** – classify companies based on skills, capital, equipment, size of projects completed and include training, use of local material, skills and standards in regulations
- **Public sector**
  - **Increase tariffs** where appropriate and address operations, maintenance and upgrading of infrastructure
  - **Invest** in economic and social infrastructure
  - **Fill vacant posts** and ensure that engineering professionals are employed in **senior decision-making** posts
  - Develop **local codes and standards**

MALAWI

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - Work towards using the **IEA standards for accreditation** of engineering qualifications and provide funding to increase lecturing capacity and expand resources
  - **Rationalise** the number being trained to **match** the number and discipline **needs**, and ensure that sufficient mechanical, chemical, mining engineering and metallurgy students are enrolled each year
- **Graduate training**
  - Develop **graduate training** programmes in the public sector
  - Fund graduate training in the private sector through incentives and linking to public sector projects
- **Registration**
  - Adopt the new Malawi Engineering Institution Bill (MEI) and fund the development and strengthening of the MEI until operating as a fully-fledge learner society and **registering body**
  - Include training, use of local material, skills and standards in **contractor** regulations
- **Public sector**
  - Increase tariffs where appropriate and address operations, maintenance and upgrading of infrastructure
  - Invest in economic and social infrastructure
  - Lift moratorium on **employment of public sector officials**, repopulate structures and ensure that engineering professionals are employed in senior decision-making posts

MAURITIUS

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - **Support** the drive to attain **IEA standards for engineering degrees** and provide funding to increase lecturing capacity and expand resources
  - Align technician and technologist training to **IEA standards**
  - **Rationalise** the engineering qualifications offered to match local demand and those of neighbouring states
- **Graduate training**
  - Encourage all employers to **participate in the YEP** programme
  - Include graduate training as a requirement of all public sector tenders
- **Registration**
  - Extend **professional registration** to technologists
  - Include training, use of local material, skills and standards in **contractor** regulations
- **Public sector**
  - Invest in economic and social infrastructure
  - **Align conditions of service** across all spheres of government, fill vacant posts and ensure that engineering professionals are employed in senior decision-making posts
  - Develop **local codes and standards**

MOZAMBIQUE

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - Consider using the IEA standards for **accreditation** of engineering qualifications and provide funding to increase lecturing capacity and expand resources
  - **Rationalise** the number of institutions offering engineering qualifications
  - Support the development of the **rail qualification** and offer it to the region in **English**
  - Encourage increased enrolments in **chemical** engineering and in the new **oil and gas** qualifications
- **Graduate training**
  - Develop **graduate training** programmes in the public sector
  - Fund graduate training in the private sector through incentives and linking to public sector projects
- **Registration**
  - Include training, use of local material, skills and standards in **contractor** regulations
- **Public sector**
  - Increase **tariffs** where appropriate and address operations, maintenance and upgrading of infrastructure
  - Invest in economic and social infrastructure
  - Fill vacant posts and ensure that engineering professionals are employed in senior decision-making posts

NAMIBIA

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - Work towards using the **IEA standards for accreditation** of engineering qualifications and provide funding to increase lecturing capacity and expand resources
  - Streamline the process of **assessing** foreign qualifications and sensitise government departments on the need to check the **suitability** of foreign institutions and associated qualifications with the ECN
- **Graduate training**
  - Develop **graduate training** programmes in the public sector
  - Fund graduate training in the private sector through incentives and linking to public sector projects
- **Registration**
  - Enhance **professional registration process** following the appointment of new council in 2018
  - Set up a **registration council for contractors** – classify companies based on skills, capital, equipment, size of projects completed and include training, use of local material, skills and standards in regulations
- **Public sector**
  - Increase tariffs where appropriate and address operations, maintenance and upgrading of infrastructure
  - Invest in economic and social infrastructure
  - Fill vacant posts and ensure that engineering professionals are employed in senior decision-making posts

SEYCHELLES

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - Work towards using the **IEA standards for accreditation** of engineering qualifications and provide funding to increase lecturing capacity and expand resources
  - Make **bursaries** available to complete studies in disciplines not taught in the Seychelles
- **Graduate training**
  - Develop **graduate training** programmes in the public sector
  - Fund graduate training in the private sector through incentives and linking to public sector projects
- **Registration**
  - Finalise Bill and set up and support **professional registration process**
  - Set up a **registration council for contractors** – classify companies based on skills, capital, equipment, size of projects completed and include training, use of local material, skills and standards in regulations
- **Public sector**
  - Increase tariffs where appropriate and address operations, maintenance and upgrading of infrastructure
  - Invest in economic and social infrastructure
  - Fill vacant posts and ensure that engineering professionals are employed in senior decision-making posts

SOUTH AFRICA

- **Schooling**
  - Address **school** maths, science and increase number of high calibre entrants for engineering studies
- **Higher education**
  - Review **BEngTech** and articulation model
  - Review and develop **technician training** to match industry needs
  - Fund departments to increase academic staff and resources to **retain IEA recognition**
- **Graduate training**
  - Expand **graduate training** programmes in the public sector
  - Fund graduate training in the private sector through incentives and linking to public sector projects
- **Professional registration**
  - Revisit the definition of **engineering work**, considering the definitions adopted by other SADC registering bodies to ensure alignment and mobility of professionals throughout the region
- **Public sector**
  - Finalise and adopt **competence frameworks** in local government
  - Rebuild technical structures and ensure that engineering professionals are employed in senior decision-making posts
  - Increase tariffs where appropriate and address operations, maintenance and upgrading of infrastructure
  - Invest in economic and social infrastructure
  - **Review mining and manufacturing legislation** to be investor friendly and to protect local markets and use of local skills and materials

TANZANIA

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - Consider using the **IEA standards for accreditation** of engineering qualifications and provide funding to increase lecturing capacity and expand resources
  - **Rationalise** the number of institutions offering engineering qualifications
  - **Enhance TCU and NACTE** capacity to gather and publish national graduation statistics
- **Graduate training**
  - **Expand** Structured Engineering Apprenticeship Programmes (**SEAP**) in the public sector
  - **Expand SEAP** in the private sector through incentives and linking to public sector projects
- **Registration**
  - Expand **contractor regulations** to include training, use of local material, skills and standards in regulations
- **Public sector**
  - Increase tariffs where appropriate and address operations, maintenance and upgrading of infrastructure
  - Invest in economic and social infrastructure
  - Re-populate technical structures and ensure that engineering professionals are employed in senior decision-making posts
  - **Accommodate the appointment of graduates** into permanent posts in the **public sector**

ZAMBIA

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - Consider using the **IEA standards for accreditation** of engineering qualifications and provide funding to increase lecturing capacity and expand resources
  - **Increase the number of enrolments and graduations** to match requirements
- **Graduate training**
  - Support the EIZ to develop national **graduate training guidelines**
  - Develop **graduate training** programmes in all public sector departments
  - Fund graduate training in the private sector through incentives and linking to public sector projects
- **Registration**
  - Encourage the **registration** of professionals **in all sectors**
  - Expand **contractor regulations** to include training, use of local material, skills and standards in regulations
- **Public sector**
  - Increase tariffs where appropriate and address operations, maintenance and upgrading of infrastructure
  - Invest in economic and social infrastructure
  - Populate technical structures and ensure that engineering professionals are employed in senior decision-making posts

ZIMBABWE

- **Schooling**
  - Address **school** maths, science and increase numbers eligible to study engineering
- **Higher education**
  - Consider using the **IEA standards for accreditation** of engineering qualifications and provide funding to increase lecturing capacity and expand resources
  - **Rationalise** the number of institutions offering engineering qualifications
- **Graduate training**
  - Develop **graduate training** programmes in the public sector
  - Fund graduate training in the private sector through incentives and linking to public sector projects
- **Registration**
  - **Update the registration Act** to remove the relaxation given to technical officials in the public sector and include technologist registration
  - Set up a **registration council for contractors** – classify companies based on skills, capital, equipment, size of projects completed and include training, use of local material, skills and standards in regulations
- **Public sector**
  - Increase tariffs where appropriate and address operations, maintenance and upgrading of infrastructure
  - Invest in economic and social infrastructure
  - Re-populate technical structures and ensure that engineering professionals are employed in senior decision-making posts
  - Engineering sector to contribute towards preparing the **National Critical Skills Audit Report**