ROYAL ACADEMY OF ENGINEERING

AFRICA-UK Engineering for Development Partnership

# ENGINEERS FOR AFRICA

## Identifying engineering capacity needs in Sub-Saharan Africa

Supporting document 2:
Analysis of survey responses

**About the Africa-UK Engineering for Development Partnership**

The Africa-UK Engineering for Development Partnership (A-UK) brings together the engineering community in Africa and the UK in a consortium comprising the Africa Engineers Forum, The Royal Academy of Engineering, the Institution of Civil Engineers and Engineers Against Poverty. The aim of the Partnership is to strengthen the capacity of the African engineering profession and promote mutually beneficial links between engineers in Africa and the UK.

**Authors**

*From Engineers Against Poverty*

Petter Matthews
Lily Ryan-Collins
Dr Jill Wells

*From the Royal Academy of Engineering*

Dr Hayaatun Sillem
Holly Wright

*This study was made possible by the kind support of the Anglo American Group Foundation, Schlumberger and the David and Elaine Potter Foundation.*

## Introduction

This paper presents the main findings from an electronic survey distributed to practicing engineers and decision-makers (that is, people in senior positions who rely on and engage with engineers) in the engineering sector in Sub-Saharan Africa (SSA). The electronic survey is complemented by two other research tools: (i) a series of semi-structured interviews with senior figures in the engineering profession and (ii) a literature review. The results of the three elements of the study are brought together in the *Summary report.* The aim of this research is to improve our understanding of *capacity building* needs in the engineering sector in sub-Saharan Africa, in support of the A-UK partnership.

The specific purpose of the electronic survey was to gather data regarding perceptions of the engineering profession in SSA, its current capacity and priorities for capacity building interventions. While some questions do not allow direct conclusions to be drawn about engineering capacity needs, they are included to provide context for other questions. Two different versions of the survey were developed. The first was intended for completion by professional engineers working in SSA. The second version was developed for completion by decision-makers in the policy, business or donor communities who engage with engineers in SSA on a regular basis. Copies of the two questionnaires are attached in Annexes 1 and 2.

The surveys were distributed to members of the African Engineers Forum (a network of professional engineering institutions across SSA), to participants at A-UK workshops held in Tanzania, Botswana and Zimbabwe, and through African contacts of the partners (ICE and EAP). We received a total of 113 completed questionnaires from professional engineers and a further 29 from the survey for decision-makers.

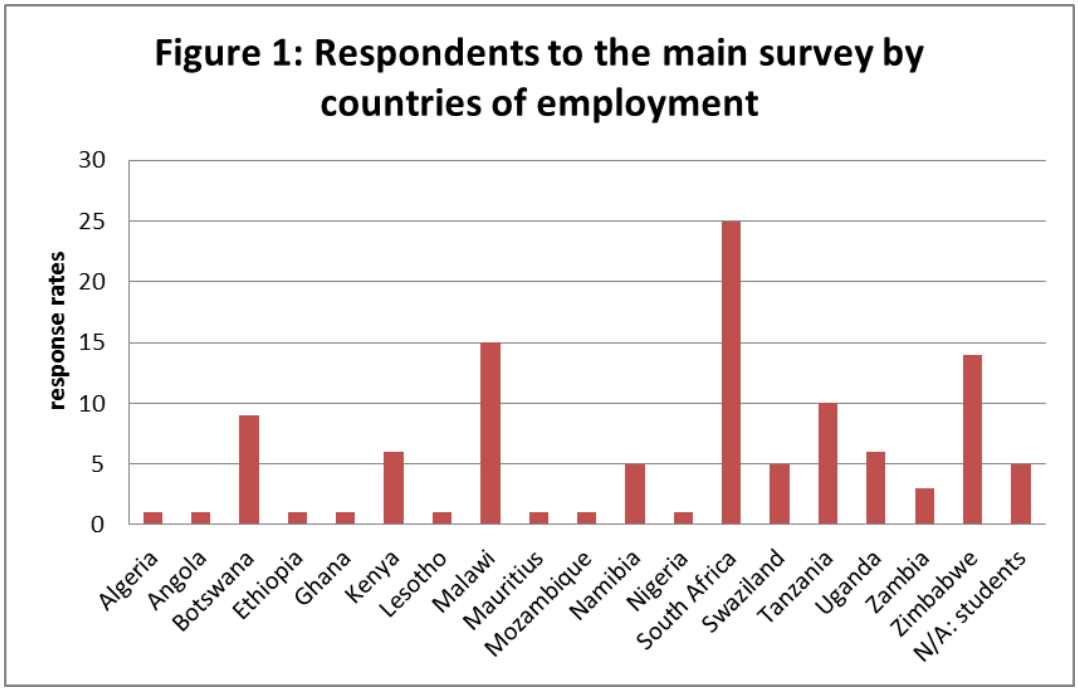
## The respondents

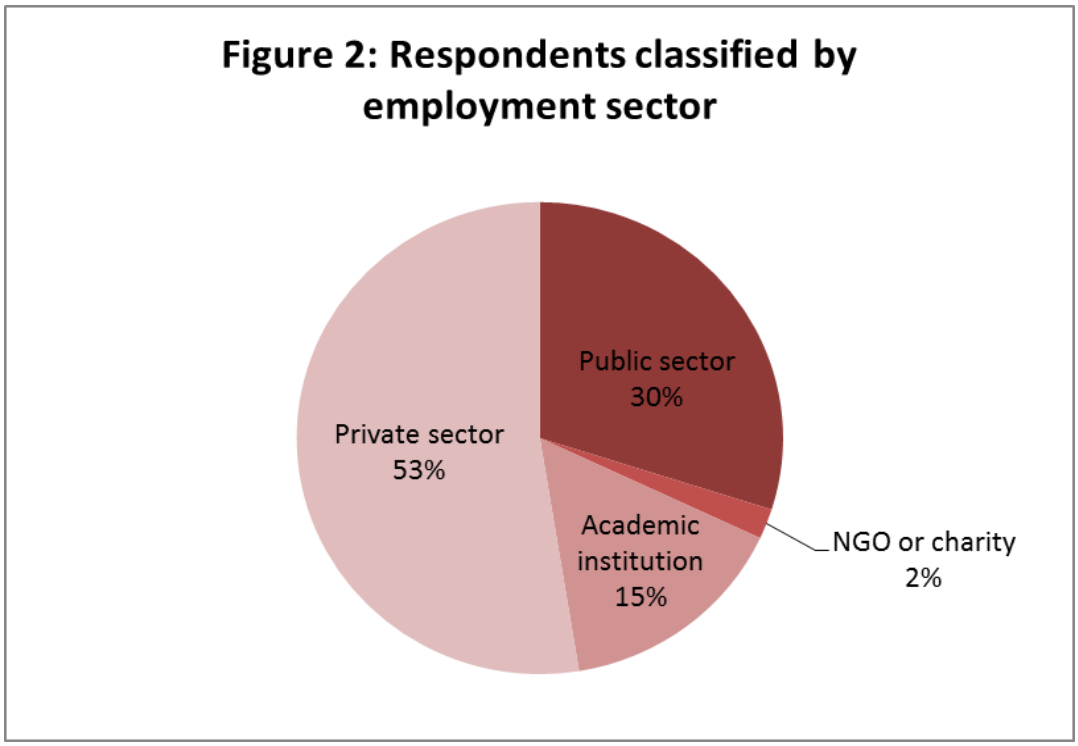
### *Main survey*

The respondents to the main survey were overwhelmingly (78%) civil engineers. Civil engineers were followed by mechanical (11%) and electrical (9%) engineers with the remaining 2% being chemical and mining engineers. There was a similar bias in our interview sample and in the literature review and this is probably indicative of the predominance of civil engineering in SSA.

In addition, there is a strong bias in the sample towards English-speaking countries in southern and Eastern Africa. The largest number of respondents were working in South Africa, followed by Malawi, Zimbabwe, Tanzania, and Botswana. 80% completed their higher education in SSA and just over 60% have worked in the region for more than five years - suggesting a reliable history of experience on which impressions and opinions expressed in answering this survey are based.

All but three respondents were members of professional engineering institutions (PEIs) in the countries in which they were working, with a sizeable minority (30) being members of more than one PEI. Most often they were members of multiple institutions in the same country, reflecting the fragmentation of the engineering sector. However, some cases also reflect global ties, combining membership 'at home' with membership of institutions in high-income countries.



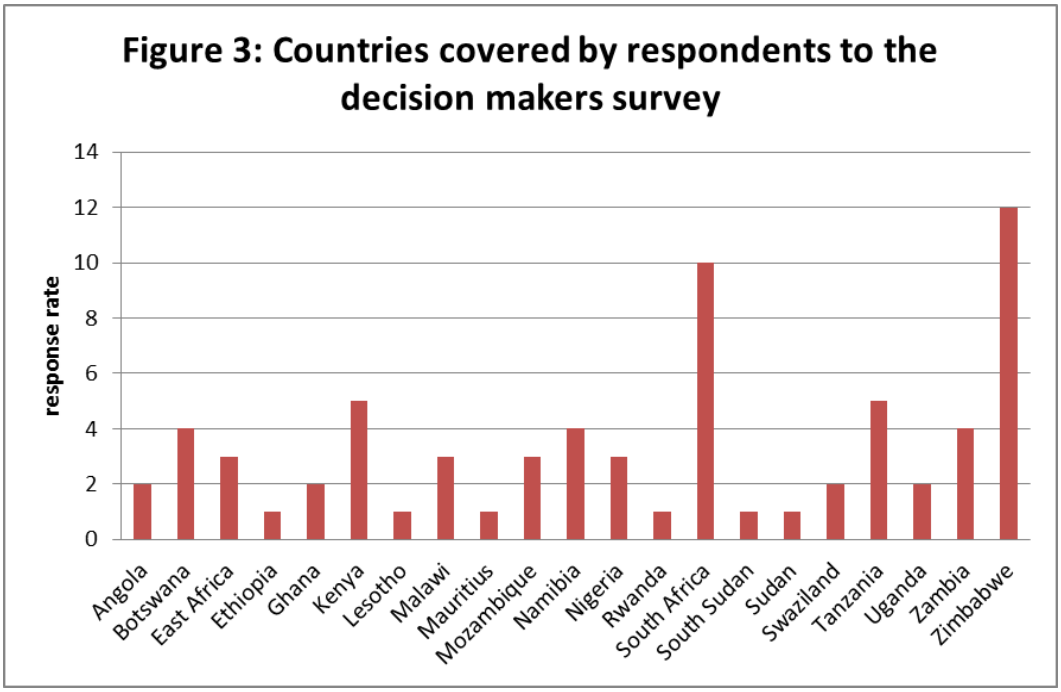



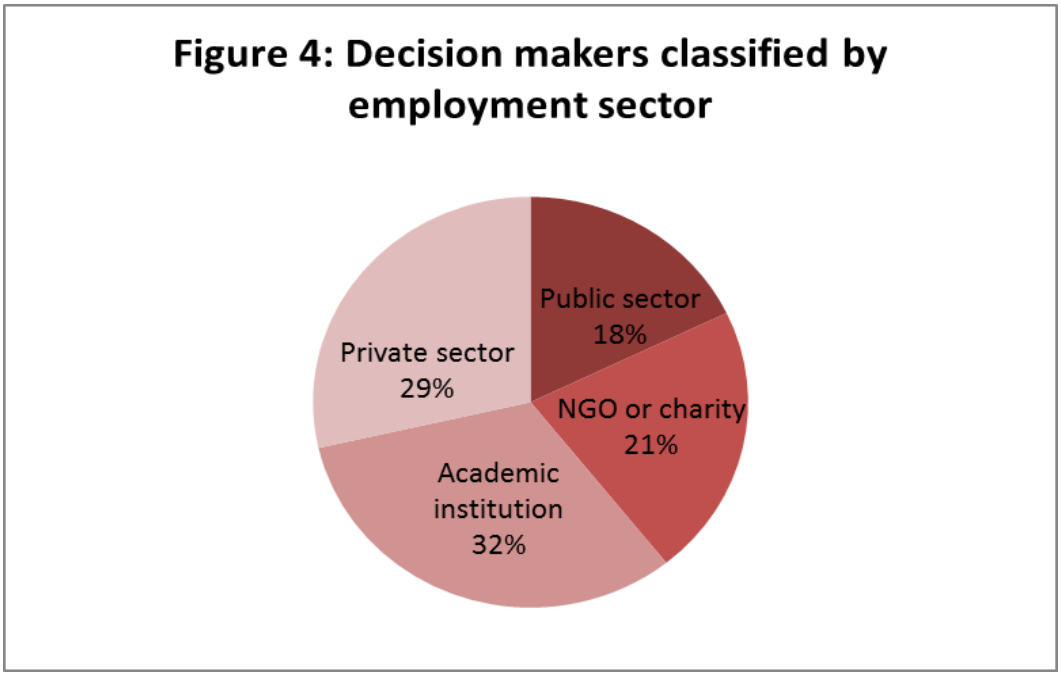

More than 50% of respondents worked in the private sector, with international organisations dominating this group. But the public sector was also well represented, although central government agencies dominated with limited representation from local government offices. Only two respondents worked for an NGO or charity and there were none from donor agencies or multilateral development banks.

The majority of respondents were employed in technical capacities, with a substantial number engaged at management level, suggesting longevity of career and experience. A small number (eight) were educators but there were 16 students (14% of the sample).

***Decision-makers' survey***

For purposes of the survey, 'decisions-makers' were defined as senior people in the policy, business and donor communities who engage with engineers in SSA on a regular basis. There is a similar geographical bias in the sample of decision-makers, with the largest number from Zimbabwe, closely followed by South Africa. The majority (>60%) of respondents were in middle or senior management, with a good balance between the public, private, education and NGO sectors. More than 60% were employing fewer than 10 engineers.



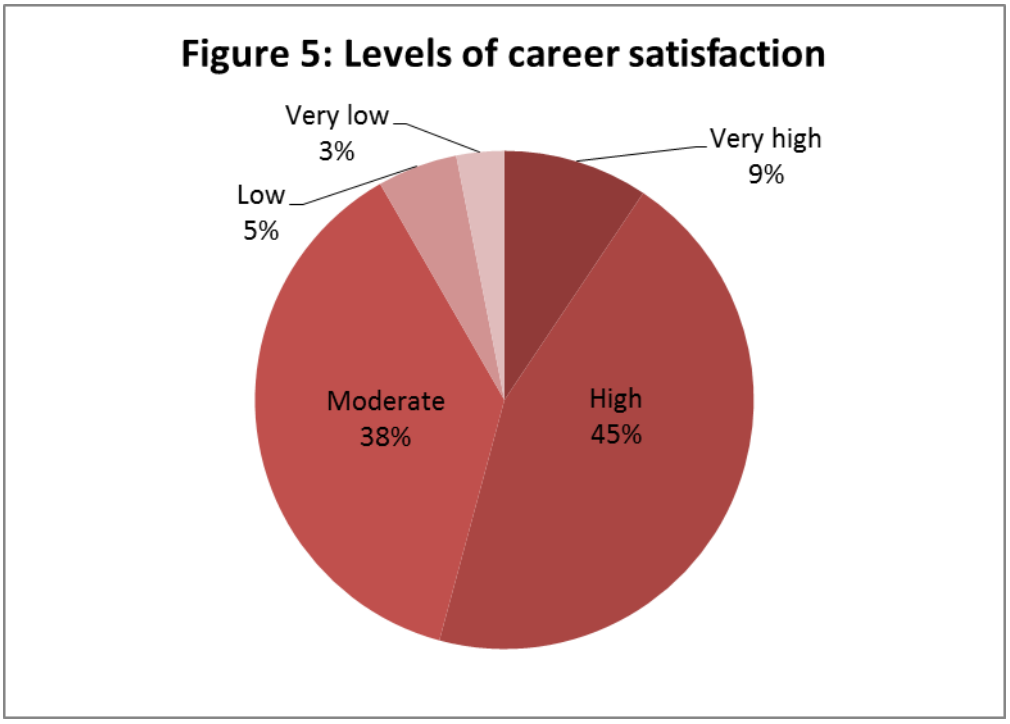

The analysis that follows will focus first on the questionnaire for professional engineers, which we will call 'the main survey'. Where the same question was asked of the decision-makers,

their response will be examined alongside and compared with that of the professional engineers. However, all figures in the main survey section refer only to data from the main (professional engineers) survey. Questions asked of decision-makers that were not included in the main survey will be examined at the end.

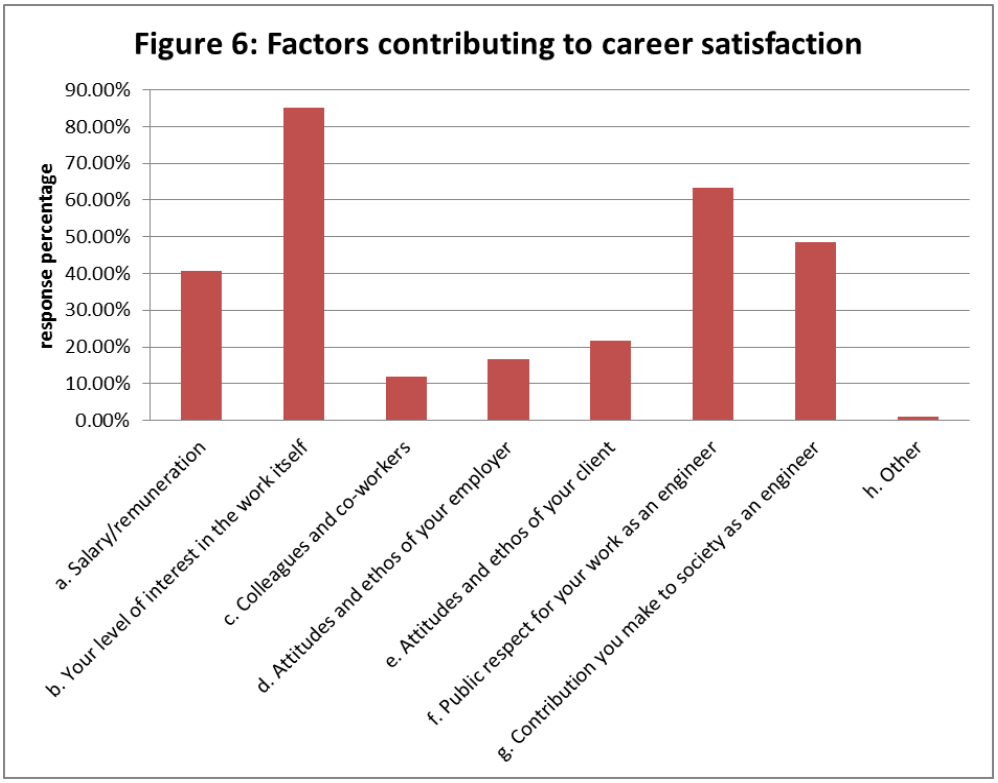
## A. Summary of responses from professional engineers (the main survey)

### 1. Career satisfaction

1.1 Respondents were asked three questions about the way they felt about their careers in engineering. The first was a straightforward question asking them to rate their level of career satisfaction. The responses to question one are shown in Figure 5. It was striking that the majority (>50%) had high or very high levels of satisfaction. That a considerable group (38%) rate their job satisfaction as only 'moderate' was also noteworthy. The following questions could help to explain why.

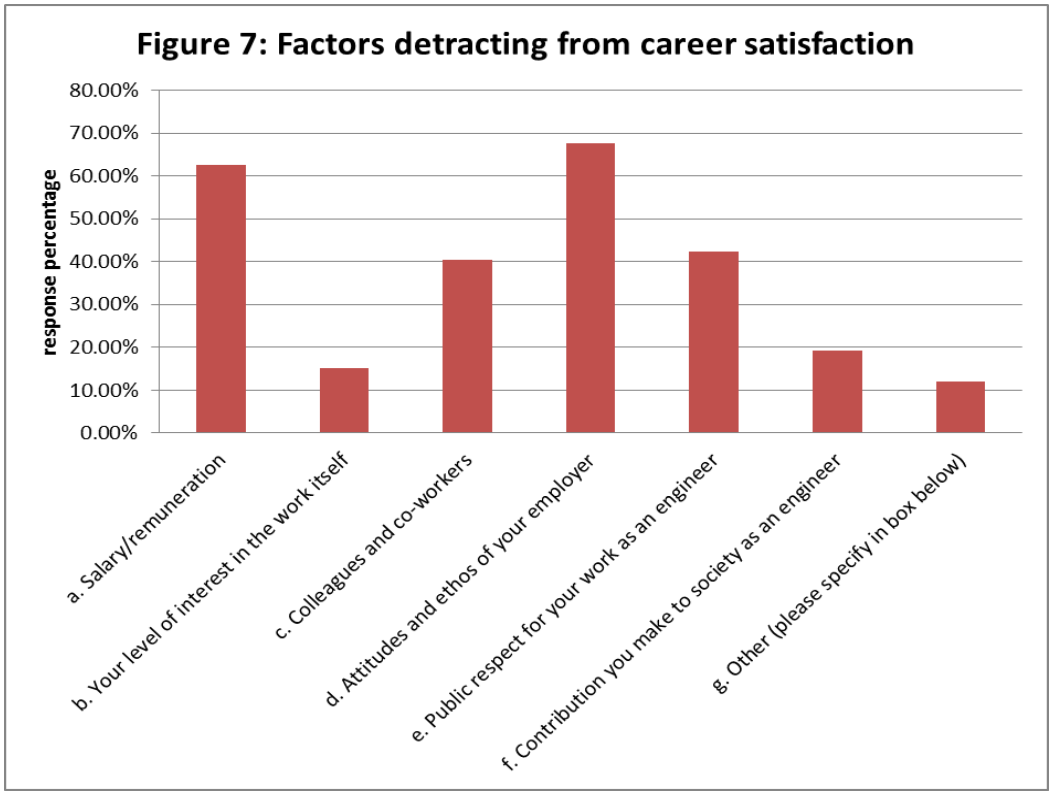



1.2 In the second question, respondents were asked to indicate (a) three factors that contribute to their career satisfaction and (b) three factors that detract from it. The findings are shown in Figure 6 and Figure 7.




From Figure 6 it can be seen that a large majority (85%) of respondents indicated that their interest in the work itself was a major factor providing satisfaction. The next two most important factors are closely related - public respect and social contribution. This suggested a strong belief among respondents of the potential for engineering solutions to be socially transformative, and a desire to fulfil this potential. It also suggested room for improving job satisfaction by raising the profile and influence of engineers in public policy.
A considerable number of respondents (around 40%) also mentioned remuneration as a key factor in their career satisfaction, which suggested that income levels were considered adequate but did not constitute a primary element of job satisfaction/motivating factor.

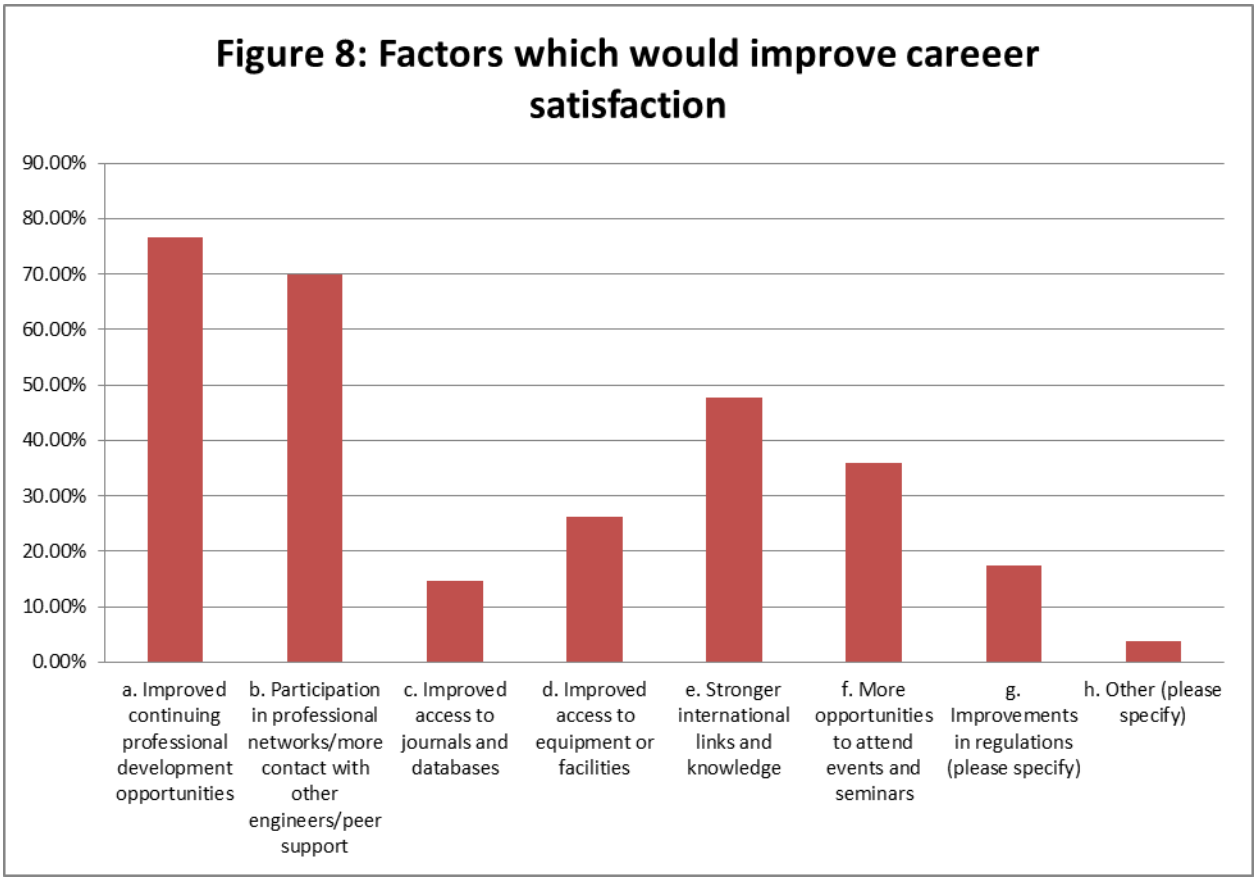
Interestingly, two of the most important factors found to contribute to career satisfaction were considered to detract from career satisfaction by significant minorities. While 63% of respondents reported that public respect for their work contributed to a sense of wellbeing in their careers, 42% said that it detracted from their job satisfaction - presumably because they perceived it to be lacking. Similarly, while 40% of respondents indicated that their salary was a deciding positive factor, around 63% felt the opposite - that their remuneration was insufficient.




However the factor most often cited (by 68% of respondents) as detracting from career satisfaction was none of the above – it was the attitudes and ethos of the employer. We checked to see if this might be a problem that is restricted to the public sector but found that it is also reported by those working in the private sector. It is interesting to note that three of the most important factors reported as detracting from job satisfaction were related to the professional environment. These were attitudes and ethos of the employer (highest with 68%), salary/remuneration (second highest with 63%) and colleagues and co-workers (fourth highest with 40%).

The 'other' options threw up some further factors detracting from career satisfaction, including the lack of adequate financial and material resources (five responses) - which was also a factor related to the professional environment. Public respect for the work of engineers was also viewed by 42% of respondents as lacking, with two further respondents citing a lack of respect and professional appreciation by other stakeholders as a major frustration. Closely related to this, another respondent directly reported 'political interference' as an inhibiting factor.

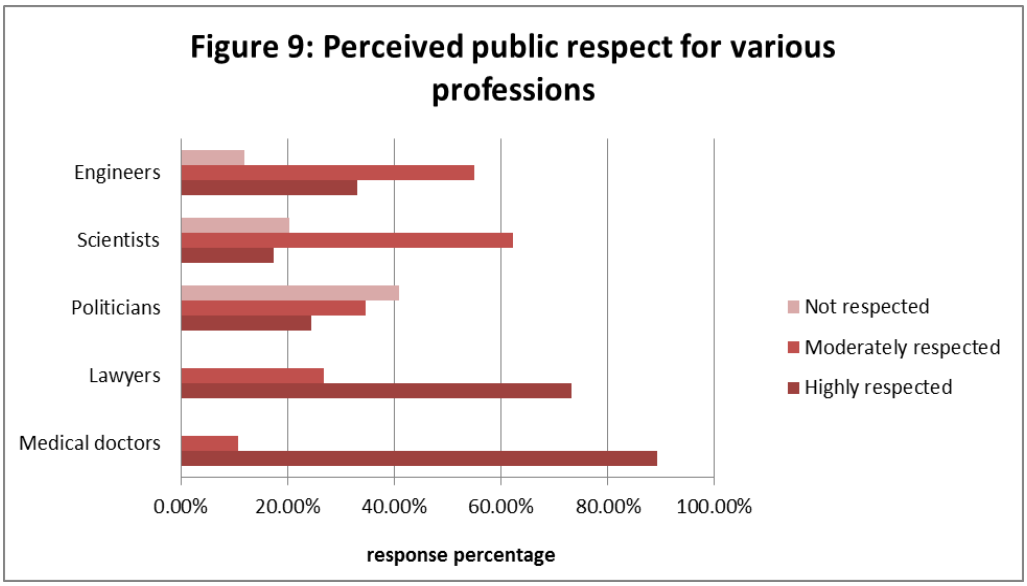
1.3. The third question asked respondents for three factors that might improve their career satisfaction as engineers. Responses are shown in Figure 8.




'Improved continuing professional development opportunities', emerged as the most important factor which would improve career satisfaction, chosen by 77% of respondents. It was closely followed by the related issue of need for participation in professional networks, more contact with other engineers, and peer support (these issues reflected the dissatisfaction with employers and the professional environment, as well as dissatisfaction with colleagues and co-workers, expressed previously). Also significant was that almost half of the respondents indicated that they would appreciate stronger international links and knowledge to support their work. This reflected the globalisation of the engineering market, and the dominance of foreign organisations and institutions. In forging stronger international links it was perhaps hoped that the engineering profession in SSA would be able to build local capacity and benefit from involvement in national and regional projects which are currently often carried out by foreign operators. Improving access to journals and databases was the least sought-after improvement, with only 15% of respondents indicating that this would be a priority for them. This suggested that, on the whole, the immediate problems to be addressed were much more fundamental, concerned with skill development and professional development.

## 2. Perceptions of engineering

Related to the issue of career satisfaction was that of how engineering is perceived by society, relative to other professions. Respondents were asked to rate engineering and four other professions as highly respected, moderately respected or not respected. The results are shown in Figure 9.



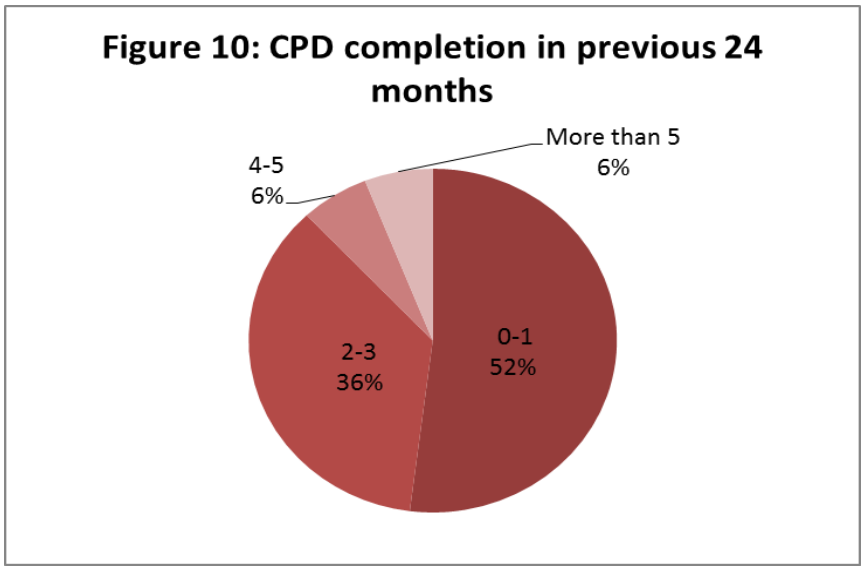

Predictably, medical doctors were perceived to be the most valued professionin society, followed by lawyers. Not a single respondent believed that these two professions were not respected at all and an overwhelming 89% believed medical doctors were highly respected. It was perhaps also predictable that politicians were the least valued, with only one in four respondents perceiving levels of respect for the profession as high, and 40% arguing that they were not respected at all. Scientists and engineers were perceived to fall somewhere in between, with a majority of respondents in both cases indicating that the profession was moderately respected. Nevertheless, about a third of respondents did think of their profession as highly respected, and only 12% perceived an absolute absence of respect.

Respondents were also asked to provide details of the evidence/experiences on which their views were based. 44% of respondents responded to the question by explaining the sources or factors that influenced their views. Most cited were 'perceptions of people', 'talking to people' or 'response of the media', and some cited the difference in pay between the professions as evidence of differing value to society. The remaining respondents understood the question to be asking them to give their views on reasons for the different levels of respect for the various professions, with most giving reasons why engineers are less highly respected than doctors or lawyers. Most frequently cited were lack of visibility of the profession (16 responses) closely followed by lack of knowledge and understanding of what engineers do (13). Some way behind were the gap in pay levels (eight) the fact that others (mostly politicians) take the credit for work done by engineers (six) and failure to maintain the standards of the profession through registration (five).

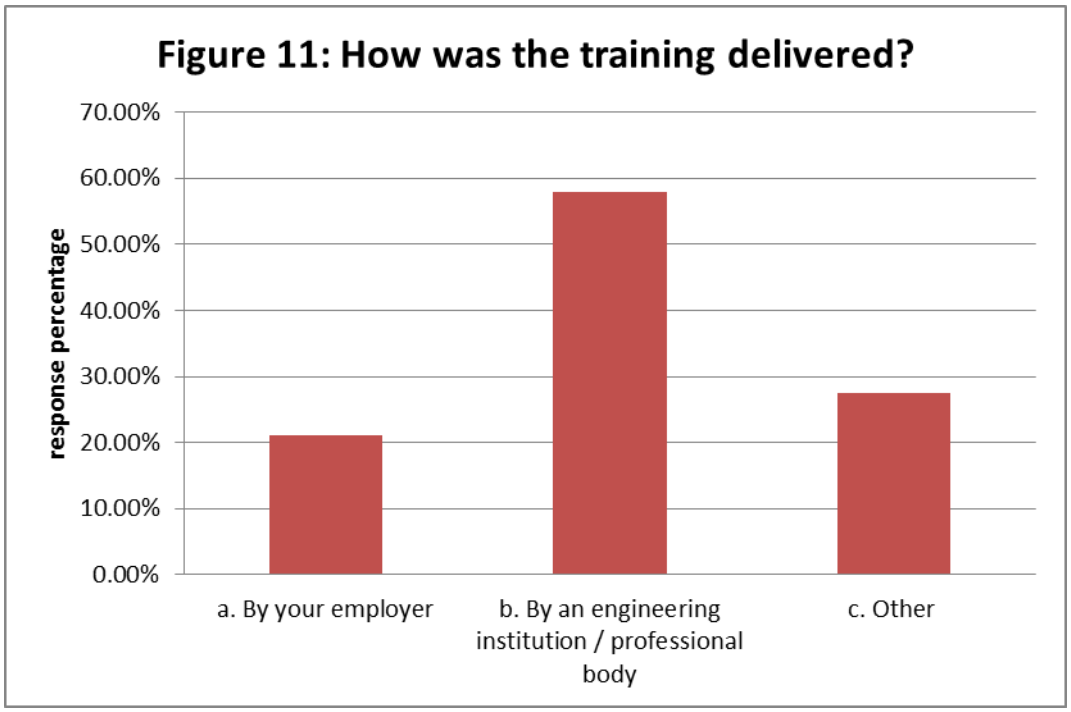
An overwhelming majority of respondents (98%) said they would recommend engineering as a career for a young person in SSA. The most important reason given, mentioned by 34 respondents in their comments, was the idea that the engineering profession meets an important public need. Career satisfaction was mentioned by 18 respondents and the development impact of engineering by 15. The main reasons given for not recommending engineering as a career were stress and low pay.

### 3. Training

The next set of questions addressed training/continuing professional development (CPD). Respondents were asked to provide information on the training they had received in the previous 24 months and about their unmet training needs.

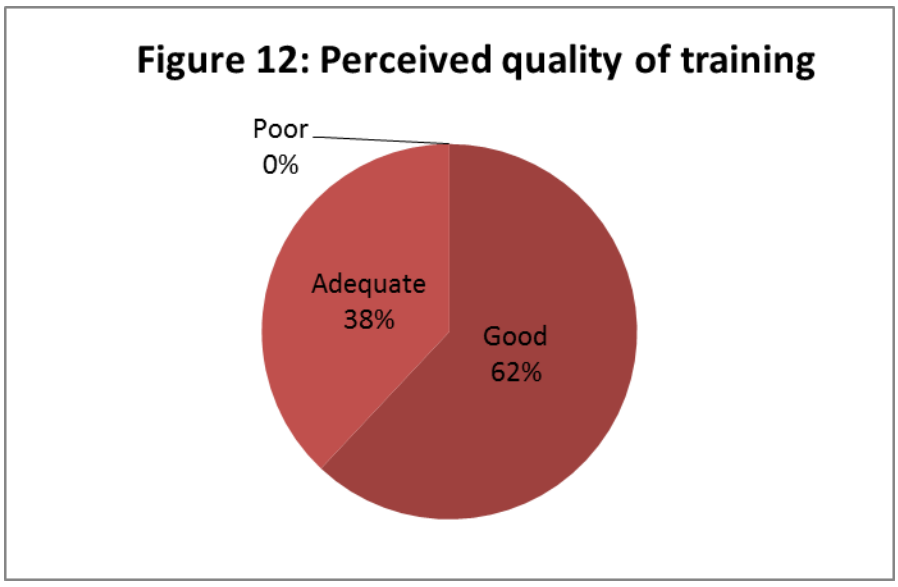



The results (Figure 10) seem to confirm that CPD learning opportunities were limited. Just over half of the respondents (52%) indicated that they had only completed one CPD course in the previous two years, or even none at all. 36% reported having attended two to three CPD sessions in the previous two years. When asked who paid for the CPD courses, the majority of respondents (63%) reported that their employers paid. It was significant that just over one fifth of respondents reported spending their own income to pay for their professional development.

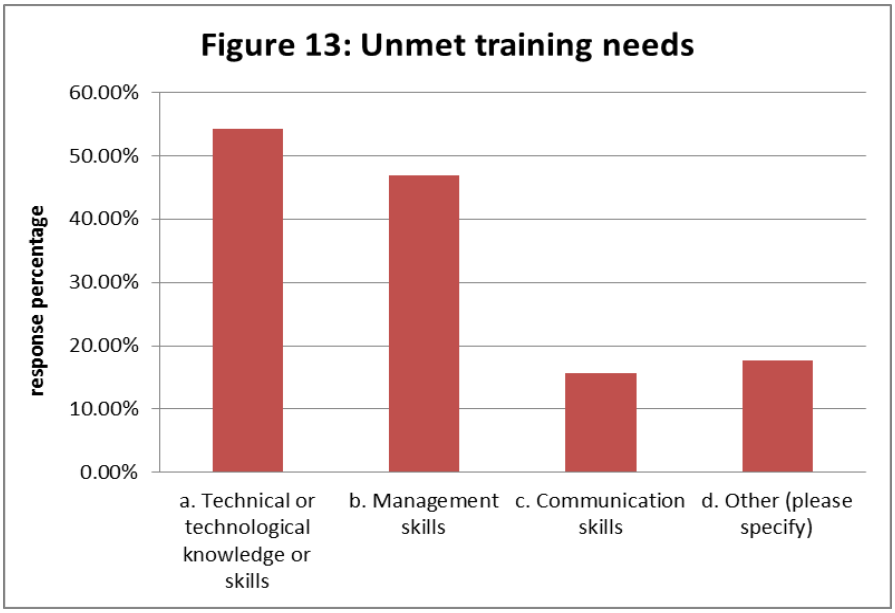


Just over half of respondents had been given training delivered by a professional body or engineering institution, indicating the central role these bodies play in supporting the professional development of engineers (Figure 11). It appeared that respondents mainly attended these CPD courses through their national membership organisation. However, 26% of respondents reported receiving their training from a range of other service providers and specified these to be learning events, including seminars, lectures, workshops, and conferences, or university programmes and scholarships. Less important, but still significant, were consultants and training organisations in delivery of CPD, as well as commercial offers on behalf of service providers, product developers, and contractors.

No respondents reported the quality of training received as poor. The majority (62%) perceived the quality of their training to have been 'good', and 38% reported the quality as 'adequate' (Figure 12).




Just over half of respondents reported having unmet training needs related to technical or technological knowledge and skills (Figure 13) and almost as many cited unmet training needs related to management skills. This supports findings from the literature review and interviews.

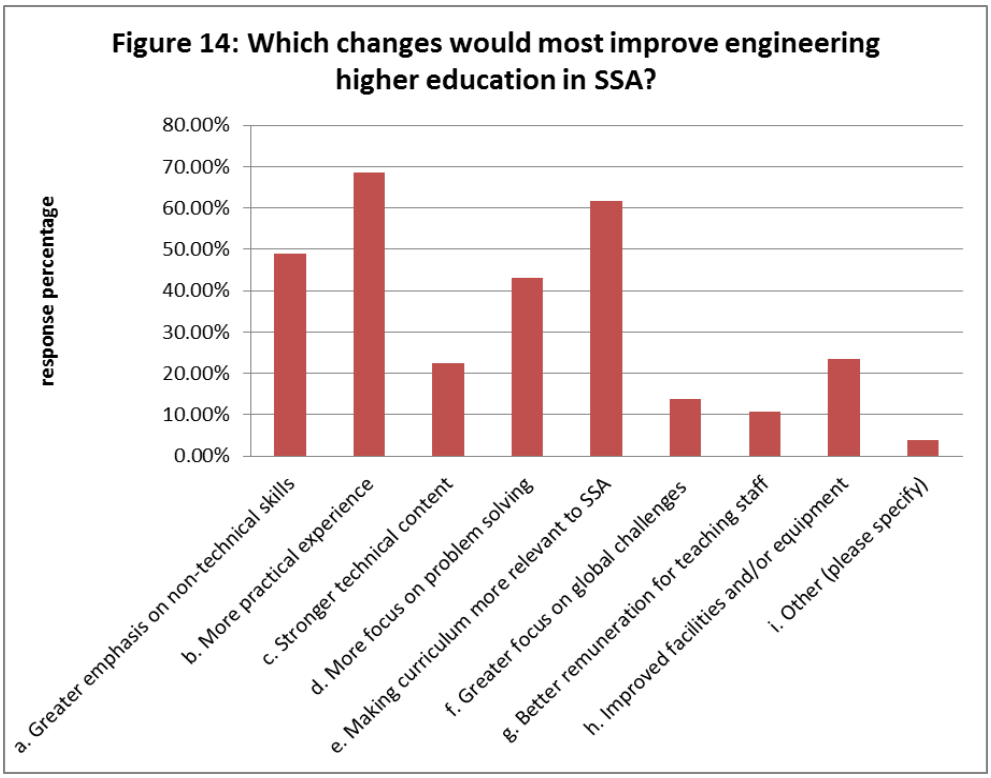


## 4. Education

Respondents were asked whether engineering education in their country provided students with the skills they need to work effectively as engineers when they graduated. 60% responded 'yes' and 40% 'no'. However, many of those who said yes also noted a number of shortcomings in their comments. The response from decision makers was exactly the same, with 60% saying yes and 40% no (Figure 14).

The major failings of formal engineering education in respondents' eyes (gleaned from their comments) were an inadequate curriculum (outdated and not relevant to the circumstances and challenges of SSA) which was indicated by nine respondents, followed by limited practical experience for students (five) and poor resources and facilities (five). Underpaid and poor quality staff and inadequate specialisation were also mentioned.

Respondents were then asked to rank suggested policy changes that would most improve engineering higher education (Figure 14). Over 60% of respondents ticked 'more practical experience' and 'making the curriculum more relevant to SSA', reinforcing the responses to the previous question. In third place was 'greater emphasis on non-technical skills' which echoes the responses shown in Figure 9. More focus on problem-solving was also considered important by just over 40% of respondents. These responses indicated that the problems in higher education were quite extensive and qualitative improvements were needed on several fronts.



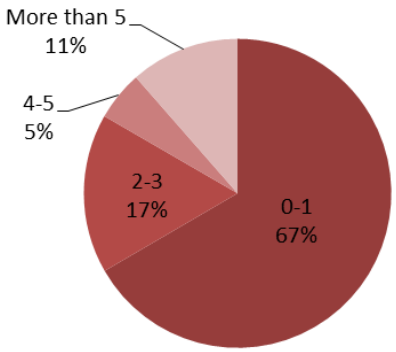

Decision-makers were asked the same question and responses were very similar, with more practical experience and changes to the curriculum being most cited. They would also put greater emphasis on non-technical skills. But they gave rather more importance to stronger

technical content and improved facilities and equipment than the respondents in the main survey.

## 5. Engineering and policy

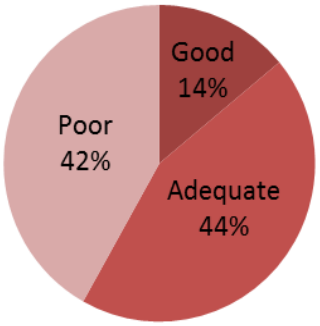
Respondents were asked a series of questions about their engagement with policymakers (defined to include local/national government, parliamentarians, donor organisations etc.) relevant to their field of work. The responses indicated that contact with policymakers is low, with the majority (67%) reporting one or fewer interactions in the previous six months.

**Figure 15: Frequency of contact with policy makers in the last six months**




Of those who answered the question, only 14% believed the quality of their interaction to have been good. The rest were roughly split with 44% saying it was adequate and 42% saying it was poor.

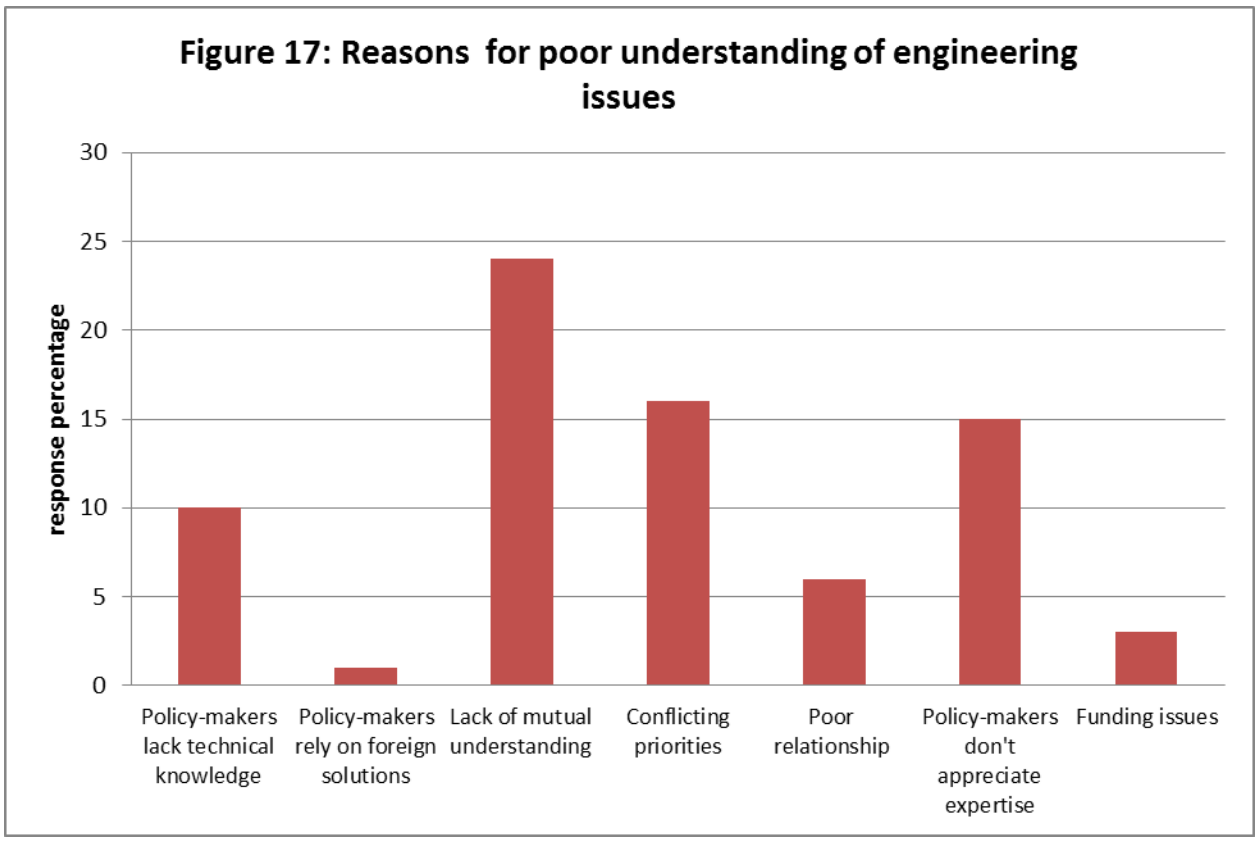
**Figure 16: How effective was your contact with policy makers?**




When asked how well policymakers understood engineering issues 55% said that policymakers had a poor understanding and 41% said the understanding was adequate. Only 14% said it was good.

Analysis of the reasons given suggested that most respondents took policymakers to mean politicians. The most cited reason for lack of understanding which emerged from respondents' comments was a belief that policymakers do not appreciate what is involved in the field of engineering, the kind of expertise it entails, and the potential contribution that a thorough application of engineering knowledge can make to the development and growth of a country (Figure 17).

Two other important and closely related themes emerged from the comments. 15 respondents complained about the fact that policymakers did not appreciate the expert advice of engineers or often simply ignored it. In a similar vein, 16 respondents described conflicting priorities, one side dictating factual know-how while the other was concerned with politics and power accumulation. Essentially, both of these groups were expressing a frustration about the politicisation of engineering agendas, and their own inability to influence or counteract this trend with sound knowledge and expertise. Very few comments went into detail as to why this was the case, but it may have been related to earlier statements by respondents that higher education did not prepare engineering graduates adequately with 'soft skills' such as relationship management. It would also seem to relate to weaknesses in professional institutions.



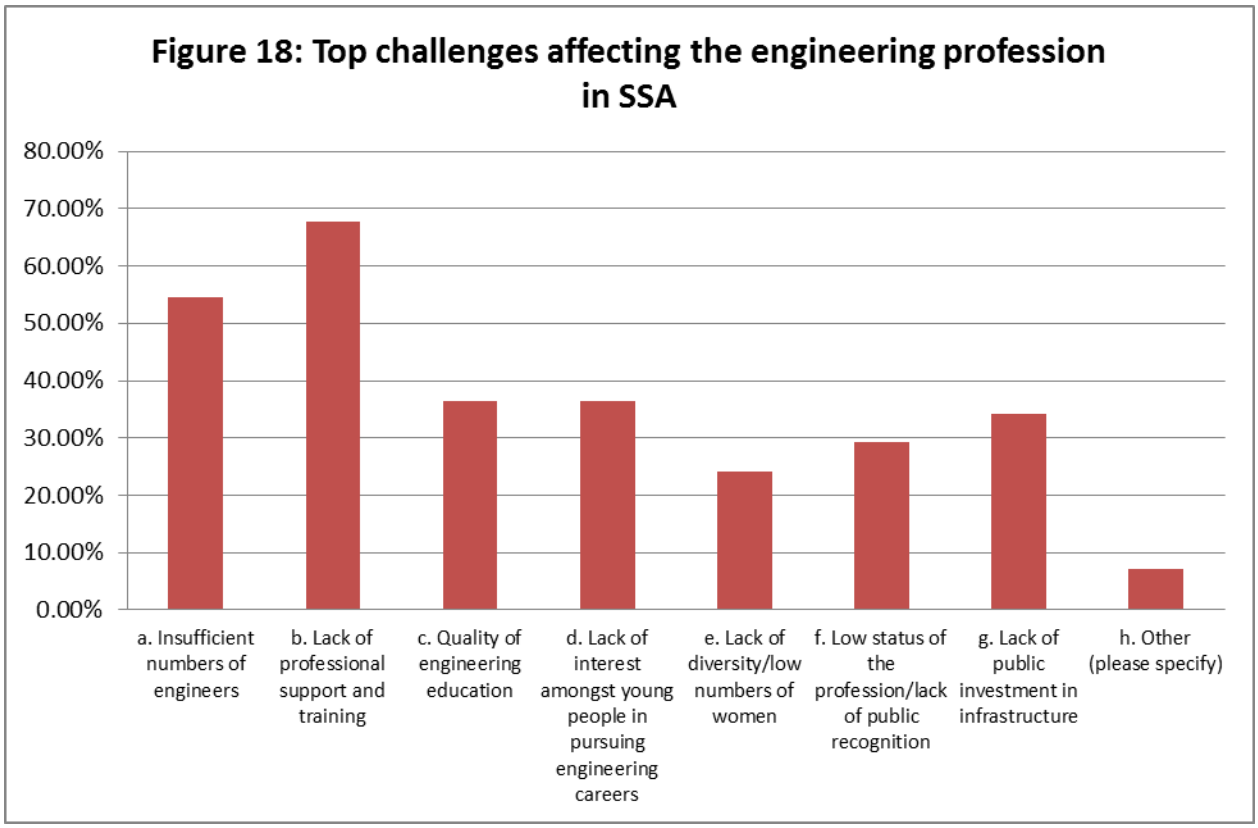

### 6. Challenges confronting the engineering profession

Respondents were asked to indicate the top three challenges facing the engineering profession in SSA (see Figure 18). The largest share of respondents (68%) cited lack of professional support and training: this mirrored the frustrations expressed in responses to previous

questions. The comments under 'other' supported these findings, with comments including 'lack of career guidance' and 'lack of professional support'.

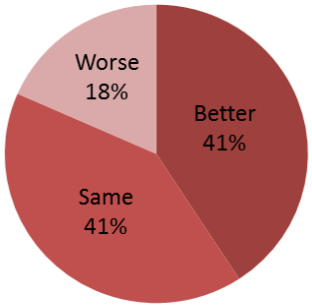
In second place, more than 50% of respondents felt that there were an insufficient number of engineers and 35% felt that there was a lack of interest among young people to follow a career in engineering. About a third of respondents pointed to two other problems which could add to the lack of interest in engineering among young people: lack of public recognition of the profession and a lack of public infrastructure investment.

Decision-makers, when asked an identical question, identified the same top two challenges, but a greater number of them attached high importance to the quality of education.




However, in response to the question as to whether the engineering profession is in a better or worse situation than five years ago, only 18% of respondents to the main survey said that it was worse, with the rest evenly divided between those thinking it better (41%) and those thinking it unchanged (Figure 19). The response of decision-makers to the same question showed a higher percentage (30%) thinking the situation of engineering to have been worse than five years ago and a smaller number (30%) thinking it had improved.

**Figure 19: Is the engineering profession in SSA in a better or worse situation now than it was five years ago?**




## 7. Engineering and development

Respondents were asked which single action would most improve the contribution of the engineering profession to reducing poverty and promoting sustainable development in SSA. This was an open-ended question. Analysis of responses revealed that the most important single action identified (with 21 responses) was 'improve the influence of engineers on policy'. This was followed by 'stronger professional institutions' (10 responses) and more solidarity (six responses) which are related issues as they could be the means through which engineers could increase their influence on government policies.

Specific actions mentioned that were considered more directly to impact on poverty and development were 'more investment in infrastructure' (seven), 'more practical innovations' (four) and 'better governance' (four). One respondent suggested 'involving local communities', while another suggested 'more poverty awareness'.

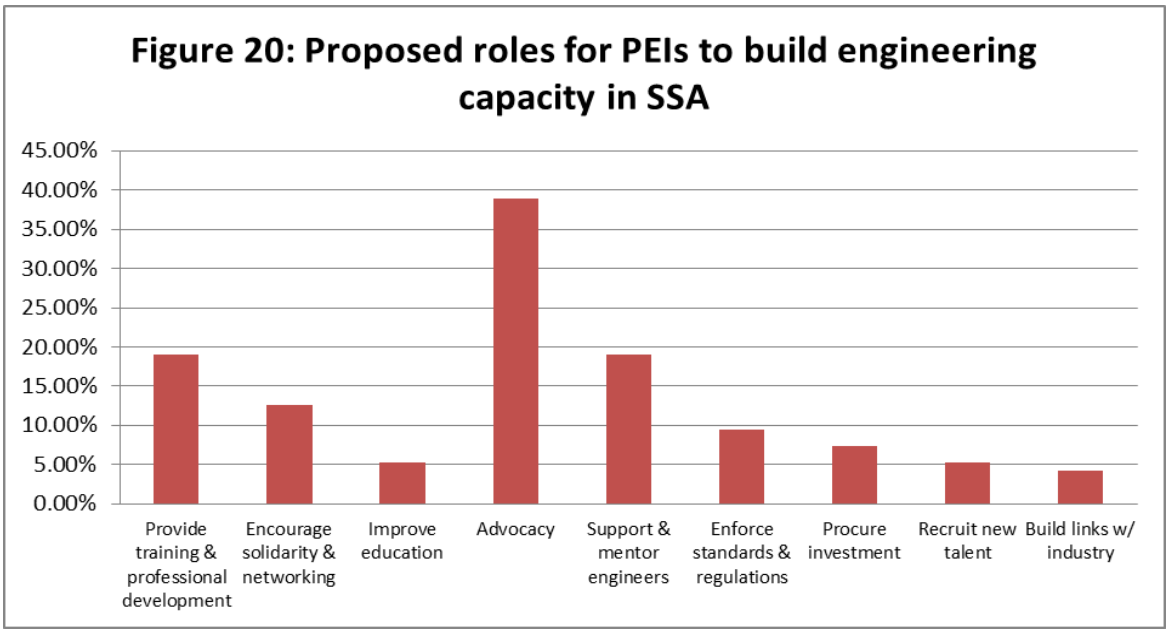
Other issues raised illustrated a belief that strengthening engineering more generally would improve the contribution of engineering to development. These issues included 'better education' (eight) 'better training' (seven) increased funding for education (seven) and 'more engineers' (four).

The responses of decision makers to this question also focussed on improving engineering in general. The largest number of responses was 'improved education and training' (seven) and 'encouraging the younger generation' (seven). Five respondents mentioned 'increased policy influence' and two raised the issue of 'collaboration with other disciplines'.

## 8. Role of the professional engineering institutions (PEIs)

In response to the question on the role of engineering institutions in building engineering capacity in SSA, the overwhelming feeling of respondents was that PEIs should engage in advocacy. Analysis of the comments clearly indicated that this was advocacy on behalf of the members of the institution and the profession as a whole. Other important functions were 'to provide training and professional development' and 'to support and mentor engineers' (Figure 20).

Respondents to the decision-makers' survey were asked the same question and the response from the 50% who answered the question was also that PEIs should function as advocates for the engineering profession. More than half of those who answered thought they should also play a major role in leading and supporting engineers and improving their education.

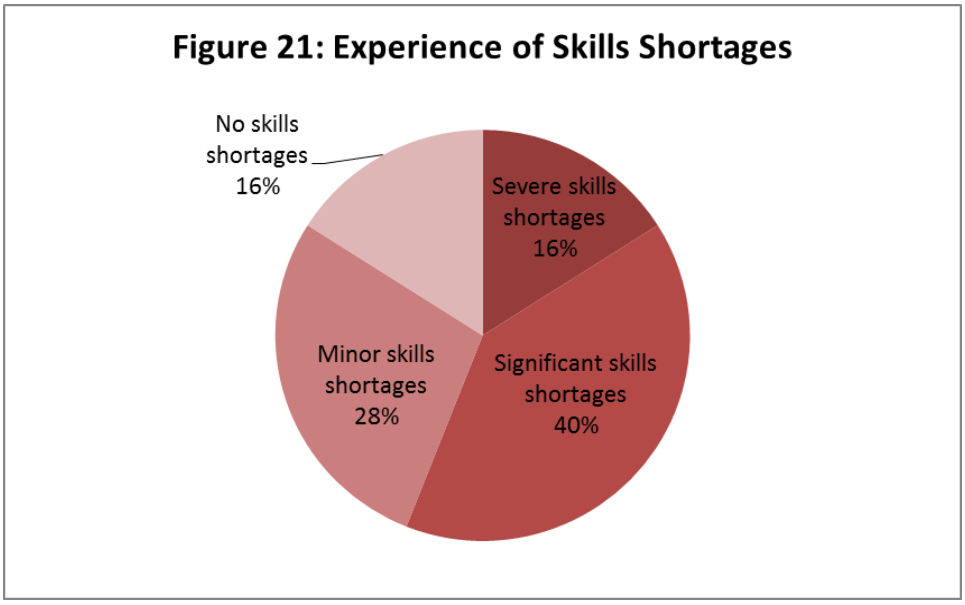



## B. Summary of responses from the survey of decision-makers

To recap, the 29 decision makers who responded to the survey were largely from southern Africa, with the largest number from Zimbabwe, closely followed by South Africa. The majority (>60%) of respondents were in middle or senior management, with a good balance between the public, private, education and NGO sectors. More than 60% were employing fewer than 10 engineers.

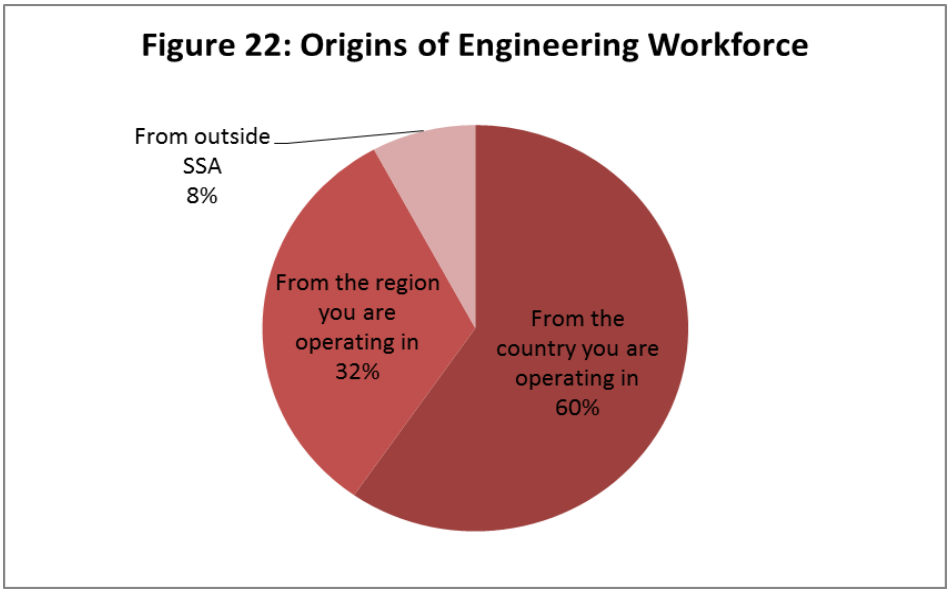
### 9. Skills shortages

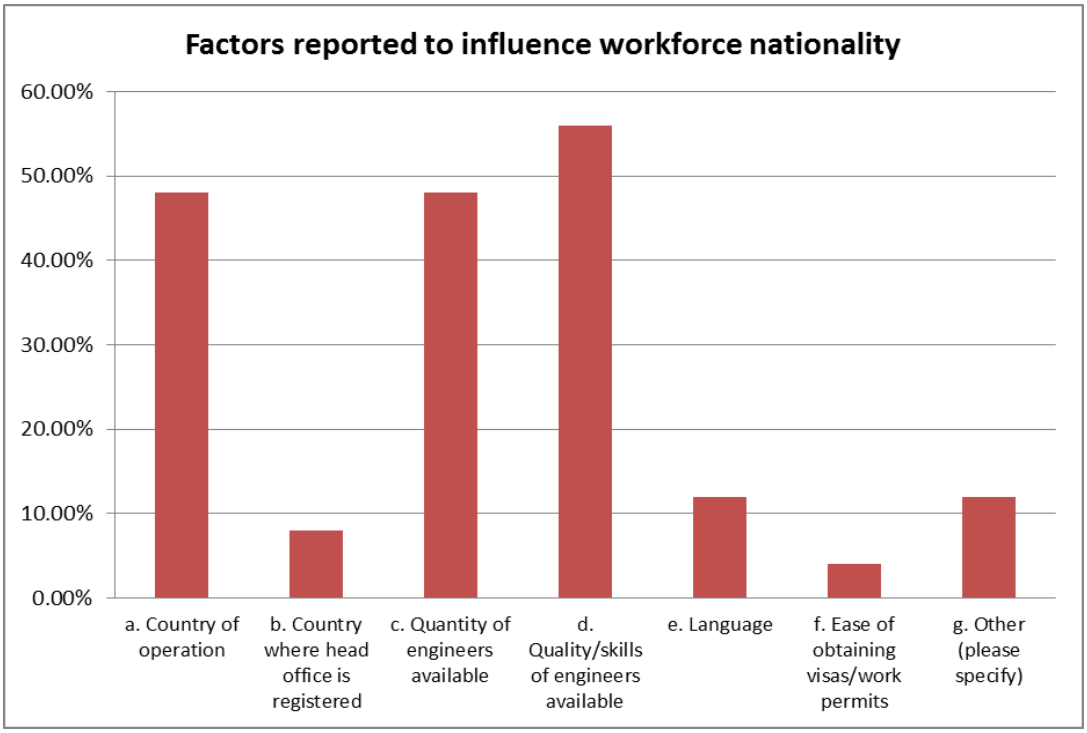
Respondents were asked whether, in their position as employers, they had experienced skills shortages in SSA. The following question asked whether they had experienced engineering skills gaps. The distinction between shortages and gaps was meant to distinguish between the quantitative issue (the number of *qualified* engineers) and a qualitative issue (engineers with the required skills - which are generally acquired through further training and practical experience). However, analysis of the comments suggested that the distinction between shortages and gaps was not always clear to the respondents. The main issue highlighted in both cases was the lack of skilled engineers, with particular specialist skills mentioned in the response to both questions. Figure 21 reveals that the majority of respondents (>50%) said that skills shortages were significant or severe.




### 10. Nationality of the engineering workforce

Respondents were asked the nationalities of their engineering workforce and which two factors had the greatest influence on the source of engineers. The results show that the majority are recruited locally, with only 8% from outside of SSA (Figure 22).






Respondents were asked to choose two factors that had greatest influence on the nationality of the engineering workforce (Figure 23). The biggest influences clearly related to local capacity, with a third of respondents choosing C (the quantity of engineers available) in combination with D (the skills of engineers available).

In response to a question on whether the organisation required its engineers to be professionally registered, only 44% said yes. As not all countries in SSA had registration procedures in place, this probably told as more about the existence of procedures for registration in a country than about the policy of the organisation.

## 11. Continuing professional development (CPD)

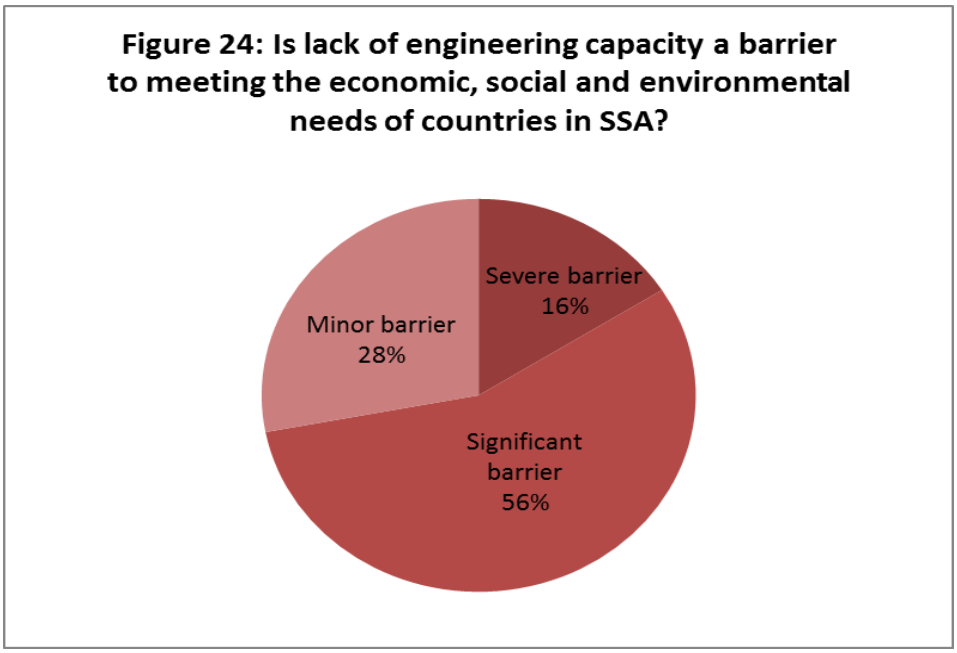
When asked whether the employing organisation required its engineers to undertake Continuing Professional Development (CPD) 52% replied in the affirmative. This was followed by a question on whether the organisation itself provides CPD for its engineering employees. One third of respondents said that their organisations did provided CPD. These are mostly short courses and workshops, only some of which are CPD accredited. However, two respondents gave full details. These were (i) 'all aspects of engineering in planning, design, contracts management and project management including soft aspects like tendering etc.' and (ii) 'Short courses on: technical report writing, management of water resources, project management, risk management, auto-CAD and occupational health and safety'.

## 12. Capacity issues

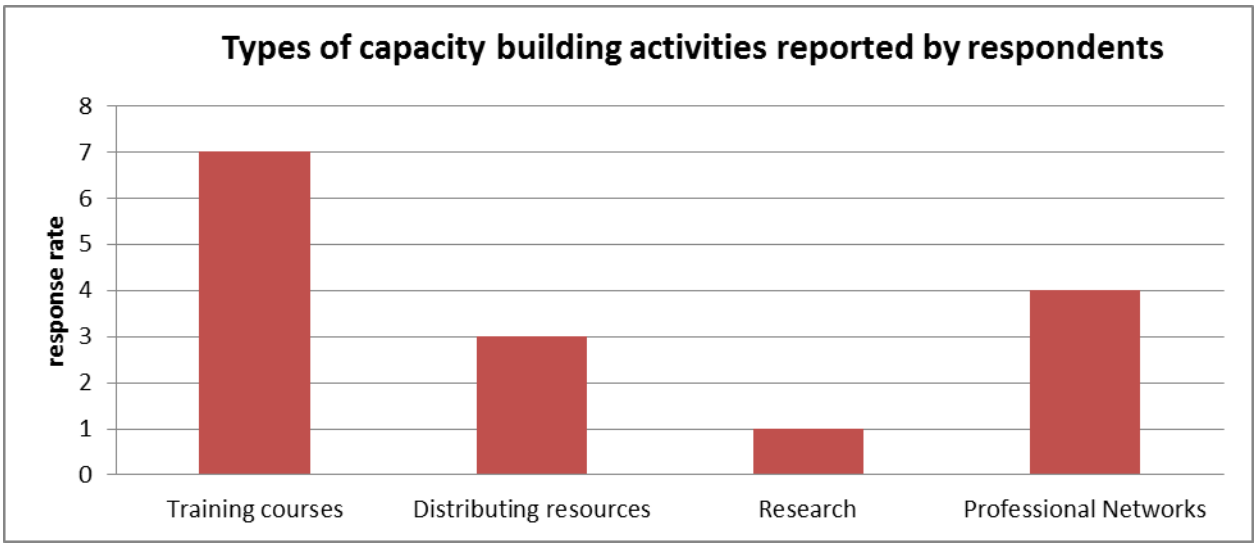
Respondents were asked a number of questions related to capacity. In response to the question as to whether engineering capacity within SSA impacted on their investment decisions,

a large majority (79%) said no, with one respondent pointing out that decisions on investment are made by non-engineers.

They were then asked to what extent a lack of engineering capacity is a barrier to meeting the economic, social and environmental needs of countries in SSA. Four options were presented but none chose to say it was not a barrier: every respondent felt that lack of engineering capacity had some kind of impact, with the majority (72%) considering the barrier to have been significant or severe. The strongest sentiments to emerge from the comments pointed to (i) the importance of infrastructure in supporting development and (ii) imported expertise being expensive and not always addressing local issues.




Asked whether respondents (or their organisations) had been involved in activities to build engineering capacity in SSA, a surprising 46% said that they had been so involved. Among those who had engaged in capacity building, the majority reported provision of training courses as a principal activity. Others mentioned the distribution of resources (training materials, tools and finance) to support engineers, and the creation of professional networks to enable collaboration and mutual learning (Figure 25).



## 13. Conclusions

Many of the conclusions of the literature review and interviews were supported by the findings of this survey analysis. However, the survey responses (particularly the professional engineers' survey responses) provided interesting alternative perspectives on some of the issues raised in the other parts of this study.

Both decision-makers and professional engineers believed there was a lack of engineering capacity in SSA

. Professional engineers identified a lack of professional support and training and insufficient numbers of engineers as the two biggest challenges facing the profession, while decision makers cited local capacity as the key explanatory factor for the nationality of the engineers they employed.

Among professional engineers, improved CPD was at the top of the agenda for improving career satisfaction with over half of respondents believing they had unmet training needs themselves. 40% of professional engineers said that education in their country did not provide graduates with the skills required, and the causes most cited for this were outdated curricula, poor quality teaching staff and lack of resources and facilities for universities. To improve education, the most popular suggestions among professional engineers were: making the curricula more relevant to SSA; increasing emphasis on non-technical skills; and enabling students to get more practical experience.

All decision makers who responded believed that lack of engineering capacity in SSA was a barrier to meeting the economic, social and environmental needs of countries in the region, and 46% reported having been involved in capacitybuilding activities. The most popular suggestion for improving the impact of engineering on development among professional engineers was improving the influence of engineers over policy makers, with the majority of respondents believing that policymakers in their countries had a poor understanding of engineering issues. Strengthening professional institutions was the second most commonly suggested strategy for improving the impact on development, reinforcing the demand expressed by the professional engineers for professional institutions capable of providing support through registration, CPD and access to networks.