# INCREASING THE POOL OF PROFESSIONALLY REGISTERED ENGINEERS BY DEVELOPING THE STAGE II PROCESS FOR TRAINING ENGINEERING GRADUATES

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# 1 Introduction

The need for Skills Development was recognised by the first democratic government of South Africa. To this end a comprehensive Skills Development framework for all sectors was developed. SETAs were tasked with developing learnerships to ensure that all trained to enhance not only their quality of life, but address the development of the country. Many phases of training have been addressed through the SETAs but unfortunately the training of engineers has only partially been considered through the provision of a limited number of bursaries for tertiary education.

With increased growth has come the realisation that more professional staff are required to lead development and under the JIPSA umbrella an initiative to increase the number of engineering graduates is being developed. After graduation, it is necessary for engineers to gain experience in their chosen field in order to develop sufficient competence to take responsibly for projects, or run their own engineering practices / companies.

The rigours of professional registration through the Engineering Council of South Africa (ECSA) is used as a measure of competence for responsible operation. However, the number able to register is being severely hampered by the lack of understanding of the training process and the capacity to provide the structured workplace oversight necessary for graduates to develop the competencies they require for mastery in their profession.

This proposal seeks to enhance the existing professional development process for ECSA registration and link the process with funding mechanisms through the Skills levy and other sources to encourage firms to offer workplace training to engineers, technologists and technicians.

# 2 Background

## 2.1 Training programmes of the past

In the past a system was in place whereby graduates would gain experience in the workplace under supervision. Technical staff of all levels were assigned supervisory duties, provided they had experience and hence knowledge to transfer. Thus not only the supervising engineer, but tracers, draughtsmen, detailers and site foreman contributed to the supervision and coaching of the young graduate. Further, all work was comprehensively checked by a more senior engineer, and much was learnt as a result of this critiquing of projects.

Most companies had training programmes in place to ensure that graduates received exposure to all aspects of the field in which they were working. These programmes were registered with the South African Council for Professional Engineers (SACPE), which later became ECSA. Graduates were able to achieve professional status by their mid to late twenties as a result of the comprehensive nature of their workplace training.

## 2.2 The demise of training programmes

In the past 15-20 years the effort put into formal workplace training has reduced, and in many instances has completely disappeared as a result of a number of factors:

### 2.2.1 IT

The introduction of IT has meant that the size of the technical team has reduced. In particular tracers and draughtsmen, who had an invaluable wealth of institutional and practical knowledge, were the first casualties of the IT era.

The size of companies has however not reduced substantially as the IT department has replaced the lower levels of all departments. Unfortunately the IT department is process oriented rather than output oriented, and staff capable of training junior staff have been replaced by process staff.

### 2.2.2 Tax incentives / rebates

Until the mid eighties government offered tax incentives for training of staff. When these were withdrawn, many training programmes were abandoned.

### 2.2.3 Economy

The twenty or more year decline in the construction industry and economy in general meant that companies needed to down size and the tendency was to retain only highly experienced and productive staff and do away with training. Where young people were taken on they were taught one or two processes and were then 'exploited' in that area, rather than being moved around to gain experience in the whole project cycle.

This approach is evident when studying the current ECSA registration statistics. Few candidates register below the age of thirty, with most only having had sufficient all round experience to register in their by their mid thirties – see Figure 1 below.

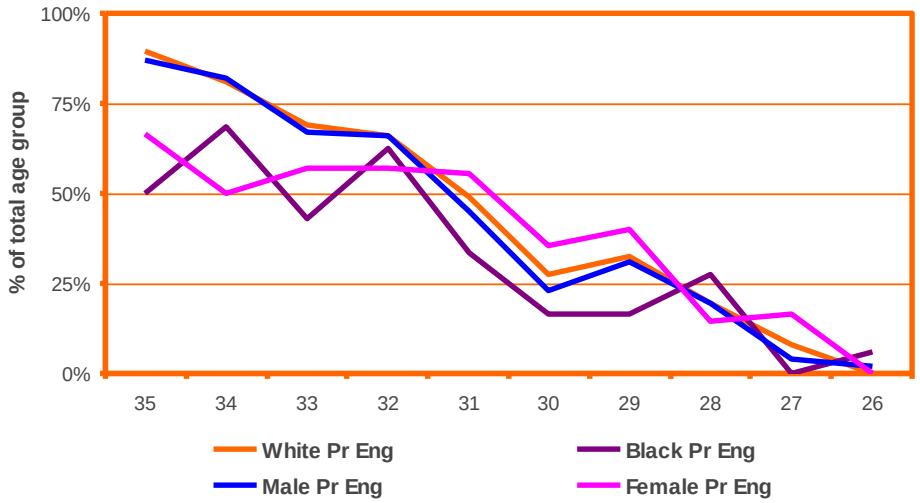


**Figure 1 : ECSA Professional Registration per age group, as a percentage of total membership**

### 2.2.4 Time

The development of ICT has resulted in the 'instant' world. This has meant that the business environment expects instant answers. Senior staff is expected to work at an exceptionally high pace, leaving little time to train their young graduates.

### 2.2.5 Non technical senior staff

In many quarters, senior technical staff have been replaced with staff trained in other fields such as marketing, management, law, finance, town planning

etc. As a result there are less or at times no senior staff with engineering knowledge capable of training young graduates.

#### 2.2.6 Young companies

The drive for BEE has encouraged many young professionals to start their own businesses soon after registering. Whilst these graduates may the have the basic skills to operate in their chosen field, they have not developed the extended knowledge, which comes from years of experience and are usually not able to cope adequately with new challenges. Further they are dedicated to bringing business in to their companies, so have neither the time nor the depth of knowledge to train their own young staff.

#### 2.2.7 Reduction in public sector training capacity

One of the largest training grounds for engineering professionals was the public sector, notably the Departments of Water Affairs and Transport and the State Owned Enterprises. Beginning in the mid-1990s the refocusing of State-Owned Enterprises into profit oriented organisations and public sector departments into strategic rather than delivery bodies has resulted in significant cut-backs in intake. This has been further exacerbated by the restructuring of the Metros and large municipalities which also served as fertile training grounds.

#### 2.2.8 The ECSA Commitment and Undertaking

The past requirement to submit company specific training programmes was superseded in the late eighties with a generic document issued by ECSA termed the Commitment and Undertaking. This called on companies to offer workplace training under a number of general headings. This generic approach has meant that companies no longer consider the detail and range of experiences that young graduates should receive. As a result training has become somewhat diluted or disappeared altogether.

# 3 The problem

The practical knowledge and leadership skills required to deliver the desired growth and the goals of NEPAD / MIG / EPWP are inadequate. Inappropriate decisions could impact on health in terms of inadequate local government infrastructure and safety in terms of mining, plant, process, structural and transport solutions.

The number of engineering graduates needs to increase, and all posts requiring technical decision making must be filled by qualified and experienced engineering personnel.

It is therefore necessary to identify functions which must be performed by engineering personnel, fill posts and re-develop detailed formal training programmes, appropriate to the needs of South Africa in the 21st century.

The workplace content needs to include revisiting theory which has been inadequately covered in tertiary institutions due to the ill preparedness of the matriculant intake at the outset. (It is hoped that by reviewing and restructuring the tertiary phase the challenges currently experienced with training graduates in the workplace will reduce in time)

Furthermore, mechanisms need to be developed to encourage companies to invest in this more rigorous workplace training approach which will ensure that an increased number of graduates develop the competence to take the country forward.

# 4 The solution

Considering the factors contributing to the demise of formal workplace training outlined above it would seem that

- Rigorous training processes need to be redeveloped and enforced to once again give companies and graduates guidelines on the process to be followed
- A pool of external coaches must be made available to assist with workplace supervision and training
- Incentives or rebates need to be made available to encourage industry to participate
- Tertiary institutions should promote the Stage II and registration process to all their students to ensure that graduates work towards this additional qualification
- The identification of processes which must be carried out by engineering professionals is essential
- Salaries commensurate with expertise and responsibility must be considered.

## 4.1 Stage II

In terms of the work already carried out by ECSA advisory teams, a more rigorous approach to workplace training is being considered. It is proposed that this candidate phase be known as Stage II. (Stage I being the undergraduate qualification).

Stage II will be the adaptation and formalisation of the training programmes of the past. ECSA has spent considerable time developing a new framework for this phase. It was intended that this process be converted into a learnership, but the inflexibility and tedium of the SAQA process has impeded this process and would make it overly complex.

Stage II would be composed of the following:

1. **Technical experience in the workplace**
2. **Detailed technical training programmes**
3. **Discipline specific management training**
4. **Development of business and life skills**
5. **Mentorship and coaching**

Considering each in more detail:

### 4.1.1 Technical experience in the workplace

It is necessary for graduates to be involved in one or more technical fields during their experiential phase. The entire project cycle needs to be understood and the young graduate must be exposed to all components, including investigation, planning, design, draughting, detailing, procurement, site work, and process, operations, maintenance and costs efficiencies.

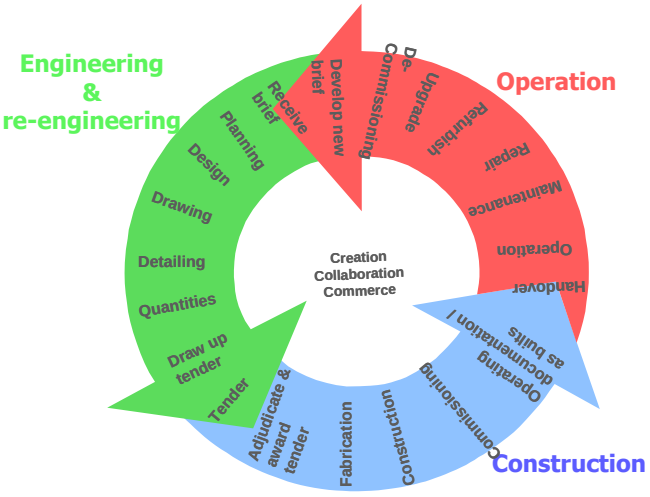


**Figure 2 : The project cycle**

Figure 2 covers the project life cycle. The graduate requires exposure to all phases and should be moved from department to department or from function to function to develop mastery in his or her chosen field.

To ensure that graduates gain sufficient all round experience a series of log frames need to be developed detailing all aspects per sector and discipline to which the graduate should be exposed.

### 4.1.2 Detailed training programmes

In terms of workplace training, it may seem that training material would generally not be necessary. However, as a result of the huge loss of experienced senior staff, it is time that a team of 'wise fathers' develop reference material covering all the practical advice which was previously passed on from senior to junior.

It will be necessary to locate the standards of the past now forgotten because of IT. Practical tips are missing, engineering judgment is not being developed and an understanding of the whole project process needs to be redeveloped. This information could be disseminated and absorbed in a number of ways as follows:

1. **Specialist lectures**
2. **Group workplace training workshops**
3. **Practical reference guides**
4. **Practical web based reference material**
5. **Computer based training**

#### 4.1.2.1 Specialist lectures

Universities cannot be expected to offer practical design and detailing training for every facet of engineering. The undergraduate degree essentially offers a foundation on which to build engineering experience. In order to fast track practical ability, young graduates should attend many of industry's practical courses. Typical organizations offering such practical training include SAISC (South African Institute of Steel Construction), C&CI (Concrete and Cement Institute), SARF (South African Road Federation), SABITA (South African Bitumen Association), and WISA (Water Institute of South Africa). More such courses need to be identified and developed in support of the candidate phase.

#### 4.1.2.2 Group workplace training workshops

To address the many situations where there are insufficient experienced personnel to grow young graduates, ongoing group training regimes covering the full project cycle need to be considered. There are currently some successful block release courses offered over a 12 or 18 month period whereby a group of graduates working in a particular field attend one week training every 6 to 8 weeks. For instance where graduates are working in a particular field such as road design and construction, the block course covers what needs to be done in the workplace for the next 6 to 8 weeks in the project cycle and the young graduate then returns to the office well briefed on what he or she should be doing. Work carried out in the previous 6 to 8 weeks is also submitted for checking/critiquing by the lecturer(s). In this way one or two seniors are able to offer the coaching/supervisory function for all attending.

#### 4.1.2.3 Practical reference material

Few of the practical tips passed on from senior to junior over the years have been documented. Indeed in their book, 'Deep Smarts', Professors Dorothy Leonard of Harvard Business School and Walter Swap of Tuft University

have highlighted the importance of coaches in order to not only provide the capacity for 'guided experience' but to teach by imparting rules of thumb and sharing knowledge through telling stories of their past experiences. The collective wisdom of seniors in the industry needs to be documented in the form of checklists, guidelines and recommended details.

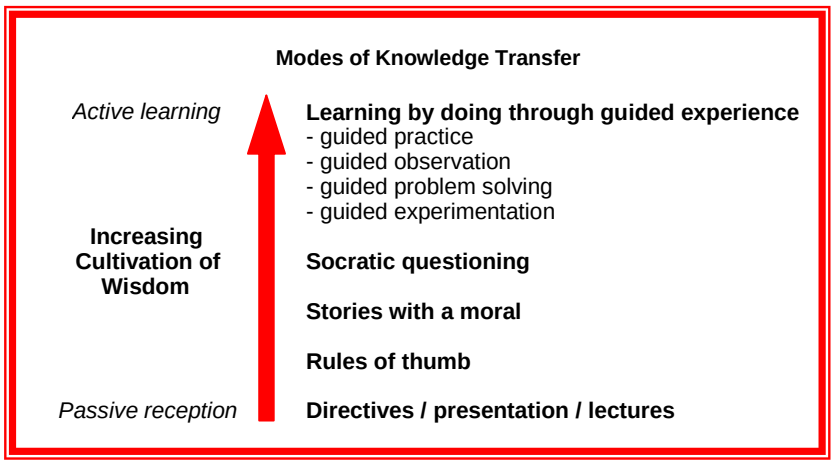


**Figure 3 : Modes of Knowledge transfer**

This material would be an invaluable investment for the future wellbeing of development in South Africa.

#### 4.1.2.4 Practical web based material

As most of the graduates requiring training will be from the X-generation or younger, they are more likely to use the above material if well structured in an interactive electronic format which can be accessed through the web.

#### 4.1.2.5 Computer based training

In instances where the details and processes are too complex to describe or visualize through formal documentation such as the operation and maintenance of machines, processes etc, Computer Based Training (CBT) displaying interactive, animated schematics and step by step operation of the actual item being studied offers a superb medium for practical training. The graduate can replay the module over and over again until he or she is fully conversant with the operation of the item being studied.

Another major registration demand on mechanical, electrical and mining engineers working in factories, local authorities, mines and plants is to have passed the GCC (Government Certificate of Competence). Less than 10% currently pass this test first time as few are gaining adequate workplace training to achieve the required level of competence. Provided they have had sufficient design experience, those who do pass have no difficulty registering with ECSA, as the GCC is a good indicator of the ability they have developed in the workplace. A comprehensive CBT programme for the GCC would go a long way to improve the practical knowledge of a significant group of engineering graduates.

CBT can also be used to describe other complex processes such as structural design, industrial systems etc. There is substantial evidence, including OBE metrics, that the efficiency and effectiveness of CBT knowledge transfer is significantly higher with such content than traditional learning processes, and while the investment cost is initially high to develop the course content, as long as it is designed with the ability to be readily updated, the ROI is massive when measured in comparative pass rates.

#### 4.1.3 Discipline specific management training

Experience and skills required vary per industry. In the consulting world, project management, ethics, indemnity etc are of key importance, whilst in the contracting world contract management, materials, labour and contract law etc are of key importance. In local authorities and other government departments, issues such as the budgeting cycle, Division of Revenue, procurement, working with decision makers, legislation etc is of major importance. Mining has its own challenges in terms of Labour, Mining rights, safety etc. Specific material needs to be developed per field.

#### 4.1.4 Development of business and life skills

Over and above technical competence, proficiency in life skills including communications, negotiations, leadership, and inter-personal relationships must be honed during this phase. Further young graduates must be exposed to the many soft issues which are critical to the success of their projects including political, socio-economic, institutional, environmental, health, legal, financial and management issues.

Many commercial courses are in place to address these aspects and graduate training should include attendance at a number of these courses as the needs arises in the workplace.

#### 4.1.5 Mentorship and coaching

Much is currently being written about mentorship and mentorship programmes have been called for in the Construction Charter. The term mentor implies personal counselling and career path development, whilst the term coach implies knowledge transfer and skills training.

##### 4.1.5.1 ECSA requirements

The current ECSA policy statement on 'Acceptable Engineering Work for Registration' draws the distinction between mentors and supervisors. Mentors '..give guidance to trainees regarding their career path planning…' whilst supervisors undertake to '…direct supervision of daily tasks…'. The graduate will not progress unless his or her work is evaluated on an ongoing basis; hence the supervisor becomes the coach and plays a very important role in developing the young protégée.

##### 4.1.5.2 Industry profiles

As the age distribution in engineering is skewed, few experts in the industry are available or have time to train young protégées. Hence many students or graduates cannot find employment as all advertisement call for a minimum of five years experience. Where young people are employed, they rarely have the luxury of a coach and either do not learn at all, or learn on prototypes, in some cases making very expensive mistakes.

No other process can replace on the job coaching, and it replicates the accepted functions of coaches in any skills development initiatives in other professions, sports training etc.

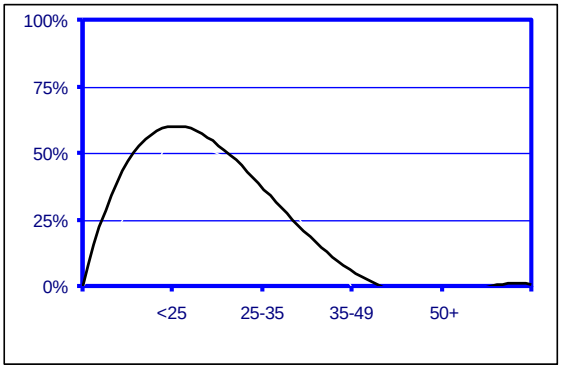


**Figure 4 : % technical staff per age group – young company**

The typical company age profiles and characteristics are indicative of the need for additional staff and the

capacity to supervise.

The **young** company typically has insufficient expertise to train or cash flow to afford senior staff.

This type of composition is seldom sustainable.

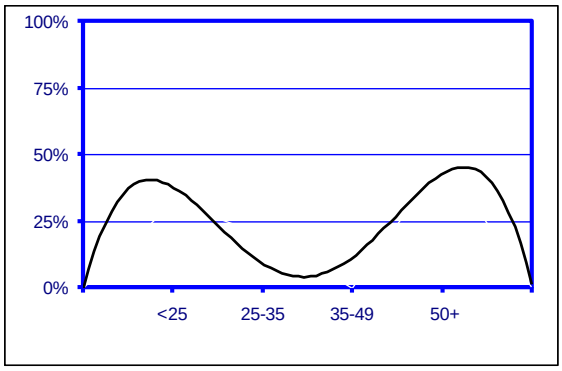


**Figure 5 : % technical staff per age group – stretched company**

The **stretched** company has insufficient mid career production staff hence senior staff is also drawn into the production process and none have time to train.

The **efficient** structure has a large proportion of well trained mid career production staff, young people to carry out basic duties and a balance of senior staff available to supervise and transfer skills.

Unfortunately few companies exhibit this profile.

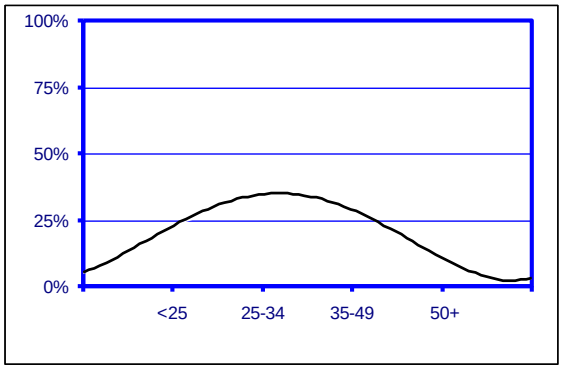


**Figure 6 : % technical staff per age group – efficient company**

With the passage of time, the availability of dedicated mentors is rapidly diminishing and unless the mentor role is seen as a specific job requirement, identified and rewarded accordingly, the skill transfer process will be jeopardised to the point of total crisis. Together with the general shortage of engineering resources, there is a tendency for mentors to be “taken over” into a line capacity once allocated to the mentor role in a business. This makes the need for a formal, recognised and rewarded mentor role all the more urgent.

SETAs should set funding aside for this type of skills development.

#### 4.1.5.3 Developing a pool of mentors

Of further importance would be access to and management of mentors/coaches. An ‘Engineering Corps’ composed of a pool of available retirees needs to be developed, which can be tapped for the appropriate skills for knowledge coaching. The professions/voluntary associations should be tasked with managing this process, supplying material appropriate to their disciplines, orientating mentors and monitoring and evaluating progress.

### 4.2 Student awareness of the process

It is essential that students are made aware of the process and the benefits of registration. Awareness of the registration process and the responsibilities of the young graduate in terms of his or her own career path development should become part of the curriculum in all engineering studies.

### 4.3 Identification of Engineering Work

ECSA is currently involved in the process of identifying work which should only be carried out by various levels of registered engineering professionals. Once implemented, all employed in the engineering process will need to be registered with

ECSA, either as a candidate or a professional. At present many of these functions are being carried out by non-engineering or non-professional personnel (with disastrous consequences in some instances). This classification is likely to further increase the number of engineers required in South Africa. It will also put pressure on all in the field to register.

### 4.4 Salary scales

Having driven the demand for more comprehensive training, and self study on the part of the graduate, to improve the calibre of the engineering pool, it is important that salaries commensurate with the level of responsibility taken by engineering professionals be paid for their services. In various quarters, particularly in the public sector, salaries are extremely low. For example, smaller municipalities and the provinces, have not kept apace with salary levels which should be offered for the requisite expertise over recent years, and are this suffering from substantial shortages of engineering staff.

Salary increases should not be limited to promotions but should also be offered upon professional registration with ECSA in recognition of the level of expertise attained.

## 5 The qualification

ECSA has spent the past three or fours years developing a learnership model to replace the current candidate phase to enable industry to claim from their skills levies towards the workplace training expense. However, the structuring and complexity of learnerships does not lend itself well to the candidate phase. This has been the experience of several professional bodies. Hence, the SAQA guidelines for professional registration have been modified to offer professional bodies the choice of developing learnerships or using or improving existing candidate phases coupled with assessing the achievement of various outcomes to ensure mastery is achieved.

The ultimate qualification for engineering graduates will be Pr Eng, Pr Tech Eng or Pr Techni for engineers, technologists and technicians respectively.

The qualification will be structured as per Figure 7 below.

| STAGE II ENGINEER | STAGE II ENGINEERING TECHNOLOGIST | STAGE II ENGINEERING TECHNICIAN |
|---|---|---|
| Management<br><br>Design<br><br>Investigation<br><br>Plus one elective | Management and two of:<br><br>Design<br>Investigation<br>Operations Management<br><br>Plus one elective | Management<br><br>Design or Investigation<br><br>Construction Management or Operations Management<br><br>Plus one elective |

Where not forming part of the mandatory activities electives will be chosen from

1. Management of engineering operations or processes for Stage 2 Engineers.
2. Managing implementation or construction projects for Stage 2 Engineers.
3. Research, development and commercialization of engineering products for Stage 2 Engineers.
4. Education, training and development of engineering personnel for Stage 2 Engineers.
5. Occupational Health and Safety under the OH&S Act
6. Operation and maintenance of plant (unless the same as 4 above)
7. Occupational Health and Safety under the MH&S Act.
8. Environmental Management for Stage 2 Engineers
9. Value Engineering
10. Engineering for Large Dams
11. Inspection of Lifts and Elevators
12. Clinical Engineering
13. Quality Management
14. Commissioning
15. Technical Sales
16. Procurement of Engineering Materials, Components and Services (Logistics?)

**Figure 7 : Stage II**

The process will be composed of workplace experience under the supervision of registered persons, complimented by various forms of formal training including short courses, block releases or Computer Based Training as described above. A log frame per discipline will be developed describing the administrative, management and technical aspects that candidates should be exposed to.

## 5.1 Outcomes

A Candidate who has completed his or her education and the experiential phase and achieves the requisite level of competence may apply for registration as a professional. The Candidate should be able to

1. **Perform work in the engineering environment**
2. **Solve engineering problems**
3. **Take responsibility for engineering work under the general direction of a more experienced engineering professional.**

The level to which the Candidate is able to perform the above is determined by his training. The engineer will be competent to perform complex tasks, the technologist, broadly defined tasks and the technician well defined tasks.

## 5.2 Assessment criteria

In order to determine whether the Candidate has developed the appropriate competence, a number of assessment criteria per outcome are defined. The mentor

acting as the assessor will assess the candidate's progress in each of these areas, against the discipline in which the candidate has chosen to work.

### 5.3 Quality assurance

The ECSA registration committee will assure quality through a rigorous process of interviewing the Candidate, examining his or her documented log of workplace experience, and reviewing essays written by the Candidate under examination conditions on the day of the professional interview.

# 6 The Benefits

The benefits of registration are threefold:

1. **Benefits to clients and society at large**
2. **Benefits to employers**
3. **Benefits to graduates**

### 6.1 Benefits to clients and society at large

Society's rights and expectations to live and work in an environment that is not hazardous or harmful can only be addressed by those who are competent to deliver the full range of engineering products, from municipal infrastructure and structures to plant and machinery. At the same time, owners need assurance that the value of their investments will not be compromised or damaged during normal operating conditions.

The services of specialist engineering professionals are thus required to ensure that loss of life and damage to property during the lifetime of a project due to the instability or lack of strength, serviceability or durability or part thereof, is within acceptable limits.

### 6.2 Benefits to employers

Registration offers employers, potential employers and clients the assurance that the professional has developed sufficient skills to be able to design, construct and manage engineering processes that are efficient, safe and durable. Further the registered professional is able to work independently and can thus pick up some of the load that industry is battling with at present.

### 6.3 Benefits to graduates

Considerable time will be invested in a graduate in order that he or she may register. Thus the graduate will be given an excellent grounding in his or her profession. This will enable the graduate to progress in his or her professional life and will drastically improve his or her employability. It should also offer improved levels of remuneration and responsibility, something which young people lament that they are not afforded.

# 7 Cost estimates, funding and incentives

To enhance the current process and ensure that there are courses, materials and sufficient capacity to supervise, funding is required for development and ongoing delivery as follows:

1. **Employment**
2. **Development**
    1) **A rigorous training approach**
    2) **Training material**
3. **Training costs**
    1) **Attending courses**
    2) **Mentorship and coaching**

### 7.1 Employment

Industry has by and large always employed graduates and paid their salaries. The take up of all graduates has not occurred as industry has complained that experienced staff

are overstretched and do not have time to train young graduates. Without training these young people are of little benefit to industry, so do not get employment opportunities. If mentors, subsidised training and incentives were paid towards the employment and subsequent registration of graduates, industry is likely to absorb and pay for more graduates. Industry would fund a total salary bill of R2bn per annum if all were to be absorbed.

## 7.2 Development

There are two components to development. Firstly, determining all the aspects of the project cycle to which the young graduates must be exposed per discipline and secondly, developing supporting training material. An estimate of development costs follow:

### 7.2.1 A rigorous training approach

Log frames of activities per discipline which graduates must be exposed to must once again be developed. It is estimated that some 50 log frames will be required. At say R 80 000 each, allow R4m.

### 7.2.2 Training material

The different regimes of training were listed in section 4. Estimates for development of courses and training material are as follows:

| Type of training | Number of modules | Rate | Total cost |
|---|---|---|---|
| Log frames | 50 | R 80,000 | R 4,000,000 |
| Specialist lectures | 30 | R 100,000 | R 3,000,000 |
| Group workplace training workshops | 20 | R 500,000 | R 10,000,000 |
| Practical reference guides | 60 | R 75,000 | R 4,500,000 |
| Practical web based reference material | 60 | R 50,000 | R 3,000,000 |
| Computer based training | 80 | R 125,250 | R 10,020,000 |
| | | | **R 34,520,000** |

Thus a total of some R35m would be required to develop all the material to cover the workplace process and supporting training material at the outset. Having developed much of this material for high level users such as engineers, technologists and technicians it could also be reworked into simplified forms for other technical workers such as artisans, foremen etc.

## 7.3 Training costs

The cost of employing and developing young graduates is not limited to their earnings. Their ability can only be developed at an acceptable rate provided they are supervised on an ongoing basis and are able to attend practical training courses as they encounter new topics or responsibilities. These additional costs are the costs which companies have in the past not felt that they could afford, and hence the phenomenon of the unemployed graduate. Appendix A calculates these costs in detail. Rebates and/or incentives must be considered to allow industry to fund these essential components of workplace training.

### 7.3.1 Attending courses

It is expected that some R220m worth of short and specialist courses and workshops should be attended by graduates per annum i.e. 12% of the salary bill. Annual management surveys reveal that the Consulting Sector already spend some 4% of their salary bills on training i.e. an additional R145m is required for this type of training. It should be possible to claim these from the respective SETAs as part of the Skills Levy rebates, or in sectors governed by Charters, to score additional points for training over and above that covered

by the Skills Levy. This may require Charter definitions to be adjusted slightly to earn points for support of learnerships as well as Candidate phase training.

### 7.3.2 Mentorship and coaching

Roughly 35% of the employment cost of graduates is required to cover the cost of supervisors who must mentor and coach graduates. As this type of investment in graduates will make them useful to their companies relatively quickly, companies should be called upon to carry a part of the cost and should be able to claim the balance back from a national fund, as the graduate progresses.

Having set the rebate or incentive value per registered professional, a possible model could be as follows:

1. **The trainee who has met the educational requirements enters employment and registers as a Candidate in the relevant category. A firm qualifies for x % of the amount payable when the employee registers as a Candidate.**
2. **A registered person (in an appropriate category) is designated in the firm as the Candidate's training supervisor. When a supervisor is appointed another y % is payable.**
3. **The Candidate is required to keep a training logbook that has a generic part prescribed by ECSA (that deals with the competencies) and an industry-specific part (that deals with the content).**
4. **Halfway through the training period the Candidate submits the logbook to ECSA. If satisfactorily kept, the total payment moves up to 50%.**
5. **When the Candidate applies for registration (with a fully documented logbook, portfolio etc) and is successfully registered, the remaining 50% is paid.**

**Note** : Steps 1 and 2 could be simultaneous and once there is confidence in the system, step 4 may be dropped.

This is a simple yet effective approach to funding Candidate training. Although the Department of Labour lists bursaries, apprenticeships, learnerships, internships and the Candidate phase for Professionals as learning pathways against which SETAs may pay Skills rebates or discretionary grants, SETAs have only funded learnerships and to some extent bursaries to date. The above Candidate process must be sold to the SETAs since it has stood the test of time and needs to urgently be implemented on a much larger scale than at present.

## 7.4 A management team

The costings in the Appendix also include a component relating to a management team which government needs to consider funding to source, orientate, place, monitor, evaluate and support the progress and success of the mentors. For instance newspaper adverts to find retired personnel, who would not normally be looking for employment would not be as effective as the Voluntary Associations contacting all their members to encourage those who have retired to return to industry for this specific duty.

Further, industry would be better placed to understand discipline specific needs and would thus select the most appropriately experienced mentors for each situation. Champions need to be drawn from the collective expertise of the voluntary engineering associations to form such a task team. The business model will focus on the goal units of the combined initiative: employable professionals that add value to the built environment and become the mentors and coaches of the future.

### 7.5 Net costs

The figures outlined above assume that all graduates enter industry after graduation. There will be reductions since some 7-9% of university graduates and 3-5% of the U of T graduates are foreign and would generally return home. Further, other students decide on alternative career paths during their studies and hence move on to other disciplines, or go overseas. As such some 25% of the graduates from universities and 10% or more of the graduates from U of Ts do not enter the industries from which the have graduated.

This would mean that the funding which needs to be raised to support this more comprehensive Stage II phase would be as follows:

As suggested, the private sector could possibly be called upon to contribute 40% to 50% of the mentorship costs overall.

#### 7.5.1 Developing of Stage II and supporting courses

**Once off cost R 35m**

This would be a once off cost

#### 7.5.2 Mentors for the private sector

**Annual cost R 206m p.a.**

As suggested, the private sector could possibly be called upon to contribute 40% to 50% of the mentorship costs overall. A Rand for Rand scheme to match investment by the private sector could be implemented by the various SETAs similar to the system which is currently in place to match investment in bursaries. Thus the private sector and the SETAs would each contribute R 206m p.a.

#### 7.5.3 Mentors for the public sector

**Annual cost R 222m p.a.**

The return of senior personnel into the public sector is currently being facilitated through the Siyenza Manje initiative of the DBSA, funded by the Development Fund and Treasury. Some R500m has already been set aside over a five year period. The scope and the size of the project needs to be expanded to address the knowledge couching requirement to grow young skills.

#### 7.5.4 Management of mentors and the Stage II process

**Annual cost R 126m p.a.**

Funding to cover management of the process by the Voluntary Associations could be made available through grants such as the Capacity Development Grant.

### 7.6 The period

It must be borne in mind that if there were sufficient staff to place in all the vacant positions, the State would be spending billions of Rand more on technical skills, hence these figures represent a most investment to grow capacity and subsequently address service delivery.

The process and associated costs should be considered for a period of five to seven years, to grow the culture of training and a sound pool of young professionals for the future of the country.

## 8 Conclusions and the role JIPSA can play

There is an urgent need to increase the number of experienced and competent engineering professionals in South Africa. The ECSA registration process is a measure

of the progress made by graduates and offers some assurance of ability and independence. This can only be achieved through rigorous workplace training under the supervision of experienced personnel.

The JIPSA process is being driven to accelerate skills development and overcome hurdles whether they relate to lack of funding, resources or unwieldy processes. JIPSA could therefore assist the process by

- Ensuring that the new registration process is accepted as a learning pathway
- Ensuring that funding is unlocked to develop the more rigorous process and supporting material
- Ensuring that funding is made available to harness a pool of retired engineers to supervise the workplace training process
- Ensuring incentives or rebates are put in place to encourage companies to train their graduates towards registration as engineering professionals.
- Assigning and funding a Special Task Force group within the Vas, on a basis that avoids traditional bureaucratic interventions that will slow and frustrate a process that is in effect in EMERGENCY MODE.
- Ensuring that the 'Identification of Engineering Work' is completed, recognized and implemented
- Ensuring that appropriate salaries are paid for engineering expertise in the public sector

# 9 APPENDIX A – WORKPLACE COSTS

## 9.1 UNIVERSITY of TECHNOLOGY GRADUATES

| DIRECT AND SUPPORT COSTS FOR UNIVERSITY of TECHNOLOGY ENGINEERING GRADUATES FOR 2007 ON A STRUCTURED ECSA CANDIDATE PROGRAMME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Discipline** | **Sector** | **Funder** | **Number of protégées and salaries paid by industry** | | | | **Knowledge coaching / supervision** | | | | **Formal courses** | |
| | | | **Number 1st year in workplace** | **Number 2nd year in workplace** | **Number 3rd year in workplace** | **Cost of salaries per annum** | **Hours of supervision required** | **No of seniors required** | **Cost of supervisory salaries per annum** | **Selection, orientation, management & monitoring** | **Cost of technical courses** | **Cost of other courses** |
| **Civil engineering** | | | **750** | **600** | **543** | **R 232,740,000** | **215592** | **138** | **R 82,920,000** | **R 16,584,000** | **R 22,716,000** | **R 11,358,000** |
| | Consulting | CETA, Services SETA and companies | 315 | 252 | 228 | R 97,750,800 | 90549 | 58 | R 34,826,400 | R 6,965,280 | R 9,540,720 | R 4,770,360 |
| | Contracting | CETA and companies | 135 | 108 | 98 | R 41,893,200 | 38807 | 25 | R 14,925,600 | R 2,985,120 | R 4,088,880 | R 2,044,440 |
| | Public Sector | LGSETA, ESETA, TETA and departments | 300 | 240 | 217 | R 93,096,000 | 86237 | 55 | R 33,168,000 | R 6,633,600 | R 9,086,400 | R 4,543,200 |
| **Electrical Engineering** | | | **1600** | **1300** | **1028** | **R 475,440,000** | **476112** | **305** | **R 183,120,000** | **R 36,624,000** | **R 47,136,000** | **R 23,568,000** |
| | Private sector | ESETA and companies | 800 | 650 | 514 | R 237,720,000 | 238056 | 153 | R 91,560,000 | R 18,312,000 | R 23,568,000 | R 11,784,000 |
| | Public Sector | ESETA and departments | 800 | 650 | 514 | R 237,720,000 | 238056 | 153 | R 91,560,000 | R 18,312,000 | R 23,568,000 | R 11,784,000 |
| **Mechanical Engineering** | | | **390** | **340** | **278** | **R 123,600,000** | **146848** | **94** | **R 56,480,000** | **R 11,296,000** | **R 12,096,000** | **R 6,048,000** |
| | Private sector | MerSETA and companies | 312 | 272 | 222 | R 98,880,000 | 117478 | 75 | R 45,184,000 | R 9,036,800 | R 9,676,800 | R 4,838,400 |
| | Public Sector | MerSETA and departments | 78 | 68 | 56 | R 24,720,000 | 29370 | 19 | R 11,296,000 | R 2,259,200 | R 2,419,200 | R 1,209,600 |
| **Industrial Engineering** | | | **90** | **65** | **94** | **R 32,280,000** | **33956** | **22** | **R 13,060,000** | **R 2,612,000** | **R 2,988,000** | **R 1,494,000** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Private sector | SETAs and companies | 68 | 49 | 71 | R 24,210,000 | 25467 | 16 | R 9,795,000 | R 1,959,000 | R 2,241,000 | R 1,120,500 |
| | Public Sector | SETAs and departments | 23 | 16 | 24 | R 8,070,000 | 8489 | 5 | R 3,265,000 | R 653,000 | R 747,000 | R 373,500 |
| **Mining Engineering** | | | **44** | **33** | **22** | **R 11,616,000** | **15673** | **10** | **R 6,028,000** | **R 1,205,600** | **R 1,188,000** | **R 594,000** |
| | Private sector | MQA and companies | 40 | 30 | 20 | R 10,454,400 | 14106 | 9 | R 5,425,200 | R 1,085,040 | R 1,069,200 | R 534,600 |
| | Public Sector | MQA and departments | 4 | 3 | 2 | R 1,161,600 | 1567 | 1 | R 602,800 | R 120,560 | R 118,800 | R 59,400 |
| **Chemical Engineering** | | | **550** | **430** | **338** | **R 158,640,000** | **205192** | **132** | **R 78,920,000** | **R 15,784,000** | **R 15,816,000** | **R 7,908,000** |
| | Private sector | CHIETA, FOODBEVSETA and companies | 495 | 387 | 304 | R 142,776,000 | 184673 | 118 | R 71,028,000 | R 14,205,600 | R 14,234,400 | R 7,117,200 |
| | Public Sector | CHIETA and departments | 55 | 43 | 34 | R 15,864,000 | 20519 | 13 | R 7,892,000 | R 1,578,400 | R 1,581,600 | R 790,800 |
| **Other** | | | **400** | **350** | **300** | **R 129,600,000** | **127400** | **82** | **R 49,000,000** | **R 9,800,000** | **R 12,600,000** | **R 6,300,000** |
| | Private sector | SETAs eg FOODBEVSETA and companies | 200 | 175 | 150 | R 64,800,000 | 63700 | 41 | R 24,500,000 | R 4,900,000 | R 6,300,000 | R 3,150,000 |
| | Public Sector | SETAs eg DIDTETA and departments | 200 | 175 | 150 | R 64,800,000 | 63700 | 41 | R 24,500,000 | R 4,900,000 | R 6,300,000 | R 3,150,000 |
| **Totals** | | | **3824** | **3118** | **2603** | **R 1,163,916,000** | **1248853** | **783** | **R 469,528,000** | **R 93,905,600** | **R 114,540,000** | **R 57,270,000** |
| | Private sector | | 2364 | 1922 | 1607 | R 718,484,400 | 772835 | 495 | R 297,244,200 | R 59,448,840 | R 70,719,000 | R 35,359,500 |
| | Public Sector | | 1460 | 1196 | 996 | R 445,431,600 | 447938 | 287 | R 172,283,800 | R 34,456,760 | R 43,821,000 | R 21,910,500 |
| | | | | | | | | | | | | |
| **Average cost of training per graduate per annum excluding salary** | | | | | | **R 67,191** | | | | | | |
| | | | | | | | | | | | | |
| Reduced figure based on nett graduates entering industry | | | 10% | loss | | **R 1,047,524,400** | | | **R 422,575,200** | **R 84,515,040** | **R 103,086,000** | **R 51,543,000** |
| Private sector mentor subsidies/rebates required (50% 0f the cost) | | | | | | | | | **R 133,759,890** | | | |
| Public sector mentor subsidies/ capacity building grants | | | | | | | | | **R 155,055,420** | | | |

## 9.2 UNIVERSITY GRADUATES

| DIRECT AND SUPPORT COSTS FOR UNIVERSITY ENGINEERING GRADUATES FOR 2007 ON A STRUCTURED ECSA CANDIDATE PROGRAMME | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Discipline** | **Sector** | **Funder** | **Number of protégées and salaries paid by industry** | | | | **Knowledge coaching / supervision** | | | | **Formal courses** | |
| | | | **Number 1st year in workplace** | **Number 2nd year in workplace** | **Number 3rd year in workplace** | **Cost of salaries per annum** | **Hours of supervision required** | **No of seniors required** | **Cost of supervisory salaries per annum** | **Selection, orientation, management & monitoring** | **Cost of technical courses** | **Cost of other courses** |
| **Civil engineering** | | | **190** | **185** | **184** | **R 117,210,000** | **84091** | **54** | **R 32,342,500** | **R 6,468,500** | **R 6,708,000** | **R 3,354,000** |
| | Consulting | CETA, Services SETA and companies | 124 | 120 | 120 | R 76,186,500 | 54659 | 35 | R 21,022,625 | R 4,204,525 | R 4,360,200 | R 2,180,100 |
| | Contracting | CETA and companies | 38 | 37 | 37 | R 23,442,000 | 16818 | 11 | R 6,468,500 | R 1,293,700 | R 1,341,600 | R 670,800 |
| | Public Sector | LGSETA, ESETA, TETA and departments | 29 | 28 | 28 | R 17,581,500 | 12614 | 8 | R 4,851,375 | R 970,275 | R 1,006,200 | R 503,100 |
| **Electrical Engineering** | | | **460** | **450** | **442** | **R 283,380,000** | **197366** | **127** | **R 75,910,000** | **R 15,182,000** | **R 16,224,000** | **R 8,112,000** |
| | Private sector | ESETA and companies | 230 | 225 | 221 | R 141,690,000 | 98683 | 63 | R 37,955,000 | R 7,591,000 | R 8,112,000 | R 4,056,000 |
| | Public Sector | ESETA and departments | 230 | 225 | 221 | R 141,690,000 | 98683 | 63 | R 37,955,000 | R 7,591,000 | R 8,112,000 | R 4,056,000 |
| **Mechanical Engineering** | | | **310** | **280** | **257** | **R 176,280,000** | **134654** | **86** | **R 51,790,000** | **R 10,358,000** | **R 10,164,000** | **R 5,082,000** |
| | Private sector | MerSETA and companies | 248 | 224 | 206 | R 141,024,000 | 107723 | 69 | R 41,432,000 | R 8,286,400 | R 8,131,200 | R 4,065,600 |
| | Public Sector | MerSETA and departments | 62 | 56 | 51 | R 35,256,000 | 26931 | 17 | R 10,358,000 | R 2,071,600 | R 2,032,800 | R 1,016,400 |
| **Industrial Engineering** | | | **95** | **85** | **79** | **R 53,910,000** | **40726** | **26** | **R 15,663,750** | **R 3,132,750** | **R 3,108,000** | **R 1,554,000** |
| | Private sector | SETAs and companies | 71 | 64 | 59 | R 40,432,500 | 30544 | 20 | R 11,747,813 | R 2,349,563 | R 2,331,000 | R 1,165,500 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Public Sector | SETAs and departments | 24 | 21 | 20 | R 13,477,500 | 10181 | 7 | R 3,915,938 | R 783,188 | R 777,000 | R 388,500 |
| **Mining Engineering** | | | **65** | **60** | **56** | **R 37,740,000** | **29192** | **19** | **R 11,227,500** | **R 2,245,500** | **R 2,172,000** | **R 1,086,000** |
| | Private sector | MQA and companies | 59 | 54 | 50 | R 33,966,000 | 26272 | 17 | R 10,104,750 | R 2,020,950 | R 1,954,800 | R 977,400 |
| | Public Sector | MQA and departments | 7 | 6 | 6 | R 3,774,000 | 2919 | 2 | R 1,122,750 | R 224,550 | R 217,200 | R 108,600 |
| **Chemical Engineering** | | | **230** | **215** | **199** | **R 134,310,000** | **103779** | **67** | **R 39,915,000** | **R 7,983,000** | **R 7,728,000** | **R 3,864,000** |
| | Private sector | CHIETA, FOODBEVSETA and companies | 207 | 194 | 179 | R 120,879,000 | 93401 | 60 | R 35,923,500 | R 7,184,700 | R 6,955,200 | R 3,477,600 |
| | Public Sector | CHIETA and departments | 23 | 22 | 20 | R 13,431,000 | 10378 | 7 | R 3,991,500 | R 798,300 | R 772,800 | R 386,400 |
| **Other** | | | **350** | **310** | **300** | **R 200,100,000** | **142285** | **91** | **R 54,725,000** | **R 10,945,000** | **R 11,520,000** | **R 5,760,000** |
| | Private sector | SETAs eg FOODBEVSETA and companies | 175 | 155 | 150 | R 100,050,000 | 71143 | 46 | R 27,362,500 | R 5,472,500 | R 5,760,000 | R 2,880,000 |
| | Public Sector | SETAs eg DIDTETA and departments | 175 | 155 | 150 | R 100,050,000 | 71143 | 46 | R 27,362,500 | R 5,472,500 | R 5,760,000 | R 2,880,000 |
| **Totals** | | | **1700** | **1585** | **1517** | **R 1,002,930,000** | **735550** | **469** | **R 281,573,750** | **R 56,314,750** | **R 57,624,000** | **R 28,812,000** |
| | Private sector | | 1151 | 1073 | 1022 | R 677,670,000 | 499243 | 320 | R 192,016,688 | R 38,403,338 | R 38,946,000 | R 19,473,000 |
| | Public Sector | | 549 | 513 | 495 | R 325,260,000 | 232848 | 149 | R 89,557,063 | R 17,911,413 | R 18,678,000 | R 9,339,000 |
| | | | | | | | | | | | | |
| **Average cost of training per graduate per annum excluding salary** | | | | | | **R 76,637** | | | | | | |
| | | | | | | | | | | | | |
| Reduced figure based on nett graduates entering industry | | | 25% | loss | | **R 752,197,500** | | | **R 211,180,313** | **R 42,236,063** | **R 43,218,000** | **R 21,609,000** |
| Private sector mentor subsidies/rebates required (50% 0f the cost) | | | | | | | | | **R 72,006,258** | | | |
| Public sector mentor subsidies/ capacity building grants | | | | | | | | | **R 67,167,797** | | | |

## 9.3 COST SUMMARIES

| | Number of protégées and salaries paid by industry | | | | Knowledge coaching / supervision | | | | Formal courses | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number 1st year in workplace | Number 2nd year in workplace | Number 3rd year in workplace | Cost of salaries per annum | Hours of supervision required | No of seniors required | Cost of supervisory salaries per annum | Selection, orientation, management & monitoring | Cost of technical courses | Cost of other courses |
| Totals technicians | 3824 | 3118 | 2603 | R 1,163,916,000 | 1,248,853 | 783 | R 469,528,000 | R 93,905,600 | R 114,540,000 | R 57,270,000 |
| Totals engineers | 1700 | 1585 | 1517 | R 1,002,930,000 | 735,550 | 469 | R 281,573,750 | R 56,314,750 | R 57,624,000 | R 28,812,000 |
| **Total - all graduates** | **5524** | **4703** | **4120** | **R 2,166,846,000** | **1,984,403** | **1252** | **R 751,101,750** | **R 150,220,350** | **R 172,164,000** | **R 86,082,000** |
| Total - reduced number of graduates coming into industry | 4717 | 3995 | 3480 | R 1,799,721,900 | 1,675,630 | 1056 | R 633,755,513 | **R 126,751,103** | **R 146,304,000** | **R 73,152,000** |
| Total - Reduced coming into private sector | 2991 | 2535 | 2212 | R 1,154,888,460 | 1,069,984 | 686 | R 411,532,296 | R 82,306,459 | R 92,856,600 | R 46,428,300 |
| Total - Reduced coming into public sector | 1725 | 1460 | 1268 | R 644,833,440 | 577,780 | 370 | R 222,223,217 | R 44,444,643 | R 53,447,400 | R 26,723,700 |
| **Private sector mentor subsidies/rebates required (50% 0f the cost)** | | | | | | | **R 205,766,148** | | | |
| **Public sector mentor subsidies/ capacity building grants** | | | | | | | **R 222,223,217** | | | |