




Engineering Management Feasibility Study

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EXECUTIVE SUMMARY

A case is made for the need for Engineering Management and its related body of knowledge in industry and in general organisational practice. However, most professionals still guide their perception around the Engineering Management field according to the traditional concepts and knowledge silos, which have created the need and market gap for Engineering Management in the first place. Engineering Management deviates from this accepted norm.


Engineering Management instils new characteristics from bodies of knowledge. It should, therefore, be a different knowledge base and not continued professional development of an existing engineering discipline. It is a discipline in and of its own. One of the core outcomes of the ECSA evaluation of Professionals includes a managerial scope. Through this consideration, ECSA has already recognised the requirement for engineering-related professionals to be in responsible and leadership roles.

In modern, dynamic organisations, and considering the present requirements and economic circumstances of South African businesses, recognition of the Engineering Management body of knowledge and skillset will motivate and stimulate growth in this new facet of engineering. Statutory bodies, as with registered professionals, must ensure that regulatory structures keep pace with and adapt with developing requirements and movements in industry and the applied fields. However, this movement should be supported by the expansion of statutory procedural considerations in order to accommodate future hybrid engineering requirements, such as Engineering Management.

The establishment of an Engineering Management Specified Category appears to be broadly supported by the 2777 engineering practitioners who responded to a survey asking for their input, although careful consideration still needs to be given to the structure of and requirements for registration in this category. Comments provided by respondents were either very positive, such as “I would like to commend ECSA for forward thinking in the changing world of engineering. And understanding that a more dynamic engineering team would lead to better execution of engineering projects” (Comment 834) or very negative: “This idea is a recipe for disaster” (Comment 791) and “What a stupid idea in the first place to even contemplate another category” (Comment 793). It is clear that should this Specified Category be established, significant effort will need to be taken to inform all engineering

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practitioners about what Specified Categories are and the value proposition associated with this particular proposed category.

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1. INTRODUCTION

1.1 Preamble

In order to determine exactly where Engineering Management fits into the ECSA structures and vision, different relevant concepts are outlined in simplified form. An engineering related person is evaluated according to different guidelines in order to judge their competence in the field of engineering. The different *registration categories* of ECSA constitute different characteristics in the registered persons. These can be summarised as follows:


- **Candidate:** A person who has covered the content of the relevant body of knowledge in the field, however, is learning the application of this knowledge to practical applications.
- **Professional:** A person who has covered the body of knowledge and has learnt the practical application of the field to render himself/herself a competent and accountable professional.
- **Specified Categories:** A person who has refined the content of the body of knowledge to a specific subset with in-depth, specialised knowledge, through further studies (short courses etc.) and/or through expansive experience, and who is a competent and accountable person in this field.

Once a person is recognised as a competent and accountable professional, *continued professional development* ensures that: firstly, the person retains the acquired knowledge through applied accountable experience, and; secondly, stays abreast of the expansion of the body of knowledge in the form of new technologies, applications and techniques. The *ECSA outcomes* review a person's competence in the accountable application of the recognised comprehension of the body of knowledge. These outcomes are divided into required topics in the discipline that is evaluated (i.e. Civil, Mechanical, Electrical etc.).

Further, ECSA does not consider post-graduate study to constitute a new body of knowledge, to right, and therefore a different discipline for registration. This aligns with the principles outlined earlier. In principle, post-graduate study expands on the core body of knowledge of the individual and may therefore align more accurately with the need for continued professional development and can thus reduce the experience required for

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registration as a Professional.

2. BACKGROUND

The case can be made of the requirement and utmost importance of the content of the field of Engineering Management. A critical link, which is presently missing from organisational structures, is most often filled by dynamic individuals who take it upon themselves to double qualify in the knowledge silos of *technical engineering* and *management and business sciences*. The dynamic nature of these individuals allows them to draw presently vague parallels between these two facets of the organisation and become effective in their positions. This divide is crossed in the positions of Project Manager, Program Manager, Engineering Manager, Operations Manager or Chief Operations Officer amongst others.


Though these positions may present opportunities to register as professionals in the individual capacities (i.e. Project Management Professional; Program Management Professional, etc.), the organisation still requires a means to evaluate a trusted and accountable person that can progress through the organisation (move from entry positions through to senior positions). Therefore, an individual with the knowledge and skillset of covering the Engineering Management body of knowledge that develops himself to remain relevant in the field, should progress through the organisation's structure.

The Engineering Management body of knowledge (See Figure 1) includes the following knowledge areas, but is not limited to:

- Physical Asset Management and Maintenance Engineering
- Quality Engineering
- Energy Management
- Waste Management
- Environmental Management
- Life Cycle Management
- Supply Chain Management
- Engineering Project Management
- Business Dynamics
- Technology Venture Creation

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- Financial Management and Accounting
- Human Resource and Change Management

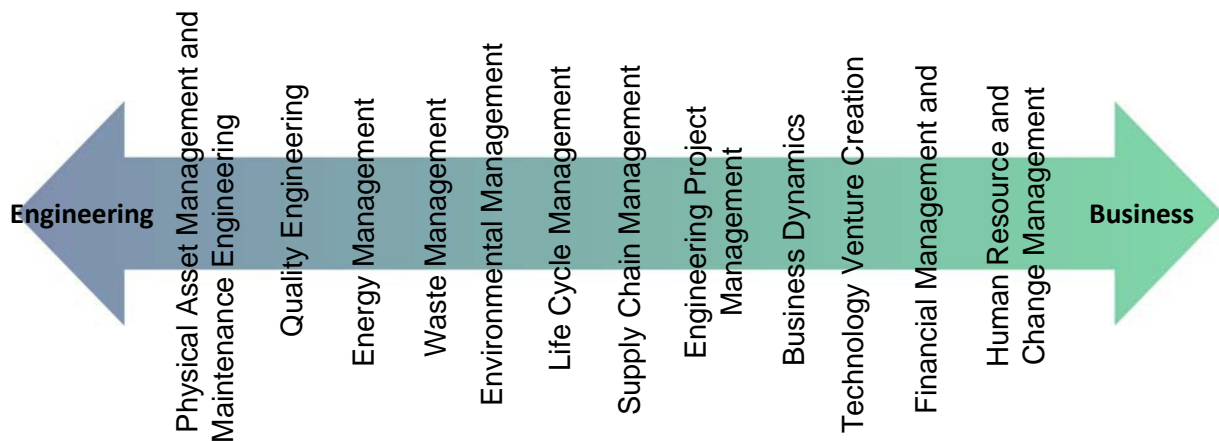



Figure 1: Outline of Engineering Management Body of Knowledge

Present economic and operational circumstances in South African organisations further support the need to evaluate the proven quality of an individual that is employed in these technical management positions. Examples of organisations and economic sectors that require these professionals include Eskom, Transnet, South African Airways, Mining Industries, Construction, to only name a few.

Notwithstanding the above-mentioned requirement for these professionals, the question regarding the limitations of ECSA's mandate to register these professionals can be reflected upon. It can be stated that the above spread of topics through the Engineering Management body of knowledge constitutes the requirement for a hybrid form of registration. Therefore, a collaborated or endorsed registration in which ECSA works together with another professional body in order to evaluate and register different candidates. However, there is no professional body for business professionals. These registrations are limited to the different bodies for Chartered Accountants (SAICA, IRBA, ICASA, ACCA, CIMA, SAIPA, SAIBA, ICB, IACSA and IISA), South African Institute of Tax Professionals, South African Board for People Practices, and Southern African Marketing Research Association, amongst others.

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3. ENGINEERING MANAGEMENT IN PRACTICE

3.1 Competencies of an Engineering Management Practitioner

Amongst the important attributes and skills required, skills with a social component (referred to as “soft skills” below) such as communication, teamwork, leadership, motivation and general management are important to the success of engineers. These areas are often not specifically focussed on in the undergraduate engineering curricula. Currently, engineers learn leadership and management skills while working in the workplace, employers prefer engineers with “strong” soft skills. Even when looking for promotion and senior management positions, engineers with strong soft skills are preferred. Engineers are overlooked to senior management positions and attributed that to the lack of education in communication, leadership and management skills.


Graduate programs in engineering management should maintain a balance between quantitative and qualitative concepts. According to the American Society of Engineering Management (ASEM) certification standards, the curriculum requirements include a balance between qualitative and quantitative courses and at least one third of the curriculum to be management. The body of knowledge for engineering managers include three areas: lifecycle issues, core processes and enabling processes, which is the core discipline. The lifecycle issues include topics such as new product development, value chain management, production and technology marketing. Core processes include strategic management, project/programme management, systems engineering, knowledge management and change management. The third area are the core disciplines and include organizational and workplace design, economics of engineering, quantitative methods and models, quality management and developing engineering management professionals.

Through the natural career-path progression of engineering graduates, engineers pass through the phases of apprentice, professional, mentor and finally the sponsor phase. During these phases, engineers face many difficulties when they assume management responsibilities within their organizations. Their undergraduate education seldom prepares them to deal with the complexities and challenges of managing people.

Since engineers are the most qualified to work in and manage technical engineering

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organizations at different levels, technical engineering competencies are a must for engineering managers in order to properly communicate technical engineering issues with staff and customers inside and outside the organization. They must be able to develop organizational systems that are efficient and effective as well as robust. Their function requires the ability to assess risk and to use innovative technical knowledge and skills as well as interpersonal and conceptual skills. Mastering technical knowledge by itself is therefore not sufficient to assure the engineering manager's success. They would also require expertise in, for example, decision making tools and system optimization techniques to efficiently utilize organization resources including information technology.

Engineering managers are best suited to manage either a technical function such as production and design or in a general management function such as marketing management in a technical engineering organization. The expertise to combine functions such as these will require the development of necessary core competencies according to El-Baz and El-Sayegh (2007), which includes a balance of the core competencies for engineering managers that may be divided into four broad categories outlined in Figure 2 below; technical competencies, financial competencies, managerial competencies and leadership competencies.

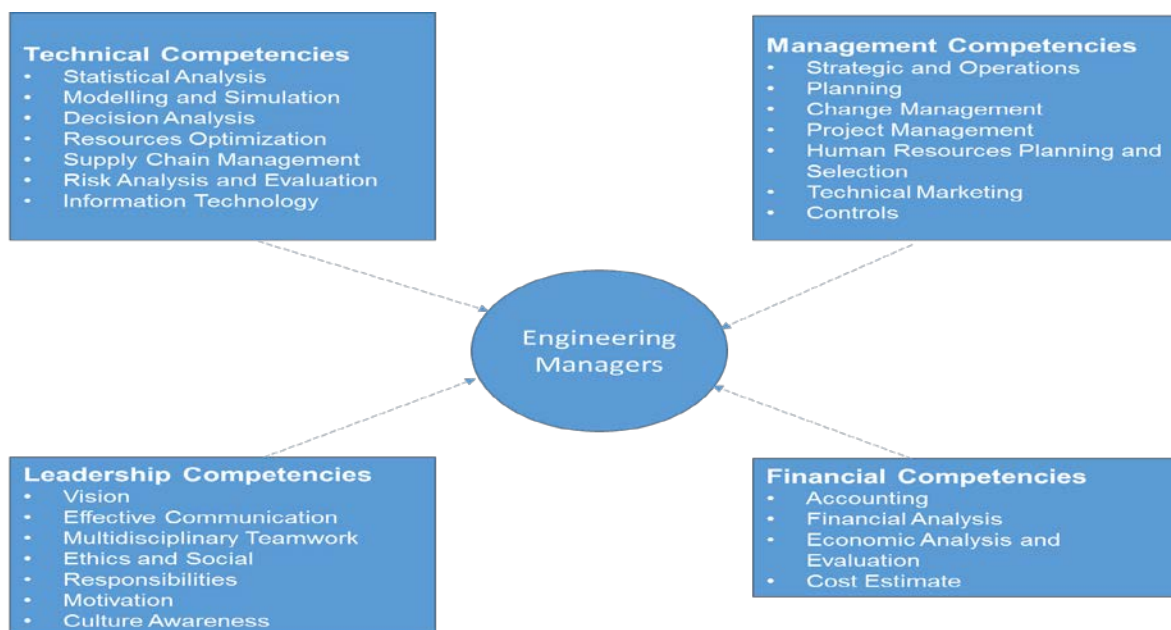



Figure 1: Core competencies for engineering managers may be divided into four

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broad categories


Demonstrating technical competence must be accompanied by competencies in the management function of planning which includes strategic, operational, as well as tactical planning. According to Shah (2015), competencies in other management functions such as organizing, staffing and controlling are necessary for the engineering managers to be able to direct organizational resources, in a focused manner in order to serve and contribute to the mission and vision of the organization. Developing financial competencies is no longer an option for engineering managers. Engineering Managers must not be concerned only if their designs will work, they must assure that designs will exceed the needs and expectations of their customers and make money for the organization. [Table 1 indicates typical positions that may be require EMBOK.](#)

Table 1: Typical potential positions that may require EMBOK

Position Title	Benchmark Qualification	Competency Requirement	Potential EMBOK requirement level
Head of Department	NQF 8	Technical, Leadership, Management and Financial	Masters
Divisional Head – Strategic Planning Implementation	NQF 7	Technical, Leadership, Management and Financial	Honours
Divisional Head – Implementation	NQF 7	Technical, Leadership, Management and Financial	Honours
Divisional Head – Governance and Compliance	NQF 7	Leadership, Management and Financial	N/A
Divisional Head – Functional Planning	NQF 7	Technical, Leadership, Management and Financial	Honours
Divisional Head – Maintenance	NQF 7	Technical, Leadership, Management and Financial	Honours
Divisional Head – Support Services	NQF 7	Technical, Leadership, Management and Financial	Honours
Chief Specialist Design	NQF 7	Technical, Leadership, Management and Financial	Honours
Chief Engineer Implementation	NQF 7	Critical	Honours
Specialist GIS	NQF 7	Technical, Leadership, and Management	N/A
Specialist Design (Engineer)	NQF 7	Technical, Leadership, Management and Financial	Diploma
Specialist Implementation Design	NQF 7	Technical, Leadership, Management and Financial	Diploma

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(Engineer)			
Specialist Supply Chain Management	NQF 6	Technical and Financial	N/A
Engineering Technician	NQF 6	Technical, Leadership, Management and Financial	Diploma
Technical Assistance	NQF 5	Technical and Financial	N/A
Administration Officer: Supply Chain Management	NQF 5	Technical and Financial	N/A
Community Liaison Officer	NQF 5	Leadership	N/A
Engineer in Training		N/A	N/A
Administration Officer: Finance	NQF 6	Financial	N/A

3.2 Engineering Management in the Public Sector


The public sector (Wikipedia, 2019) is that portion of an economic system that is controlled by national, state or provincial, and local governments. In the South African Government and Public Sector engineering practitioners provide independent and objective advice to clients across the broad public sector at the municipal, provincial and national government levels, including respective state-owned entities.

Public services in general include public goods and governmental services such as the military, law enforcement, infrastructure (public road, bridges, tunnels, water supply, sewers, electrical grids, telecommunication, etc. also public transit, public education, along with health care and those working for the government itself, such as elected officials. The public sector might provide services that a non-taxpayer cannot be excluded from basic services such as street lighting, services which benefit all of society rather than just the individual who uses the service. There are also public enterprises or state-owned enterprises, which are self-financing commercial enterprises that are under public ownership which provide various private goods and services for sale and usually operate on a commercial basis.

The primary role of engineering is for development and maintenance of the infrastructures within the public sectors. Infrastructure is the fundamental facilities and systems serving a country, city or other area including the services and facilities necessary for its economy to function. In general, it has also been defined as the physical components of interrelated systems providing commodities and services essential to enable, sustain or enhance

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societal living conditions.

There are two general types of ways to view the infrastructure; hard or soft. Hard infrastructure refers to the physical networks necessary for the functioning of a modern industry. This includes roads, bridges, railways, etc. Whereas soft infrastructures refer to all the institutions that maintain the economic, health, social, and cultural standards of a country. This includes educational programs, official statistics, parks and recreational facilities, law enforcement agencies and emergency services. Both soft and hard are controlled and managed differently under various workbooks and scopes, hence there is no generic organogram or portfolios for engineering management functions. Generically since projects follow a certain project life cycle; initiating, planning, execution, monitoring and controlling. The nature of these projects may differ in degree and complexity, it would make sense for personnel structure to include engineering management body of knowledge such as; introduction to a framework for the engineering management discipline, leadership and organisation management, strategic planning, financial resource management, project management, operations and supply chain management, marketing and sales management engineering organisations, management of technology, research and development, system engineering, legal issues in engineering management, professional codes of conduct and ethics.

3.3 Engineering Management in the Private Sector


The consulting engineering organisational structure in the private sector varies as a function of the size (number of employees) and engineering services offered. A typical consulting engineering organisation has the structure as shown in Figure 3.

Candidates that specialise in the Engineering Management body of knowledge could possibly fill the roles from senior engineers and technologist up until technical managers as the personnel are likely to perform these functions without necessarily having the title of 'engineering manager'.

For the candidate who wants to function as a specialist in engineering management, they must have the base engineering qualification from a university or university of technology. In addition to this, the candidate needs to have met the following criteria:

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- Further study in the form of attaining an honours or master's degree in engineering management, a short course could also suffice but the contents would need to be vetted in terms of its alignment to the above degree; and/or
- A certain number of minimum years of practicing as an engineering manager or fulfilling engineering management role (recognition of prior learning); and
- The candidates need to be agile in their interactions with an array of multidisciplinary teams; and
- A good understanding of operations and/or project management.

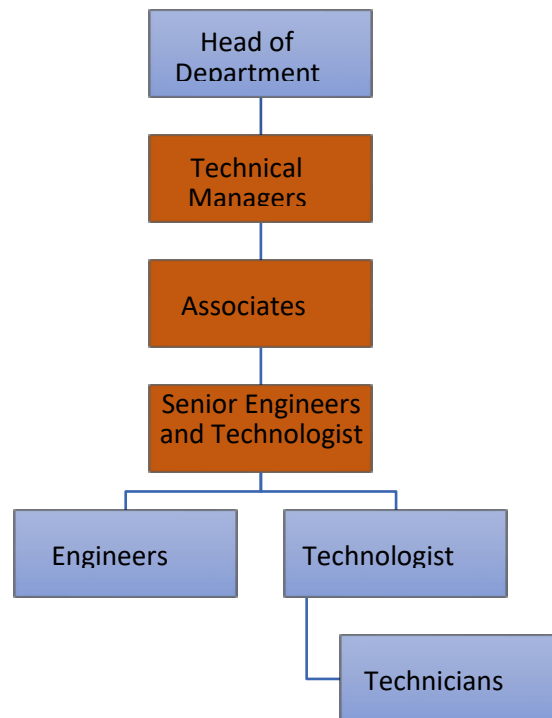



Figure 2: A typical organisational structure of a consulting engineering organisation

It is thus clear that further investigation and analysis needs to be conducted to fully understand the value of having specialist engineering practitioners that specialise in engineering management. Furthermore, there will be value to also explore the construction engineering organisations and what the value ad will be of having specialists that practise engineering management within an organisation.

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4. REGISTRATION AND SPECIFIED CATEGORIES

Registration with ECSA takes place in five categories: Professional Engineer, Professional Engineering Technologist, Professional Engineering Technician, Professional Certificated Engineer, and Council-prescribed Specified Categories; in addition to the corresponding candidate categories. Documents R-01-P (Policy on Registration in Professional Categories) and R-01-SC-POL (Policy on Registration of Practitioners in Specified Categories) define policies set by the Council that govern the registration of persons in these categories. These policies give effect to provisions in the Engineering Profession Act (No. 46 of 2000) with regard to professional and candidate registration.


A Specified Category is a category created for registered persons (other than professional engineers, certificated engineers, engineering technologists and engineering technicians) who have specific training and experience related to a specialised field that has to be regulated. It is a category of registration created for persons who must be licensed through the Engineering Profession Act or a combination of the Engineering Profession Act and external legislation as having specific competencies related to an identified need to protect the safety, health and interest or the environment, in relation to engineering activity. The policy related to the registration of practitioners in Specified Categories is described in R-01-SC-POL.

Any person intending to apply for registration should register as a candidate in one of the Council-prescribed Specified Categories. While registration as a candidate is not required, it is the preferred route for those currently undergoing training. It is furthermore required that a candidate has satisfied the relevant educational outcomes determined by the Council. Document E-17-SC (Criteria and Processes for Recognition of Educational Qualifications for Specified Categories) describes a number of ways for an applicant to satisfy these educational requirements.

The essential requirement for registration in a Specified Category is for the Council to be satisfied that the candidate has demonstrated his or her competence as measured against standards determined for that category. The expected outcomes and level of performance for demonstrating competence for each specified category, in the form of competency standards together with sub discipline-specific requirements, are defined in document R-02-

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SC (Competency Standard for Registration in a Specified Category). Each Specified Category has Sub Discipline-specific Training Requirements that are defined in document R-05-XXX-SC.

Document R-01-SC-POL describes the consideration that is required for a specified category to be established. This consideration includes an identified need to protect public safety, health and interests, or to protect the natural environment, or to promote competent performance in specifically defined areas of engineering work. The justification for a category may arise from an existing legislative requirement, a need to ensure accountability among all practitioners in a specifically defined area of practice, or a need identified for regulation of the work and behaviour of Specified Category practitioners in an industry in the absence of specific legislation.

The process of experience and training that develops an individual to the level of competency required for registration is not prescribed by ECSA; the level of achievement is however defined in the competency standards. It is recognised that many routes to attaining this competency exist. Guidelines to employers, mentors and aspiring registrants are given in document R-04-SC (Training and Mentoring Guide for Specified Categories) and may be supplemented by guidelines for sub-disciplines of registration and work contexts.

Applicants for Specified Category practitioner registration who have completed higher education programmes beyond the level required for registration in the category may offer appropriate aspects of the advanced programme as part of the evidence of competence.


Once registered, a person is obliged to subscribe to the ECSA Code of Conduct as well as any ECSA-approved code of practice. The registered person is also subject to continuing education and training (CPD) requirements as described in document ECPD-01-STD (Standard for Continuous Professional Development Validators, Providers and Activities).

5. THE VIEWS OF ENGINEERING PRACTITIONERS

In order to more fully understand the views of engineering practitioners, in early 2020 a survey was distributed via Survey Monkey that investigated registered professionals' views on the feasibility of developing a Specified Category for practitioners focussed on

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engineering management. Specifically, they were invited to participate as follows:


“The Engineering Council is looking into the feasibility of developing a Specified Category for **practitioners focussed on engineering management**. A Specified Category is a registration category at ECSA that provides for the registration of people who perform critically important work of an engineering nature and who have specific training and experience pertaining to a specialised field but for which there is no professional category available for them to register in. The establishment of the Engineering Management Specified Category would promote competent performance in this specifically defined areas of engineering work and would ensure accountability among all practitioners in this area of practice. Before we establish such a category, we need to ensure that engineering management practitioners **feel that there is value in doing so**. With that in mind, we ask that you take a few minutes to give us your views on the following questions. Your contribution will be anonymous, and all data will be reported in aggregate so that you are not identifiable in any way.”

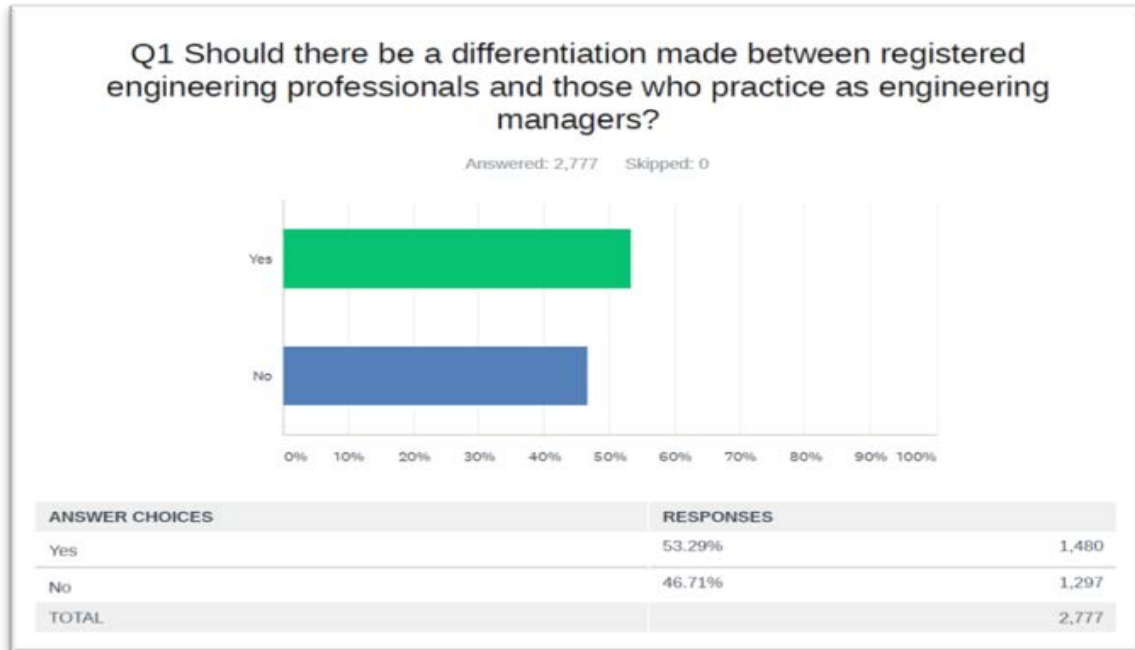
The first survey response was received on 24/01/2010 and the final response was received on 21/02/2020. A total of 2777 people on ECSA’s database of practitioners completed the survey. Key results from the survey are presented in the figures to follow. For the full results of the survey, please refer to Appendix A.

Question 1 of the survey shows that there is the view amongst *more than half* (53%) the engineering practitioner community that there *should* there be a differentiation made between registered engineering professionals and those who practice as engineering managers. This is important because a significant number of the engineering professionals surveyed view the role of an Engineering Manager as *sufficiently different* from the categories of registration to be recognised as such.

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Typical comments in support of this view are as follows:

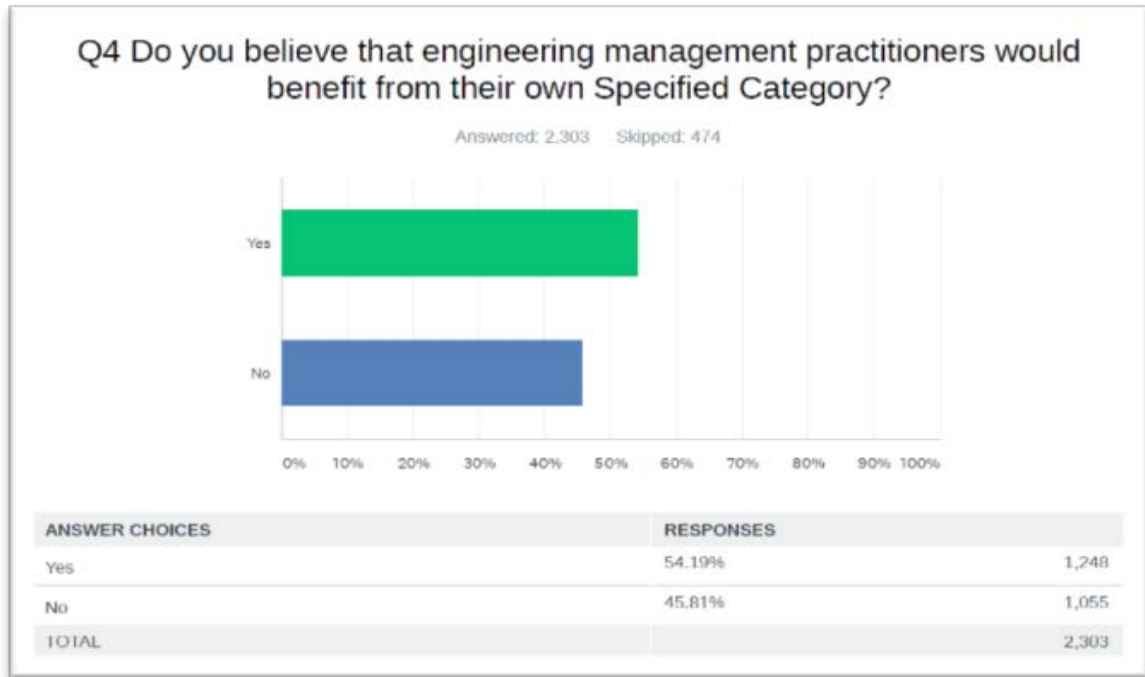
“In my environment there is a tendency to assume that high performing technical professionals make good technical managers. I have found this not to be the case. ... [A] different registration category will ensure that individuals are aware of the other skills and attributes that an engineering Manager should have and demonstrate that they are suitable for it. Furthermore, aspiring managers will know what interventions to take to acquire the necessary skills in preparation for taking up such roles.” (Comment 5)

“Engineering professionals are generally involved in fields related to ENGINEERING SCIENCE, while engineering managers are generally involved in ENGINEERING MANAGEMENT. As per the Engineering Code of Conduct, the issue around the AREA OF COMPETENCE is explicitly different between them. Given that Engineering Management is an important function, I feel that it should have a differentiating place holder in the engineering profession.” (Comment 664).

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It is clear from Question 4 that the majority (54%) of those surveyed believe that engineering management practitioners would benefit from having their own Specified Category. If one combines this outcome with the result of Question 7, there would be value in ECSA having the Engineering Management Specified.

Category available as a registration category for its practitioners. Even though only 44% of those completing this question indicated that they would consider registering in such a category that is still 927 individuals who indicate clearly that they would consider registering.

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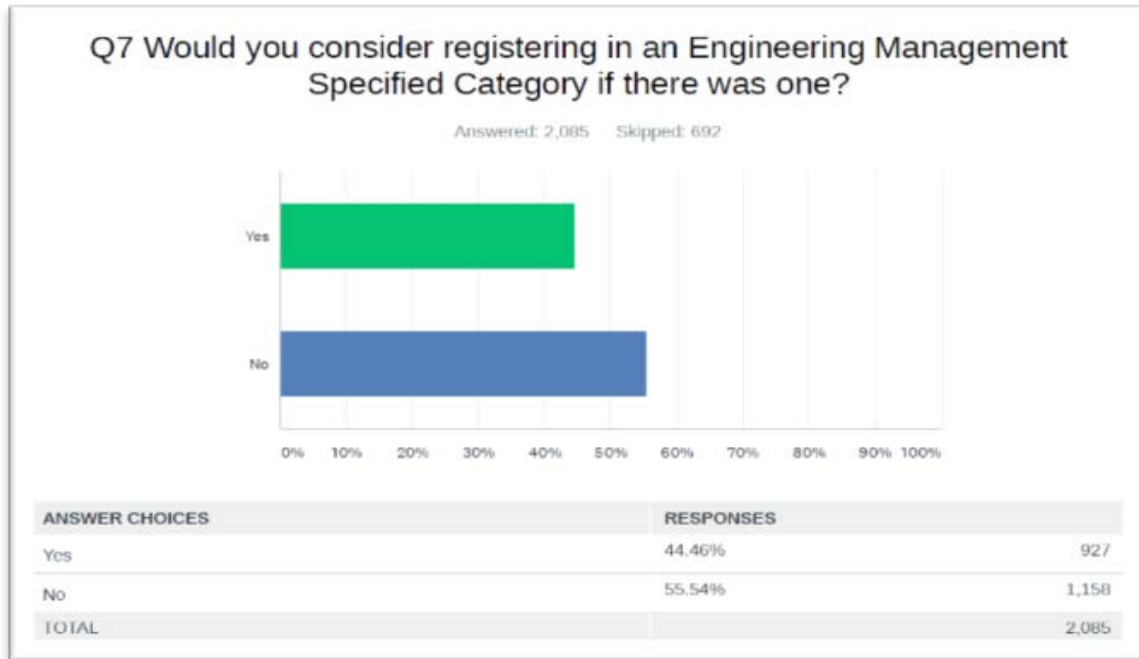
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It is worth further considering the responses to Question 4 and 7. If one assumes that the 927 people who answered Yes to Question 7 are practicing Engineering Managers, Question 4 suggests that there are other engineering practitioners who recognise the value of this specified category, even though they do not practice in this area.


The outcome of the survey suggests that there are up to 1000 engineering practitioners who do not see *specific* value in a dedicated Specialised Category. A typical comment would be:

“I believe it would be useful to me (as an engineering manager) to have my daily work recognised as valid engineering work, and to have management development courses recognised for CPD. I however do not think I need a dedicated specified category for this to be done. I also do not want it implied that somehow just because my core work is management, I am no longer also a technical professional.” (Comment 2)

The survey also sought to understand if the engineering community would view members of a dedicated Engineering Management Specified Category *differently* because of this registration. 59% of respondents indicated that they believed that this would be the case:

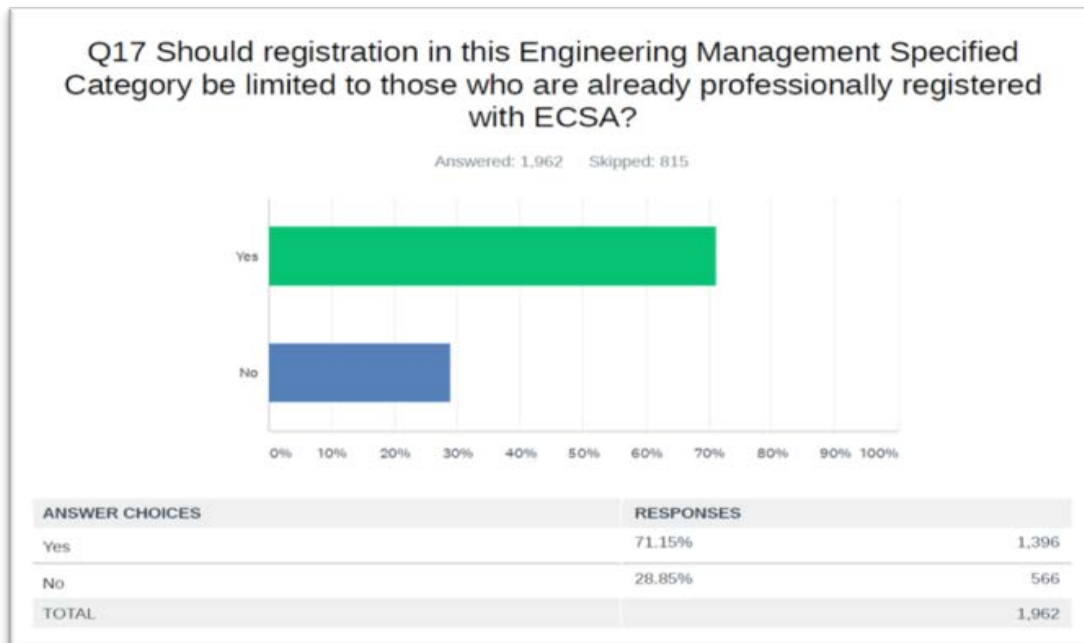
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“In the company where I'm employed, engineering professionals are managed by engineering managers. Engineering professionals are promoted to engineering managers and are therefore more senior and experienced engineers. I find my ‘saleability’ as an engineering manager much better than as an engineering professional. Others in my company view engineering managers more senior than engineering professionals because of the additional human management burden that they carry.” (Comment 83)

“The additional knowledge acquired over and above the engineering fundamentals will also be recognised. Engineering Management is a is a big picture view on the engineering process and reflects maturity of engineering judgement and experience. Included are cross-cutting disciplines such as Operations, Production, Systems, Maintenance and Asset Management concepts in Engineering Management.” (Comment)



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Question 17, “Should registration in this Engineering Management Specified Category be limited to those who are already professionally registered with ECSA?” provoked significant response. Throughout the comments made by respondents to the various other questions, issues associated with this question were regularly included in the responses. More than 70% of respondents suggested that this Specified Category should be reserved for those who were already professionally registered. While it is clear from the response to the survey that there is broad support for the establishment of an Engineering Management Specified Category, there is a fairly strong feeling that this should be an additional category of registration over and above one’s registration in one of the professional categories. This notwithstanding, 40% of respondents who answered Question 20 suggest that even if one has completed the educational and experiential requirements for Professional registration in one of the nine discipline categories, there would still be value in registering in this specified category *only*. This is an important outcome as it suggests that almost 8% of the engineering practitioners completing the survey believe that this is a *more appropriate* category to be registered in even if they have developed the necessary competencies to be registered in one of the professional categories.


Question 23 indicates that 61% of the respondents support that practitioners registered in this Specified Category be referred to as “Registered Engineering Managers”. The response by those who did not support this as an appropriate descriptor clearly indicated that were those who were stridently opposed to the establishment of such a specified category. In some cases, this was because they thought that this would be an additional Professional category, but most were simply very critical of the very notion of such a category.

6. CONCLUSION

While the establishment of this Specified Category appears to be broadly supported by the engineering practitioners who responded to this survey, careful consideration still needs to be given to the structure of and requirements for registration in this category. Comments provided by respondents were either very positive, such as “I would like to commend ECSA for forward thinking in the changing world of engineering. And understanding that a more dynamic engineering team would lead to better execution of engineering projects” (Comment 834) or very negative: “This idea is a recipe for disaster” (Comment 791) and “What a stupid

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idea in the first place to even contemplate another category” (Comment 793). It is clear that should this Specified Category be established, significant effort will need to be taken to inform all engineering practitioners about what specified categories are and the value proposition associated with this proposed category.

REVISION HISTORY

Revision number	Revision date	Revision details	Approved by
Draft A	6 April 2020	Receipt final draft from the consultant	EL Nxumalo
Draft B	15 April 2020	Customisation to ECSA format and preparation for approval by RPSC	EL Nxumalo
Revision 0	21 May 2020	Consideration and approval	RPSC
Revision 0	11 June 2020	Consideration and approval	Council

The Engineering Management Feasibility Study

Revision 0 dated 11 June 2020 and consisting of 23 pages reviewed for adequacy by the Business Unit Manager and is approved by the Executive: Research, Policy and Standards (RPS).


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Business Unit Manager

09.03.2021
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Date


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Executive: RPS

10/03/2021
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Date

This definitive version of this policy is available on our website.

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