

A comparative study of soft skills amongst the Washington accord engineering degree graduates with industry expectations

T. T. Wilson

Postgraduate School of Engineering Management
University of Johannesburg
Johannesburg, South Africa
twilson293@gmail.com

A.L. Marnewick

Postgraduate School of Engineering Management,
University of Johannesburg
Johannesburg, South Africa
amarnewick@uj.ac.za

Abstract – Graduate engineers in the 21st century are expected to be well rounded engineers after graduating with a Washington accord degree. Academics and industry concur that engineers need to have a set of soft skills in the 21st century. Competence in soft skills may equally have a great influence over an engineer's general career achievement as hard skills competences. The purpose of this study is to investigate the magnitude to which the gap between Washington accord engineering degrees offer and industry expectations. The study found that graduate engineers with a Washington accord (WA) degree are taught the following soft skills; communication skills, teamwork, entrepreneurial skills, problem solving skills, decision making, ethic, self management skills, life long learning, and creativity/innovation. In contrast, industry found that graduate engineers are competent in the following soft skills; interpersonal skills, flexibility, teamwork, decision making skills, problem solving skills, and self management skills. Moreover, the result revealed that graduate engineers are taught the following soft skills; communication skills, ethics, and entrepreneurial skills but were not inline with industry expectations. The findings suggest that by revising the engineering curricula, it may be able to produce engineering graduates who are more prepared to meet industry expectations.

Keywords – Soft skills, Washington Accord, graduate engineers, industry

I. INTRODUCTION

The Statistics South Africa Quarter 2016, reported in Quarterly Labour Force Survey PO211 Publication that the unemployment rate in the last three months of 2016 dropped to 26.5% from 27.1% in the previous year [1]. The unemployment rate decreased by 0.6% quarterly and employment increased by 2.0% yearly [1]. The employment rate increased including that of graduates. Yearly variations reveal that employment increases in four occupations namely domestic worker, elementary, managerial and professionals with the biggest improvements in the two skilled occupations, professionals with 15.6% (120 000) and managerial with (8%) 106 000 occupations [1].

To enable the increase in professionals and managers' employability in the engineering environment several studies have been conducted to find the factors of incrementing employability.

The present-day economic challenges and the economic integration of the world are compelling engineering employers to pursue competent engineers [2]. Subsequently, engineering graduates have to get ready with skills as well as decent academic qualifications desired by their future employers.

In the 21st century, all new graduates require employability abilities to be successful. In order to prosper in their entry level employment, engineers are expected to have soft skills [3]. ECSA has included some soft skills in its engineering criteria in addition to the conventional hard skills to help students become better prepared for the challenges of the real corporate world [4]. The modernized curriculum helped as a key stride towards linking the gap between the skills that engineering graduates are exposed to in university and the skills that employers anticipate engineering graduates to have. Since, they do not constantly operate at their anticipated levels of responsibility at their work place [5]

Today's competitive universal market and changing surroundings mandating that engineers should have soft skills [6]. Soft skills are sometimes referred to as employability skills, generic skills, basic skills, essential skills, core skills, key skills, and competency skills [7] [8] [9]. Soft skills have been regularly been acknowledged as the most essential employing criterion for entry level jobs [7].

Currently engineers enquire technical skills similarly known as hard skills. Engineers get to enquire soft skills during their working career [9]. Core soft skills are a basic requirement for engineers [10] [11]. They can transform engineers to individuals that have self-confidence and capable of managing different situations in their workplace [9].

It is a challenge for the faculty of engineering to include soft skills into the traditional technical curriculum because the faculty may find it challenging to find an equilibrium between the different skills [12].

To explore the point to which the breach between university contributions and industry prospects has been linked through examination of the degree of experience and understanding of several soft skills by engineering graduates. A research was conducted to determine two research question;

- Which soft skills are graduate engineers competent in when graduating with a Washington Accord degree and
- Which soft skills is industry expecting from graduate engineers with a Washington Accord degree.

Engineering education is considered to be the predominate source of changing students into practicing engineers; universities need to keep up with the pace and the requirements of the engineering field and workplace [13]. South Africa has had a national transformation to the outcomes-based education [14]. Subsequently, the South

South African engineering undergraduates are required to meet a prescribed curriculum by ECSA known as Exit Level Outcomes (ELOs). There are eleven ELOs that are prescribed. ECSA has developed a set of ELOs as shown in table 1 [15].

Table 1 Accreditation ELOs for undergraduate engineering programs [5] [15] [16]

No.	Exit Level Outcome
1	Problem solving
2	Application of scientific and engineering knowledge
3	Engineering design
4	Investigations, experiments and data analysis
5	Engineering methods, skills and tools, including information technology
6	Professional and technical communication
7	Sustainability and impact of engineering activity
8	Individual, team and multidisciplinary working
9	Independent learning ability
10	Engineering professionalism
11	Engineering management

Soft skills are acknowledged as an essential area of studies and contribute extensively to ELOs 1,3,5,6,8,9,10, and 11. Problem solving fall within ELO 1, creativity falls within ELO 3, information technology fall within ELO 5, professional and technical communication fall within ELO 6, individual, team and multi-disciplinary work fall within ELO 8, independent learning fall within ELO 9, Professionalism and ethics fall within ELO 10 and management skills fall within ELO 11 [4] [15] [16] [17]. Suffice to mention that the ECSA ELO document

mentions that life long learning is a core requirement for the engineering programme [15].

The soft skill set that the employers are looking for in graduate engineers has changed in the recent years [4]. The majority of employers envisage employees to show and transcend in numerous core soft skills such as communication skills, teamwork, professional skills, interpersonal skills, problem solving, decision making skills, self esteem, lifelong learning, entrepreneurial skills, motivation, leadership style, negotiation, time management, conflict management, management, enthusiasm and innovation [7] [8] [18] [19] [20] [21] [22] [23].

Industry executives, managers and leaders in government agree that in the 21st century engineers more especially graduate engineers must have core soft skills in order for them to be better prepared for the professional world challenges and for them to succeed in their career development [24]. Present and future organizations require specific soft skills which are outside the university traditional taught curriculum [10].

Literature generally consider the following soft skills important for engineers to managing a successful workplace and for an individual career development [7] [8] [13] [22] [25] [26] [27] [28]:

- Communication skills
- Teamwork
- Problem solving skills
- Leadership
- Entrepreneurial skill
- Interpersonal skill
- Life long learning
- Self management skills
- Decision-making
- Flexibility
- Ethics

The ECSA ELOs development is regularly determined by an aspiration to produce engineering graduates that better meet the hard skills and soft skills required by industry [29]. The author compared the soft skills that the ECSA curriculum offered to the Washington accord degree engineering students and soft skills required by the engineering industry. The comparison is shown in Figure 1. Figure 1 describes the gap analysis between the soft skills that are in the ECSA ELO framework, soft skills that are required by industry and the gap of the soft skills that industry requires from the soft skills that university offers.

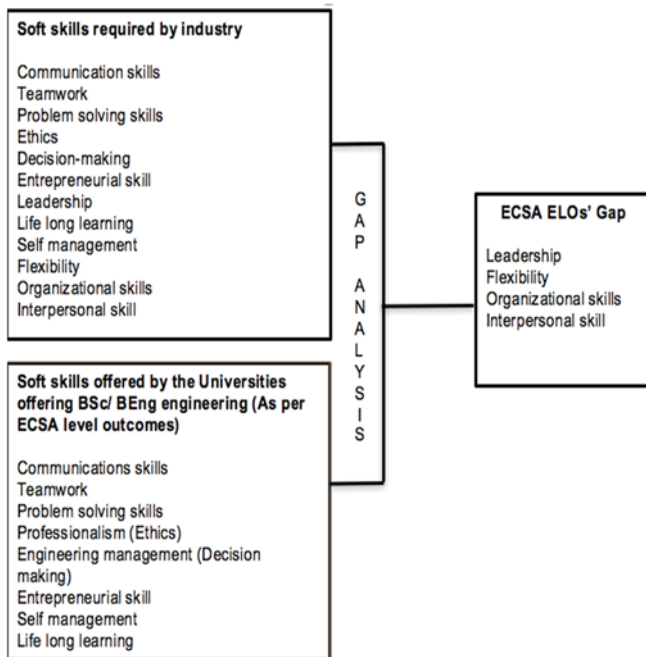


Figure 1 Soft skills gap between industry and accredited engineering Washington accord degree

ECSA ELOs' and industry share the following soft skills; communication skills, teamwork, problem solving skills, ethics, decision making skills, life long learning and entrepreneurial skills. Literature shows that ECSA ELO's are missing the following skills; leadership skills, flexibility, organizational skills, and interpersonal skills. However, Kumar et al mentions that engineers learn management skills and leadership skills during the working lives [9].

II. METHODOLOGY

A qualitative research method was designed and guided by using the transcendental phenomenology. Individual one on one interviews seemed to be the most suitable selection. It would not have been sound to research on a subject matter like *soft skills*, and not use direct contact with people as the main method. The notion was to discover a deeper connotation and collect rich data.

The research sampling had a total of 14 participants as Moustakas supports participants sample size of 12 -15 or until saturation has been reached within a phenomenological method [30] .

The participants of the study were graduate engineers with the following criteria:

- Washington accord degree, one to two years working experience after graduating

and professional engineers with the following criteria:

- Professional engineer was registered with ECSA as a professional engineer.
- Professional engineer was a mentor to the graduate engineers.

A total of 12 participants were interviewed which constituted of 6 graduate engineers and 6 professional engineers.

The research instrument was a procedure prepared by the author with eight questions that covered soft skills based on the literature review. The data was analyzed using Atlas ti which was guided by the transcendental phenomenological research analysis steps [30] [31]:

- Epoche – declared and set aside prejudice of the researcher
- Framing the research problem within literature on the phenomenon
- Horizontalization – Every experience is studied in its uniqueness (Every statement has equivalent significance).
- Phenomenological Reduction:
 - Horizontalization – Every experience is studied in its uniqueness (Every statement has equivalent significance).
 - Delimited horizon or meanings – (horizons stand out as a never changing quality of an experience, bundling important statements into collections of meaning).
 - Identifying invariant qualities and themes: discussing statements that were made during an interview however are not in the scope of the phenomenon.
 - Individual textural descriptions - Integrate results and demonstrating the phenomenon in different viewpoints.
 - Composite textural description – Integrating all individuals textual descriptions into a universal textural description.
 - The essence of the experience is refined to make sense and ascribe to the experience.

III. RESULTS

In order to determine which soft skills graduate engineers are competent in and which soft skills is the engineering industry seeking. The collected data was analyzed into themes. significant statements were acknowledged in the transcripts that specify information about the experience of the participants. The findings were found through the horizontalization process were the consideration of frequency of significant statement was mentioned during the interview. Through this process table 1 shows the frequency of the soft skills mentioned in the interviews.

Table 2 Soft skills frequency mentioned during interviews

Soft skills	Frequency					Total
	Company 1	Company 2	Company 3	Company 4	Company 5	
Interpersonal skills	192	195	132	595	144	1258
Flexibility	200	205	143	274	176	998
Leadership Skills	220	266	204	134	97	921
Communication Skill	148	217	32	217	96	710
Teamwork	73	203	105	68	120	569
Decision making	157	174	57	85	42	515
Problem solving skills	102	214	43	78	73	510
Ethics	79	119	96	101	113	508
Self management skills	75	53	97	142	121	488
Entrepreneurial Skills	95	102	51	155	44	447
Confidence	75	63	87	87	92	404
Life long learning	71	126	40	81	83	401
Organization skills	41	58	54	152	60	365
Innovation/creativity	0	130	0	0	0	130

Fourteen groups emerged by means of thematical analysis. The caption of each category consist of the main theme to allow for a wide range of subthemes to be incorporated. The fourteen themes are communication skills, confidence, decision making skills, entrepreneurial skills, ethics, flexibility, interpersonal skills, leadership skills, life long learning, organizational skills, problem solving skills, self management skills, team work, and innovation. A discussion of each theme follows.

The participants mentioned that engineering industry is a communication and teamwork industry. They communicate their technical skills by means of designs and reports to their clients, colleagues and other subordinates outside their employment. As much as they communicate and work in a team, interpersonal relationships are very important because if the is miscommunication, it may lead to project failure. This suggests that hard skills and soft skills cannot be disconnected from each other.

IV. DISCUSSION

One of the objectives of higher professional education is to acquire common student competencies throughout a variation of disciplines that play a fundamental part in education and that offer broader opportunities for graduates in finding decent employment and greater chances of getting promoted [32]. Today's aggressive market and fluctuating work environment requests that engineers acquire soft skills in addition to their hard skills [33]. If this is factual it is worthwhile to explore which soft skills graduate engineers must acquire while in university.

Table 3 Soft skills comparison gap

Soft skills	Literature		Data collected	Gap
	WA	Industry	Industry	
Interpersonal skills	•	✓	✓	Interpersonal skills are not incorporated in the ECSA ELOs as one of the soft skills
Flexibility	•	✓	✓	Flexibility are not incorporated in the ECSA ELOs as one of the soft skills
Leadership skills	•	✓	✓	Leadership skills are not incorporated in the ECSA ELOs as one of the soft skills
Organizational skills	•	✓	✓	ECSA ELOs' partly have organizational skills since it is linked with decision making
Confidence	•	•	✓	Confidence was identified as an emerging soft skill in the interviews.
Entrepreneurial skills	✓	✓	✓	Both literature and industry deem entrepreneurial skills important however, industry found that graduate engineers do not seem to be competent.
Communication	✓	✓	✓	No gap
Teamwork	✓	✓	✓	No gap
Decision making	✓	✓	✓	No gap
Problem solving skills	✓	✓	✓	No gap
Ethics	✓	✓	✓	No gap
Self management	✓	✓	✓	No gap
Life long learning	✓	✓	✓	No gap
Creativity	✓	✓	✓	No gap

- - Soft skills is found to be important
- ✓ - Little research or no mention of soft skill is mentioned as important

Table 3 suggest that interpersonal, flexibility, leadership, and organizational are not incorporated in the ECSA ELOs as one of the soft skills. Interpersonal, flexibility, leadership, and organizational skills is a gap in the ECSA ELOs. Confidence was found to be an emerging soft skill during the interviews. Confidence is essential for graduate engineers. Literature indicates that engineering students display a high level confidence in their own ability in hard skills and soft skills [34].

The author found that graduate engineers were not competent in entrepreneurial skills in line with industry expectations however, it is mentioned in literature that entrepreneurial skills as part of creativity falls within ELO 3.

The author got a better insight from the interview that

engineering graduates are competent with communication skills however, they are not inline with the industry expectations.

Graduate engineers are competent with teamwork and professional engineers acknowledge the fact that the level of team work graduates have is to the expectation of industry.

The study found that the following soft skills were consistent with the universities ELO's. Graduate engineers were competent in the following skills decisions, solve problems, and life long learning and meet the expectations of industry.

The research found that graduate engineers were competent in ethics. However, it is worth mentioning that the ethics taught by universities is not in line with the expectations of industry. Universities may need to incorporate the ECSA code of conduct in their ethics study material such that they meet the expectation of industry.

The researcher learnt that self management skill is linked with other soft skills that that graduate engineers are competent and industry is expecting from graduate engineers with, more especially problem solving skills.

V. CONCLUSION

From the findings this study concludes that soft skills are important for graduate engineers and for the engineering industry. The study has found that universities teach graduate engineers the following soft skills communication, teamwork, decision making skill, problem solving skills, ethics, self management skills, life long learning, entrepreneurial skills, and innovation. Moreover, graduate engineers are competent in the following soft skills that industry expects engineering graduates with a Washington accord degree; interpersonal skills, decision making, life long learning, organizational skills, problem solving skills, self management, and team work. It is worth mentioning that graduate engineers are partially competent in communication skills, ethics as per the expectation of industry.

In contrast industry does not expect graduate engineers to be competent in leadership skill once they graduate with a WA degree because they are not going to lead rather will be lead. The findings and conclusion can comparatively provide all solutions to the difficulties facing soft skills expected by industry from graduate engineers. The researcher is of the view that the study provides a path for the study of required soft skills in a South African context.

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