

Innovative Lifelong E-learning for Professional Engineers in Egypt

Abdelrahman El-Sehsah

Consultant for Promoting Industries in Upper Egypt, Federation of Egyptian Industries (FEI), Aswan Office

*Corresponding author: Abdelrahman El-Sehsah

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Abstract

Nowadays, Engineers are superheroes as such, must be ready for anything in an increasingly technology-dependent world. Throughout the work of engineers, we are able to have smart-phones, computers, HD video, satellites TV, airplanes, electric cars, robots, and air conditioners. The list goes on and on. Engineers have enabled us to explore the galaxy, break the sound barrier in a car, replace the broken parts, and instantly connect with anyone all over the world and so much more. This report focuses on engineering job preferences. The Egyptian engineering graduates are said to be more likely to apply for or wait for public sector jobs. Certainly, this seems to be the same in other Arabic countries. The past government supported practice of expanding youth employment in the public sector is no longer sustainable. More and better economic opportunities for professional engineers need to be generated in the private sector by encouraging youth entrepreneurship and the development of micro and small enterprises (MSEs) [1]. The main objective of this report is as;

- Investigating the jobs and positions distributions in Egypt engineering landscape,
- Focusing on career-shift, its dimensions, and its main reasons,
- Basic consideration for seeking new engineering positions.

This report is based on a survey conducted in Egypt that examined the different engineering jobs and positions, the main factors influencing job choices and the career shift in Egyptian engineering landscape for possible actions or options that could improve structurally distorted job preferences among Egyptian professional engineers.

Keywords: superheroes, technology, engineers.

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INTRODUCTION

Egypt is currently at a stage in its demographic transition that is marked with “youth bulge”. The UN Population Division estimates and projections of the age structure of the age structure in Egypt show that the proportion of people aged 15 to 24 percent of the total population in 2005 and has been expected to decline after that [1]. The Egypt Labour Market Panel Survey indicates that the number of new entrants into the workforce has more doubled, from 400,000 per year in the late 1970s to about 850,000 per year in the early 2000s [2].

In recent years, we have profound changes in Egypt job market. Alongside a slight recovery of employment figures, different parts of the country have seen a growth in the number of start-ups, more jobs in industry, manufacturing small and medium businesses, and as well as new roles in the alternatives constructions and energy sectors. Therefore, creating

new opportunities and this opportunities diversification certainly put Egypt one step ahead in the race for securing investments and building a strong forward-looking economy.

In such a scenario, with a changing economy and new sectors creating jobs and business models that would not have even existed decades ago, many professionals including professional engineers may have considered the option of jumping ship and facing the challenges of a new career path.

An engineering profession is a chance to explore, invent and shape the world. It is a field that is endlessly creative, innovating and pioneering. Improving the quality of living, being on the cutting edge of technology and creating a healthier planet are all amazing reasons for becoming an engineer because engineers have the rare and incredible opportunity to make a difference in the lives of those they love. Within

the field, there is much job satisfaction and dissatisfactions.

Engineering is also about designing a more humanistic future – one that considers people and a healthy as much as the bottom line. Engineers work hard to protect our scarce natural resources and care deeply about all of the creatures that inhabit our fragile world. Engineering is all around us; as a career, it may be the best way to make the biggest contributions to society. Engineers work to improve our health, happiness, and safety.

With the fact that many of the jobs you may see in the next 10 years have not even been invented. Many up and coming engineers will not create new products but new engineering sectors as well.

Engineers have appeared on the list of hardest to fill jobs in the U.S for the past nine years; globally, engineers are the fourth most difficult to fill position [3].

Competition for top engineering talent continues to challenge employers, requiring them to re-examine attraction and retention strategies.

Professional Engineering

Over the last several years, many programs have been established to improve Science, Technology, Engineering, and Math (STEM) skills and introduce students to the extensive career opportunities in the STEM field.

Engineering is one of the most progressive, challenging and rewarding fields that can be studied today. Many people want to be engineers, have the ability and natural curiosity to succeed. Last year in Egypt about 13000 students graduated with engineering degrees. That graduation milestone required and perseverance.

Take a look at the job postings for just about any company and you will find several ads for fabulous job opportunities for engineers. Engineering is one of the largest profession in Egypt. With more than 50 major branches of engineering and engineering technology and over 100 specialities, there is something for everyone who pursues a career in this field.

Professional Engineering

A professional engineer (PE) is one who has been licensed by an authorized entity to practice engineering. Most engineers and engineering technologists are not licensed. This exam includes different principles and practices of engineering to the professional engineer. Various countries restrict the title of engineer to those have qualified through having successfully taken and passed both of the Fundamental of Engineering (FE) and policies and practices exams.

And to become a PE, an engineer must:

- Graduate from an Engineering Accreditation Commission (EAC) / Accreditation Board for Engineering and Technology (ABET) accredited university program in engineering or engineering technology.
- Work four years (or seven years for engineering technology graduates) under the guidance of a professional engineer.
- Pass the FE policies and practice exams.
- Train to be very focused on one area such as electrical, mechanical, biomedical, chemical, etc.

Professional Engineers apply creativity, innovation, problem-solving and analytical thinking to whatever project or process they are designing or improving

Advantage of Engineering Domaine

- Greater opportunity for advancement than an associate degree,
- Easier to continue to graduate school than engineering technology,
- Ease of the professional licensure process compared to technology degree holders,
- Great salary right out of school and excellent earning potential throughout your lifetime,
- Understanding of high-level math gives a greater understanding of the world around you, and application of this to real problems can be very satisfying,
- Consistently excellent job opportunities at the bachelor's degree level,
- Engineering often escalate to management positions and earn more over the life of their careers,
- Very rewarding to design and/or processes that can save lives and benefit human-kind.

Disadvantage of Engineering Domaine open crack

- The work can be stressful-especially when the work is associated with life and safety,
- More time in school than an associate degree (higher cost for college),
- The workload can be unpredictable and at times very high,
- A competitive atmosphere for promotions (performance, as perceived by superiors determines one's ability to be promoted),
- Fewer practical skills upon graduation. Often, engineering students have very little opportunity to take business, manufacturing, art or writing courses,
- Very rigorous and abstract mathematics is required-academic programs place a heavy emphasis on calculus, mathematics, and analytical work.

Different Engineering Career Path

There are abundant job opportunities worldwide for engineers, engineering technologists, and technicians who all use the principles and theories of science, engineering and mathematics to solve technical problems. Professional Engineers (PE) and are hired as engineers whereas Engineering Technicians (ET) are hired as technicians. The technicians' work is usually more limited in scope and typically more hands-on than that of scientists and engineers.

Professional Engineers usually build "one of kind" or "first of a kind". The Space Shuttle was an engineering marvel and so was the first cell phone. But when cell phones manufacturers wanted to produce millions of phones/year. Engineering Technology became much more important. In many design scenarios, the engineer develops "big picture" and the ET graduate fleshes out the details.

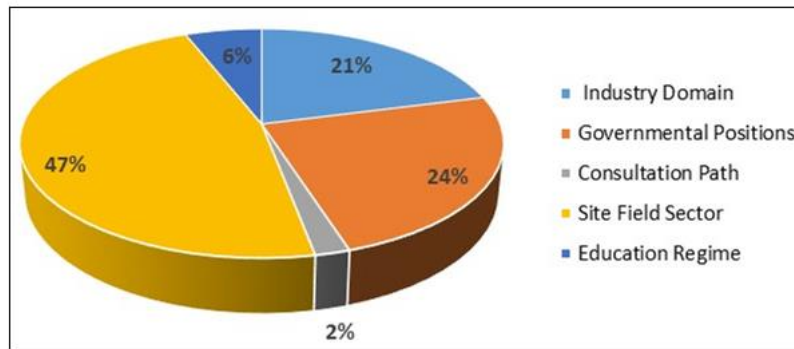


Fig-1: Distribution of Professional Engineers in Egypt

PEs are generally very focused on a very specific area. They are using theory to improve or develop products, technologies and systems; but may also work alongside engineers in research, and development applying their ideas to develop prototypes or test existing research. Others, work in quality control, inspecting products and processes, conducting tests. In manufacturing, they may work in product design, development, quality control, test engineering, sales or production. They can be supervisors to connect the design professionals with the hourly workers.

There are various engineering career paths that Professional Engineer would follow to become a corporate chief executive officer or public works. According to the survey findings, Fig-1 shows the distributions of professional engineers in Egypt. Many of the typical careers paths open to the professional engineer. The presented career paths were explored by professional engineers in these fields and represent their knowledge of a logical career progression via various methods (i.e. physical interviews, questionnaire... etc.).

Industry Engineering Domain

In industry, professional engineers work in diverse settings including manufacturing, technology, pharmaceutical, public facilities and services to the public. They manage large plants, oversee the design/constructions of facilities and obtain critical environmental, constructions and operating permits. Professional engineers are instrumental in new ventures requiring environmental site assessments and feasibility studies. They make significant contributions to decrease costs, increase profits and produce smaller environmental footprints by developing more efficient processes, implementing waste minimization programs

and finding creative solutions to a wide range of issues [4].

Governmental Positions

This career path shows many of the options available for professional engineers who have chosen a career in government such as; local, national and international agencies. Some leave the technical engineering path as they progress and move into government management. At this level, leadership training and education in public administrations or business management is recommended. Whether planning to stay on the technical track or not, government engineers should seek additional training in their area of technical expertise to advance within their organizations. Government engineers are often involved in developing policy and standards for the profession and general public [4].

Consulting Engineering Path

Consulting offers a multitude of career opportunities in firms. At smaller firms, professional engineers have the opportunity to work on numerous varied projects, design challenges, and management-related activities. At larger firms, they have the opportunity to focus on specific projects, design expertise and business management depending on the core competence of the firm. Whether at a small or large firm, professional engineers in consulting generally start with basic engineering evaluations, computations, and design which opens the door to many career paths and flexibility to change paths if they so choose [4].

Site Field Engineering Sector

In site field, professional engineers may work

for a contractor to create the built environment, transforming engineering and architectural design drawings from paper to reality. They are involved in projects of every size and complexity from airports, bridges, and tunnels to local roads and the water and water waste lines to our homes. The core professional engineering curriculum provides an excellent foundation for the critical thinking necessary to work in the construction sectors. Additional classes in project management, safety, scheduling, estimating, and risk management are recommended. As projects are hands-on early field experience is essential to building your career [4].

Education and/or Training Regime

Engineers in academia are involved with teaching the next generation of engineers and developing an engineering curriculum that prepares students with the knowledge they need to succeed in their careers. This career path requires an advanced degree, including a doctorate in most cases. Engineering educators write grants to obtain research funding and work with graduate students to conduct research aimed at developing advancements in the field of engineering. At many academic or training institutions, publishing research finding and obtaining grant funding to success. Additionally, facilitating candidates learning and achieving recognition as a top performing teacher help make this a fulfilling career choice.

Women in Engineering Domain

Engineering requires creativity, innovation, communication and passion for what you do to communicate ideas; develop tools to interact with family, friends and the environment; and make a difference in the world. We need women in the engineering workforce because women have a unique perspective and approach in solving problems. Women

have a long history of using creativity and innovation tools. For example, weaving can be a highly technical skill and some of the earliest programmable manufacturing was done by looms.

Smart companies know that to gain a competitive edge in the marketplace, it is important to hire women to design women's products. If design teams are not well-rounded and representative of the population, companies may find that they don't fully understand the problem, design options or they may not know how to evaluate constraints and potential solutions. Because of increased global competitions and a shortage of women in engineering, it is a good time for women to join the profession. The job opportunities are wide open and many companies are eager to hire women.

The gender disparity in the field of engineering remains prevalent, demonstrated by make-up of male (81%) and female (19%) survey respondents. There remains a great need to continue programs that introduce young girls to STEM careers earlier in life to balance that disparity and encourage anyone to pursue a career in engineering

The reasons behind that women choose engineering as a career are making a difference in society, having a career that is flexible, enjoyable and rewarding

According to the American Society of Engineering Education, women took home 18.1% of all bachelor's degrees in 2010. The percentage of bachelor's degrees awarded to women in each discipline as displayed in Fig-2. While, based on the Egyptian national statistics in 2016, it was found that about 47% of all engineering graduates are females.

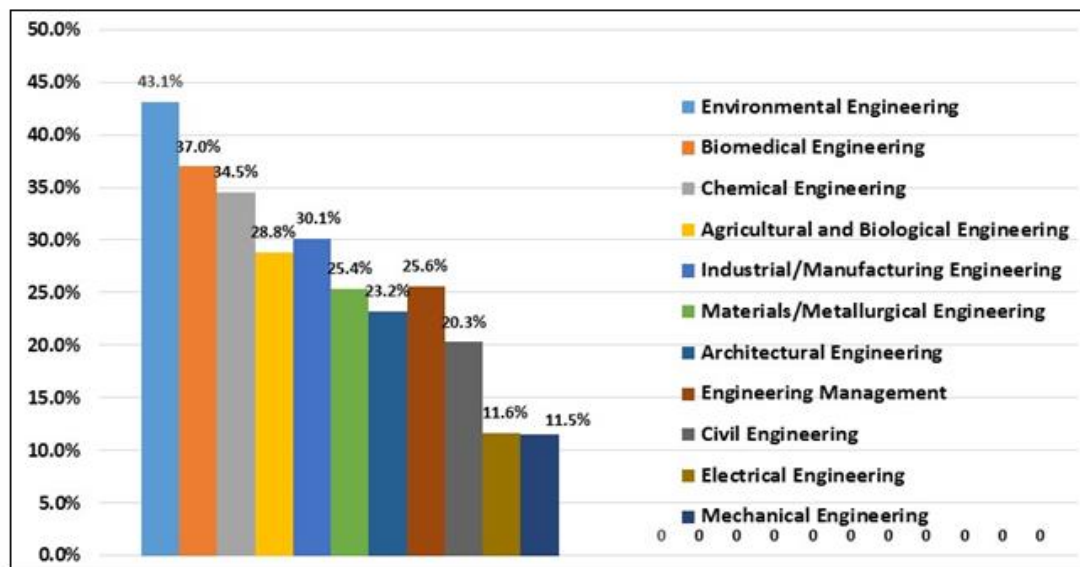


Fig-2: Female Distributions in Engineering Disciplines [5]

Minority in Engineering Domain

The world population will approach about eight billion people by 2020. As the population demographics change, the engineering workforce must also change. Diversity is essential to good engineering. At the most basic level, men, women, ethnic minorities, racial minorities and people with disabilities experience the world differently. Those differences in experience are the core or root of creativity and inspiration for each individual. Technological innovation is strongest when the products and services created to meet the needs of society. Different cultures bring new ideas to the table and the value of such input should be celebrated. By promoting a healthy and diverse engineering workforce that better reflects the population demographics, we will be able to capture benefits such as an increased standard of living, new career opportunities, increased accessibility to programs and economic prosperity. Advances in medicine, enhanced national security, environmentally sound resources management, and economic growth are all indicators of a healthy and diverse engineering workforce.

Reasons for Career Shift

In UK, for the first time in the past 4 years and the percentage of people open to changing job has spiked [6]. Meanwhile, the engineering talent gap continues as growing supply still can't keep up with demand. Even with the large flux of engineering talent, engineering has the second largest net number of people who joined the function from another in 2014 [7].

Engineer individual interests, skills and training will dictate the path that should be followed. Over time, the professional engineer may modify his career path based on various reasons. These reasons are such; personal interests, values, goals, experiences and new opportunities that present themselves... etc.

What matters most to engineers when seeking a new position is shifting a bit increased salary, bonuses and/or incentives remains one of the first priorities. Interestingly, health benefits dropped from #2 in 2016

to #5. Instead, a better work environment and culture rose to #2, followed by more interesting/challenging work, and then improved work/life balance. This is important for employers to know; so, they can ensure their attraction and retention strategies focus on what is important to today's engineers. Workplace culture matters to today's engineers [3]. Some of the most popular reasons for engineering career shift [5] are as;

The most important attributes

In terms of job preferences, Fig-3 shows the first, second and third most important attributes influencing job choice among engineering students in Egypt and Indonesia, respectively. It is obvious that "wage" is one of the most important attributes. Besides, "wages" "education opportunities/possibility of upgrading qualifications or skills" as well as "work location" were founded to be regarded as subsequently important factors. Interestingly, only Egyptian female respondents put equal importance on these three job attributes (i.e., wage, education opportunities and, work location) [1].

Biomimicry (problem-solving inspired by nature) alone offers numerous possibilities for building designs, ventilation systems, electrical systems, and many other things.

Mis-Match with engineering personality

It is important to choose a career that matches your personality. Therefore, personal assessments at career guidance centre, talking to counsellors. The engineering personality can be anything:

- Extrovert or introvert;
- Someone who thrives on change, challenge, consistency or adversity;
- Engineers can be leader or may prefer to let someone else lead;
- They will probably be hard working and lifetime learners;
- They may or may not be good under pressure and may or may not be effective communicators

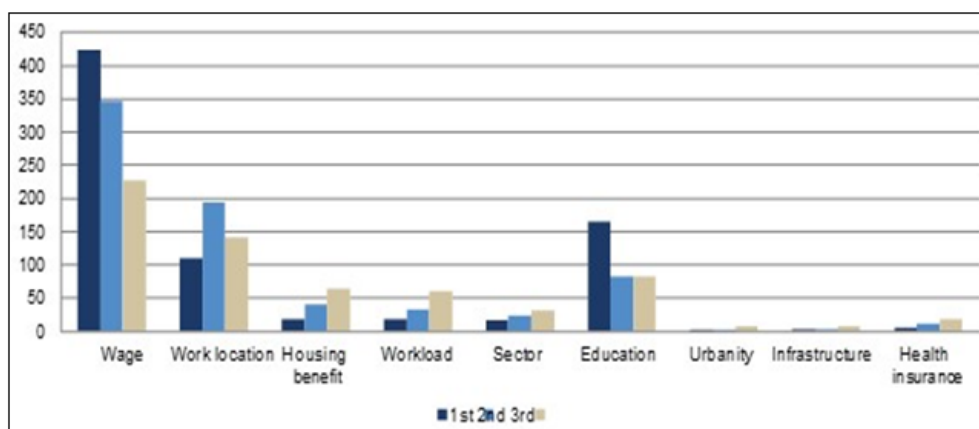


Fig-3: Important Attributes Influencing Engineering Job Choice [1]

Personal unhappiness

A primary reason people choose to study engineering is personal happiness. Studies show that the leading cause of unhappiness in USA is job satisfactions. Because of that, changing to a career that will keep you happy by providing great financial security, diversity, flexibility, prestige, intellectual development, challenges and personal satisfactions.

To work with smart people

People who enjoy working with others and travelling may become sales or field service engineers. People who enjoy life's big picture may become the systems engineers who put all the pieces together. Creative people or people who constantly have new ideas about everything may enjoy working as design engineers. People who enjoy conducting experiments or working in labs may enjoy working as test engineers. In every scenario, engineers work with other smart people to solve problems locally or at the customer's location.

To become an entrepreneur

Engineering also lends itself nicely to entrepreneurial types. In fact, more engineers are CEO's of companies than any other undergraduate degree. Usually this is because they invent something and then form a company to market sell it. Other engineers may form construction, environmental, or consulting firms because their knowledge is in high demand. Some become inventors.

Disability to lead engineering companies

Many engineer obtain higher degrees in business to become better managers and to receive a broader understanding of the inner workings of engineering companies. Many graduates work for financial companies; they may write software programs or construct financial model but fail to lead their companies. This may be due to the missing of managerial skills or due to low personal inabilities.

To fail how to think

One of the best reasons to choose engineering scheme is because an engineering education teaches how to think through a problem in order to solve it. These mental agility skills will help professional engineer to solve problems. The fascinating aspects about problem solving in engineering is that there is almost never a "right" answer. PE has to access several different approaches to solve a problem.

Top Consideration When Seeking a New Position

To reduce pollution, end world hunger,

become president of USA (three presidents were engineers), improve the environment, invent exciting technology, or solve complex problems, then engineering may be an excellent fit.

It is very important to examine the shape and identify what kind of career you really want. There are currently 2.3 million engineers, engaged in everything from design to sales, including testing, manufacturing, training and marketing. You can find engineers working in the field, behind a desk, in a production plant, at a customer site or even on an airplane. Engineer design, manufacture, build, research, write, investigate and present their findings. So, there are various aspects should be considered when seeking a new position, as:

Basic requirements

- Salary, bonuses and/or incentive
- Better work environment/culture
- Work satisfaction
- More interesting/challenging work
- Improved work/life balance
- Health benefits
- Feeling valued/appreciated

Steps for advancement

- Work experience
- Licensure as a Professional Engineer (PE)
- Advanced degree such as:
 - Master's degree in professional engineering
 - Public administration
 - Business administration
 - Doctorate degree (Ph.D.)
- Advanced credentials as appropriate
- Continued professional development

Basic Findings from Statistics

The first question put to participants was asked them about the satisfaction with engineering as a career. The trend follows a similar pattern across all age group, reinforcing the idea that most British workers are satisfied with their career choice.

The base results of the survey are very straightforward, as shown on Fig 4 & 5. And the results can be categorized as:

Satisfaction with engineer as a career

Seventy-six percent of engineer's report being at least somewhat satisfied in their current positions with 14% being extremely satisfied, as displayed in Fig-4.

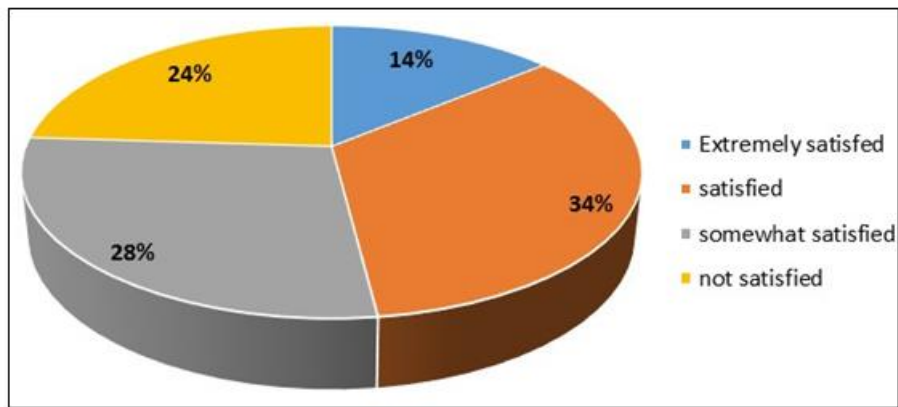


Fig-4: Survey results for the satisfactions with engineering as a career

In addition, 97% of engineering Fig-5 are likely to recommend engineering as a career, which is important because the promotion of the field of

engineering is key to building the talent needed for tomorrow's jobs.

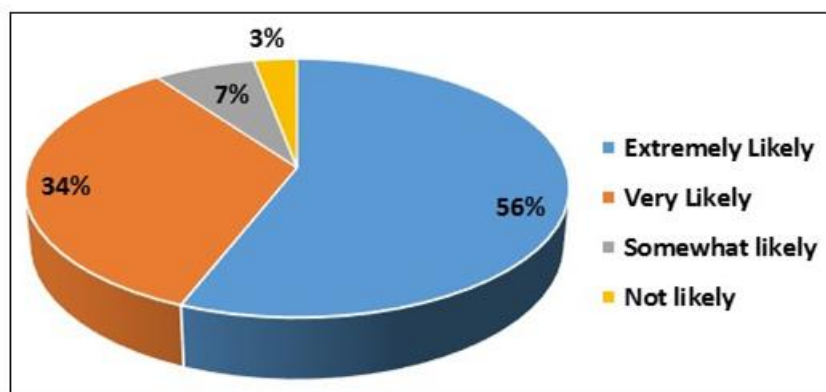


Fig-5: Probability Recommending Engineering as a career

Satisfaction with current position

The second question in the survey was whether they would like to change career. The concept of career change can be interpreted in different ways, but most people understand it as a bolder move than simply changing jobs – in most people's mind, a career change might imply working in a new area or industry where they have little or no previous experience.

From the survey results, it is clearly shown

that engineers likely to explore new engineering job opportunities, as shown in Fig-6.

Hence, today's engineer are not satisfied with their current job as 71% want to seek new position. Also, from Fig-7, it appears that, 64% of professional engineers want to change the employers. So, employers have work to do to ensure they're retaining their talent because competitor opportunities are plentiful.

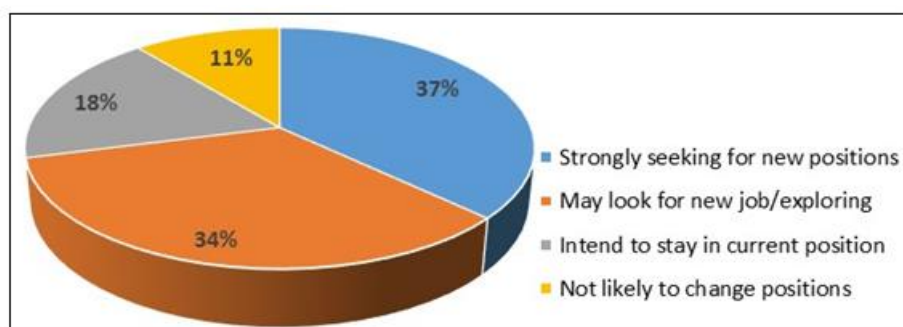


Fig-6: Survey results for the satisfactions with the current position

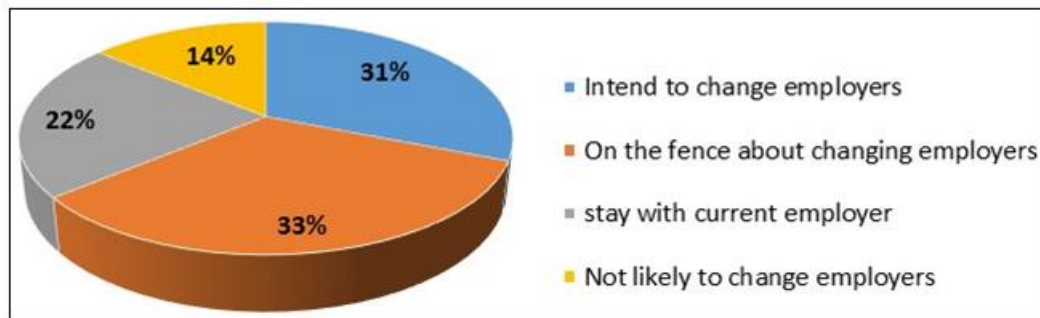


Fig-7: Survey results for the motivation of engineers to change the employers

Meanwhile, they are not fully confident that they could find a new engineering opportunity, as shown in Fig-8.

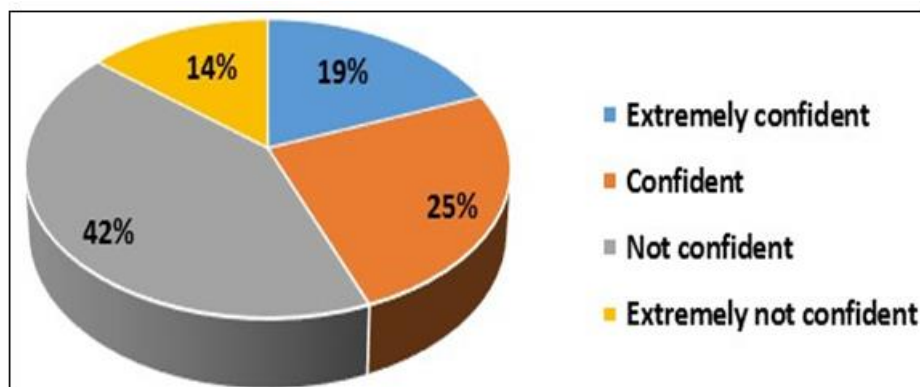


Fig-8: Survey results for confidence in finding a new engineering position

This might reflect a major generational trend as it was during the decades in which Millennials were growing up that the concepts of job satisfaction, 'do what you love' and the idea of work-life balance really took off as leading approaches to work.

Probability of remaining in engineering field for duration of career

95% of engineers intend to remain in the field of engineering for the duration of their career, as shown in Fig-9.

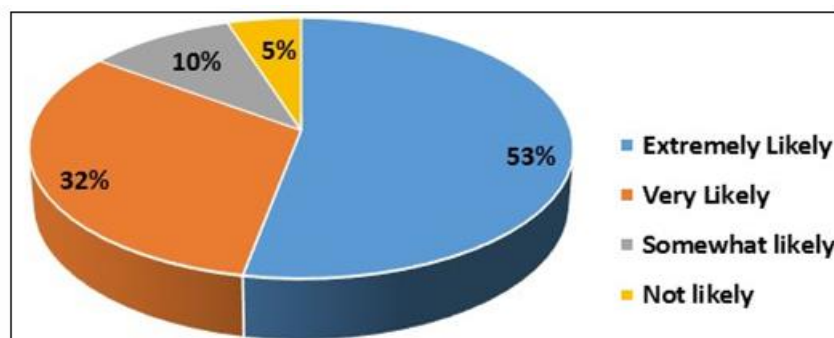


Fig-9: Probability of remaining in engineering field for longer duration

CONCLUSION

- People do not have time or need for regrets. There are many jobs today that have transferable skills that can be applied in different sectors, so engineer can understand whilst not regretting their current choice they would still like to explore something else [8].
- Professional Engineer's individual interests, skills and training will dictate the path that should be followed. Over time, he/she may modify the career

based on personal interests, values, goals, experiences and new opportunities that presents themselves,

- As highlighted in the conducted engineering survey, a large percentage -71%- of engineer are ready to jump ship.
- Employers should focus on strengthening both attraction and retention strategies for engineer,
- Professional engineer join small organizations want challenge, impact, vision and culture are

necessarily pay

- About 33% who changed jobs, changed careers entirely,
- In general, the prospect of an increased salary and better work-life balance seems to be the main drivers for people looking for a career change,
- In most people's minds, a career change might imply working in a new area or industry where they have little or no previous experience.

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