

Measuring the relationship between workplace opportunities and motivation among women in the technology industry.

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ABSTRACT

The issue of gender imbalance is one that affects almost all industries but is particularly prevalent within technology and engineering. Just 14.4% of the overall science, technology, engineering and maths (STEM) workforce in the UK are female (ONS, 2015), and with many years of government efforts having been made to increase the interest of school age girls in STEM subjects, it would be thought that the figures in the workplace would be balancing out. This does not appear to be the case, however.

This paper looks into the reasons women are still not choosing engineering and technology careers and the reasons why the women who have broken through into the industry are leaving by examining the opportunities they are offered as well as their motivation at work. The research carried out in this paper acknowledges that psychological differences between men and women mean motivators differ and observes that STEM roles tend not to cater to women's motivational needs. An example supported in this paper is the notion that women find motivation from a good work life balance and that this is generally not accommodated well within STEM roles. The online questionnaire carried out in this study draws concepts from literature to further investigate the opinions of women who are currently working in STEM roles within the UK. The survey is comprised of seventeen questions and relies upon levels of experience and levels of education to analyse. Overall, ninety-nine women took part in the survey.

Introduction

“Why don't women run the world? Maybe it's because they don't want to” (Belkin, 2003, p.45), this statement is a take on one of the many reasons for the gender imbalance that occurs in modern industries, the implication behind the statement is that something is stopping women from having the ambition to be in senior management positions, and this paper examines the possibility of a deficit of motivation for women working in engineering and technology. The technology world is one run by men; despite so many barriers falling over the years, the specific field remains lagging behind in the race to total gender equality. As the world sees progression towards the fourth industrial

revolution run by massive technological advancements being made at a rapid rate, women are needed to improve the range of perspectives in searching for the solutions to the big problems affecting people worldwide (Blickenstaff, 2005). Ada Lovelace, the world's first computer programmer and 'tech visionary' (Morais, 2013), is an example of the vitality of having women in the industry making ground-breaking contributions. The lack of women in developmental roles can have detrimental impacts on the viability of products too; for instance, early voice recognition software did not react to female voices and facial recognition technologies and are still struggling when it comes to identifying darker skinned women (Murgia, 2019). Flaws in these technologies come as a result of the designers and testers being exclusively male, and these are

very avoidable problems. In an industry that faces a significant gender imbalance, understanding the contributing factors will aid in the fight to overcome the issue, this includes investigating the barriers to entry and identifying the struggles which occur during employment.

This paper acknowledges the importance of the opportunities given to women who have broken into the industry already and the effects this has on their motivation. Existing literature on the subjects of motivation and opportunities will be used as well as primary research into the experiences of women working in the technology industry. In the UK, looking at the ratio of women to men working in science, engineering, technology and mathematics (STEM subjects) there is a large gender imbalance with women making up just 14.4% of the STEM workforce (ONS, 2015) and research from European Women in Tech (2019) shows that the turnover of women in technology companies is twice as high as the turnover of men. This implies that there are factors, specifically affecting women, either pushing or pulling them from the industry. Generally, the majority of efforts being made to improve the STEM gender ratio statistics, are focussed at school level, the age where future career decisions are beginning to form (Gov Equalities Office, 2013). The number of female undergraduate students of STEM subjects, according to STEM women (2019), has shown very marginal improvement over the last few years across the four areas and virtually no change specifically in technology and engineering. This means that women are still not pursuing careers in these industries despite the efforts being made; the research also reflects the same trend in the STEM workforce, where the amount of women entering the field is equivalent to the number of those leaving.

Many highly regarded academics have developed theories of motivation which lend specific mention to the power of opportunity and promotion and how this affects the motivation of workers. Herzberg's Two-factor theory (Herzberg, 1964), ERG theory (Alderfer, 1969) and Maslow's hierarchy of needs (Maslow, 1943) are two good examples. According to PWC (2017) only 5% of leadership positions within the technology industry in the UK are held by women, this figure could arise from the lack of opportunity for progression for women and subsequently affect the motivation of the women working in less senior positions. When soon to be graduates were asked what is important to them when applying for and taking jobs they responded with the development and training opportunities. The popular consensus is that the lower paid entry positions are a gateway into progression, and this is

the only reason individuals were seeking these roles (Maxwell & Broadbridge, 2017). With this information it can be proposed that individuals, both men and women, are seeking positions where they will progress to higher levels and where men see this happening for other men in technology the entry level roles are more sought after whereas women may see it as a role in which they are unlikely to progress and therefore avoid these positions.

The purpose of this article is to further examine sections of the wider picture surrounding the issues of gender imbalance in the technology and engineering sectors. Analysing what factors are stimulating the worsening of the imbalance, specifically the opportunities affecting motivation tying themes from work life balance and motivational goals to the glass ceiling and the leaky pipeline theories. The strategy of microenvironments is a recent concept created to engage and motivate female minorities (Dasgupta et al., 2015), within this paper the effectiveness of microenvironments is explored along with the basis on which this strategy was created in the context of STEM roles, in order to justify its use as a solution to gender imbalances in these industries.

Literature review

The Leaky Pipeline

The leaky pipeline is a phenomenon that occurs in this context where the technology and engineering sector are seeing capable female professionals leaving their jobs at an unnatural rate and disproportionate to the loss of men in the same roles (Cabrera, 2009). Women are less likely to have a linear career path than men meaning women have more career interruptions and changes (Baruch, 2007). In a study by Mainiero and Sullivan (2006) the trend of women leading a more disjointed career path is reiterated and poses a suggestion that, in some cases, this could be due to women's need for change. Literature relating to the leaky pipeline metaphor usually agrees upon several main psychological factors that stimulate the effects of the leaky pipeline. A suggested motivator for women is favouring interpersonal working cultures and STEM roles and industries stereotypically not fitting into this expectation. Another factor is based on societal roles that put women as the primary parent - it has been engrained into women that they must be in a role with decent flexible working potentials, and in some cases this expected family

dynamic is enough to persuade women to leave their careers because it is thought the STEM industry will not be able to accommodate these conditions (Jones, 2018).

Work Life Balance

Work life balance is a commonly cited theme in literature on the leaky pipeline, with the need for flexibility from the organisation being the suggested solution. The idea of the primary parent being the mother often leads women to seek flexible jobs for childcare reasons (STEM Women, 2020). That being said women tend to rank flexibility in work at a higher importance than men even when children are taken out of the equation (Williams & Multhaup, 2018) which suggests there is some psychological difference between men and women. We should therefore expect this to occur in all industries, so why is the leaky pipeline so prominent in engineering and technology? Flexible and part time job roles are often difficult to accommodate in STEM organisations, especially in more senior positions, which can be a big obstacle to overcome from the point of view of ambitious women as well as the businesses who are actively trying to create an inclusive and diverse organisational culture (Lewis & Humbert, 2010). Many of the women who are seen to be leaving the tech industry are leaving to become entrepreneurs (Cabrera, 2007) where they are less restricted and are able to work to their own timetable. Often women are seeking more than just flexible working conditions - there are other factors such as supportive environments and the ability to make decisions on their own terms, which is why they turn to entrepreneurship (Cabrera, 2007). A study by Joseph (2016) supports Cabrera's research and poses the argument that, while work life balance is a factor in considering career paths, it is less likely to push out women with already established careers on its own, but when met with ineffective supervisory relationships and additional environmental challenges it is enough to demotivate women in these larger organisations and encourage the shift into entrepreneurship. While from the point of view of successful female entrepreneurs this is a positive shift, on the other hand, the organisations are losing out on capable and talented employees that they have likely invested money and resources into training and in some cases will lose client relationships and stability in team dynamics (Baruch, 2007).

The Vanish Box

The vanish box concept is somewhat of an extension of the leaky pipeline, insofar as the latter sees capable women leaving their positions in STEM

and the former follows this pathway and leads on to the proposal that these women are leaving roles where they do not feel as though their capabilities are fully utilised, and into other roles and industries that meet their requirements and use their full potential (Etzkowitz & Ranga, 2011). In support of this proposal, a study led by Indeed (2018) found that 28% of women in tech left their last job in the industry because of the lack of career growth and another popular response to the question was slow salary growth. The two reasons shown in the study support the notion that these factors are affecting women's motivation and desire to work in the field of technology altogether. There is research to suggest that, when looking specifically at the experience of women in STEM, up to 52% of women who are highly trained and qualified in their positions may leave their jobs at a critical 'fight or flight' moment in their career (Hewlett et al., 2008). These 52% of women can be potentially looked at as the same women who are leaving STEM due to a lack of opportunities for progress or salary growth, these opportunities may be around the corner, but they are favouring 'flight' over 'fight'.

The significance of the vanish box is that it encourages and strengthens other issues and barriers that affect women in STEM. The specific mention of women leaving at the fight or flight moment suggests that these individuals were close to the opportunities they were looking for, for some this means progression opportunities for higher positions, with women entering the vanish box before they reach this point, the proportion of women at a senior level drops which, as often mentioned in literature, leads to less women joining, staying in and trying to progress in that organisation (Anderson & Bloksgaard, 2008).

Communal Goals

Those with a high communal orientation "care for the welfare of others based on others' needs and desire similar care for themselves" (Le et al., 2013, p.1). Women tend to have a high communal orientation and seek to achieve communal goals, and this is reflected in their career choices (Boucher et al., 2017). So much of new breakthrough technology is being designed for the purpose of improving lives and achieving communal goals - for example, a 12-year-old girl, Sofia Tomov, programmed an algorithm to prevent doctors and patients having adverse reactions to medication (Carley, 2017). Despite there being so many major contributions to communal goals in the technology and engineering field, there is still the perception that STEM subjects don't fit in with the altruistic personalities that many women have (Boucher., et

al, 2017) and research shows this is a contributing factor as to why women are not actively seeking careers in the sector.

‘People Engagement’ Vs ‘Thing Engagement’

It has been suggested that women have a tendency to engage more with people rather than things. This transcends through low to high status jobs ranging from nurses and teachers to doctors and lawyers (Lippa et al., 2014). It can be said that STEM subjects do not accommodate the communal values that women tend to carry, and that in general many of the roles do not have the opportunity for individuals to exercise their need for interpersonal connections (Brown et al., 2015). Despite the aforementioned point of STEM subjects often working towards communal goals, there is a strong argument to be made that roles within STEM subjects involve less engagement with people and are more ‘thing’ focused and that insofar as this can be seen as a common perception (Diekman et al., 2017), could provide some explanation as to why women aren’t choosing these careers. There is evidence showing that within the STEM fields there are professions that don’t struggle with female underrepresentation, which suggests that women are not blindly following perceptions of STEM overall, but are actively seeking those people-based roles within STEM. Social sciences and areas of biology are among the roles share the same link to communal goals that are reflected in other areas of STEM and observe far less severe gender imbalance, albeit not total equality. These areas have the people engagement factor that the other areas are deficient in (Ceci et al., 2015). This supports the notion that women are looking for people based communal work rather than the proposed basic idea of communal work.

The Lone Genius Phenomenon

The idea that interpersonal relationships are hard to come by in the STEM fields, with science and engineering being the most connected to this idea, is potentially rooted in the ‘lone scientist’ or ‘lone genius’ phenomenon which is the stereotype that a professional engineer or scientist works on their own in a lab and lacks interpersonal connections (Satell, 2016). This outdated point of view brings problems to the industry, with the clouded opinion of the roles acting as a deterrent for potential new and valuable entrants to the workforce (Hart, 2016). A point to be noted is that variance in geographical location has also been said to also be a factor in the perception of the connotations between STEM subjects and the lack of interpersonal connections -

the stereotype and ‘lone genius’ philosophy only really exists in the western world. Asian cultures generally perceive STEM subjects to either enforce the communal opportunistic nature that does exist in the industry or have a more neutral view (Brown et al., 2018). In the past, the East was less developed and their laggard timing to the entry of the industry has meant their viewpoint is more modern and actual (Brown et al., 2018). In cultures where the lone genius stigma exists, an individual with a high communal motivation orientation will have a low motivation for STEM, and because women tend to carry the need for interpersonal connections more than men in general, they are susceptible to missing out on roles when they give in to the stereotype of the lone genius.

Self-fulfilment

Self-fulfilment is a key factor for some individuals in feeling motivated at work, and can increase productivity and employee retention. Therefore, it is important for organisations to be aware of actions that will positively impact upon the extent to which self-fulfilment capabilities are fostered in its workforce (Joshi, 2012). Workplace opportunities are a factor that can affect an individual’s sense of self-fulfilment and which may in turn contribute to their motivation and likelihood to stay within their workplace role (Ruiz-palomino et al., 2013). Gwirth (1998) claims that the two factors dictate an individual’s sense of self-fulfilment are their aspirations and perceived capabilities, and when these factors are satisfied in an individual’s situation, they feel fulfilled. Aspirations and capabilities will vary from person to person, but it can be argued that there are distinct trends between the self-fulfilment aims of women and men. Is there something missing from roles in engineering and technology that means women aren’t able to reach self-fulfilment?

Home Life Self-fulfilment

For some individuals, home life fulfilment transcends into work life motivation (Elliot et al., 2000). A typical individual will achieve fulfilment from a mixture of home and work life measures but this, of course, varies between individuals (Henry & Henry, 2006). Women are often seeking the highest level of flexibility which is often in lower paid jobs or through entrepreneurship - the implication here is that women are better fulfilled by optimised time for home life rather than the higher paid jobs

(Belkin, 2003). A study by Ruiz-palomino, Sáez-martínez and Martínez-cañas (2013) supports the argument that it is common for women to not feel fulfilment from a high salary or a distinguished title and that moral fulfilment is a better motivator. Moral fulfilment can also be linked to pay satisfaction - when an individual reaches moral fulfilment they are more likely to be satisfied with a lower pay.

It is difficult to define self-fulfilment as it can mean different things to different people; for a person who is object oriented, they can feel fulfilled by tangible assets - for those who resonate at the object-oriented end of the spectrum, their fulfilment is based more on transient desires rather than fixed goals in relation to the aspiration half of self-fulfilment (Belk et al., 2003)

Using an analogy by Henry (2006), self-fulfilment can be looked at as the structure of an onion, the inner core layers being the fundamental aspirations of an individual, the core aspirations are centered in the individual and won't change, the outer layers being the transient desires, which is more frequently the tangible wants and goals; the implication of the onion is that self-fulfilment comes as a mixture of these desires and by this idea it becomes difficult to track one's own *actual* self-fulfilment. Gwirth (1998) proposed the two factors of (realistic) aspirations and perceived capabilities so that anyone has the potential to experience self-fulfilment. When applying the concepts to the context of women in technology with the aim of increasing motivation in employees from a management standpoint, it should be considered that self-fulfilment can come from home life - making adjustments such as incorporating flexible working may be a way to improve motivation from this perspective.

The Glass Ceiling

The glass ceiling can be defined as "those artificial barriers based on attitudinal or organizational bias that prevent qualified individuals from advancing upward in their organization into management level positions" (Cabeza et al., 2007, p.1). Just 9.8% of STEM managers in the UK in 2015 were female (IET, 2015) and a variety of factors have been highlighted as collectively causing the phenomenon including workplace bias, influence of societal norms, cultural influence and psychological differences between men and women.

Organisations are introducing measures to further engage women to attract potential applicants as well and retain the female employees they already have. The lack of female managers, is thought to partially come from the high numbers of potential female managers leaving the organisation before they reach the top levels. Therefore, working to improve retention throughout every level of the hierarchy of an organisation is part of the solution to eradicating the glass ceiling (Woods, 2012). The use of microenvironments is a method where large teams are strategically split into smaller groups where the female population of the group is higher. A study using microenvironments within a university found that the groups with higher female populations saw reduced levels of anxiety in the female students, particularly in the less experienced participants (Dasgupta et al., 2015). The focus of microenvironments is to create a supportive network where women feel comfortable to push their ideas from a performance based perspective, but also to feel comfortable and happy at work which in turn increases their motivation. Reportedly, when this is paired with the emotional support they achieve from the microenvironments this can fundamentally change an individual's, otherwise negative, view of her working environment (Fernando et al., 2018). The use of microenvironments in organisations can have long lasting effects on the behaviours of women - in a STEM organisation with a male dominated top management team, the culture of the whole organisation can be affected in a way that makes female employees feel excluded and perpetuates feelings of incompetence (LSE, 2018). Introducing microenvironments can alter the culture and the negative feelings that women experience that stem from the top, therefore building women's confidence and management aspirations (LSE, 2018).

The glass ceiling is a complex concept that has many factors that come together to create the issue; additional factors can be seen when the glass ceiling is put in the context of STEM as opposed to other industries, which make it even more difficult to tackle. When looking from a motivational perspective at the glass ceiling, a reason that it can still be seen in modern organisations is that motivation derived from the pursuit of power is more prominent in men than in women (Schuh et al., 2014). This is not a blanket statement to be made about all women, but it does provide an explanation as to the lower supply of women in the talent pool of potential managers.

Summary

The leaky pipeline is said to be a more modern and realistic adaptation of the glass ceiling concept (Cabrera, 2009) and focuses on the retention of female employees while drawing attention to why capable women leave at a disproportionate rate to men. Two of the concepts being held partially accountable is the lack of work life balance available in such roles, alongside the vanish box concept (fulfilment derived from aspirational and capability needs being met), which both see women seeking work elsewhere. Work life balance affects motivation as fulfilment can come from home life. Gewirth (1998) claimed the two factors that build an individual's fulfilment are their aspirations and perceived capabilities.

The damaging stereotype of STEM careers is diminishing the public opinion of the whole industry, particularly from the perspective of young women yet to choose their career paths. Working towards communal goals is said to be a powerful motivator for women and the perception that this cannot be achieved in STEM careers is reinforcing the leaky pipeline effect by discouraging women to take on higher education and careers in STEM. The leaky pipeline is resulting in a reduced talent pool of prospective female managers and, given the lack of women already in senior roles, the likelihood of more women having the aspiration of the same goal is deteriorating.

Methodology

The quantitative approach taken in this report is based on scientific modelling which focuses on collecting data to test an existing theory (Neuman, 2013) To do this, the data needs to be measurable and so is drawn in the form of numerical and statistical findings to form conclusions (Greetham, 2014). This study measures the opinions of people and there is the opportunity for more data to be collected using a quantitative method rather than a qualitative method such as interviews (Greetham, 2014).

Conducting an online survey comes with benefits that make it the most appropriate method for this survey. Being able to send the survey via email is important as it can quickly reach a high quantity of participants. Moreover, participants are more likely to take part due to the ease of completion from their perspective (Feather, 2015). Given the nature of this research, it is important for participants to be

confident in knowing their responses are confidential - as there is no face-to-face contact with online forms, and they do not give names, participants can be confident in knowing they cannot be identified (Feather, 2015).

For the purposes of this article, four of the questions have been removed from the discussion as results were inconclusive and unreliable based on analysis. For a full table of questions and relevance to the literature, see Appendix 1.

The original survey was comprised of seventeen questions in total; twelve of the questions derived from the literature review, four being the demographical questions and the remaining question "what company do you work for?" is asked to ensure that there is not a disproportionate number of participants from only one organisation which could distort results. The main twelve questions, based on research from the literature review, were specifically chosen to combine the distinctly separate themes of motivation and opportunities. It was important for the participants to be in STEM roles in order to identify authentic experiences and produce realistic recommendations for solutions to the issues mentioned in the literature. The survey was structured using the 5 point Likert scale, questions were written as statements and participants were asked to give their opinions on a scale of strongly disagree to strongly agree, including neutral as to not pressure participants into choosing a side that doesn't accurately represent their opinion. The questions were randomized so that questions were not grouped by theme in order to eliminate any potential bias from selection by pattern (Feather, 2015).

Ethical consideration

This study has approval from The University of Huddersfield Business School Research Ethics Committee. The distribution email contained an ethics sheet, informed consent sheet and information sheet as to ensure participants understood the nature and purpose of the research. The survey is anonymous, and there are no questions that would make participants identifiable. Participants were able to withdraw from the study at any point before submitting their response without giving reason and in addition, there was no obligation to take part in the study if they did not wish.

Reliability

To determine the internal consistency and reliability of the survey, a reliability test was carried out using Cronbach’s Alpha. The test produced a score of .636 which, when a score is between .6 and .7, is deemed ‘acceptable’ (Ursachi et al., 2015). Although ‘acceptable’ isn’t an ideal score this comes down to a number of considerations, most notably the survey having a low number of questions. However, the questions used in this survey were chosen with purpose and the survey was intentionally kept brief to keep participants’ interest.

(Figure 1: Reliability model)

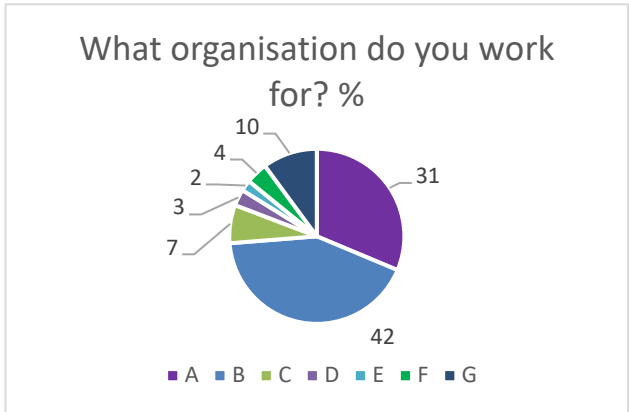
Reliability Statistics

Cronbach's Alpha	N of Items
.636	12

The Demographic

As previously mentioned, it was important to achieve some degree of variation in the experiences of the participants. As the distribution technique was to ask participants to forward the survey on to their colleagues, there was a risk of receiving a disproportionate amount of responses from women from a single organisation. The below chart shows the percentage of responses from each organisation, seven organisations in total across ninety-nine responses. Company names have been coded A-G for anonymity. The chart shows two dominant organisations and this is most likely due to their relative size. Despite this, there should still be a good breadth of experiences from all organisations.

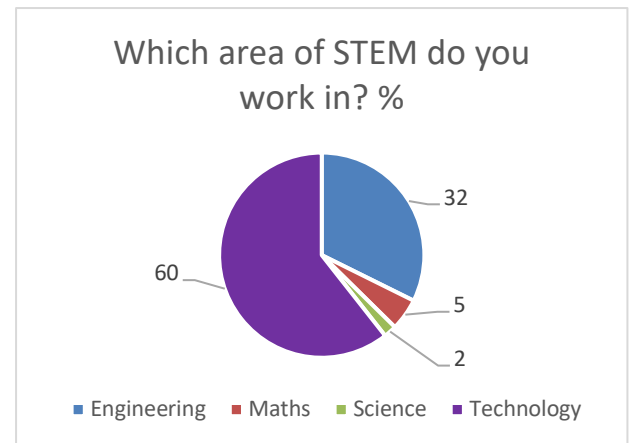
(Figure 2: a pie chart to show the number of respondents from a number of organisations)



Which area of STEM do you work in?

Some research used in the literature review was inclusive of all STEM fields and although this research is predominantly focused on technology and engineering, the maths and science fields should be acknowledged. As projected on the chart below, only a small fragmentation of the total respondents were from science and maths (7% total), the majority are from technology (60%) and a decent proportion from engineering (32%).

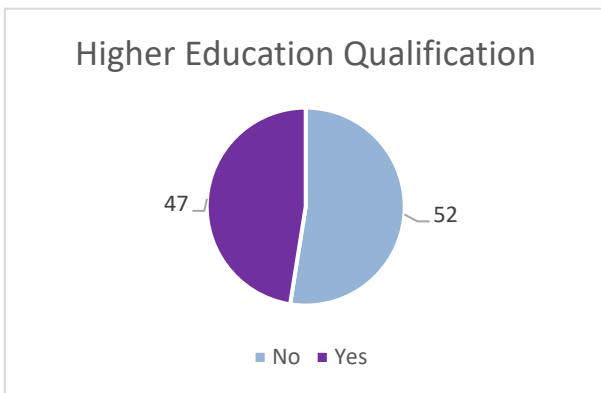
(Figure 3: a pie chart to show the proportion of respondents in relation to the areas of STEM)



Do you have a higher education qualification in a STEM subject?

Out of 99 responses there was an almost even split between how many do and don't have some kind of higher education with 47 with a qualification and 52 without. Varley (2019) reported that many women were stumbling into their roles in technology fields without intentionally seeking work in these industries, and in cases where women are undertaking higher education courses such as degrees and apprenticeships, it is reasonable to assume that the intention behind this is to gain employment based on the qualification.

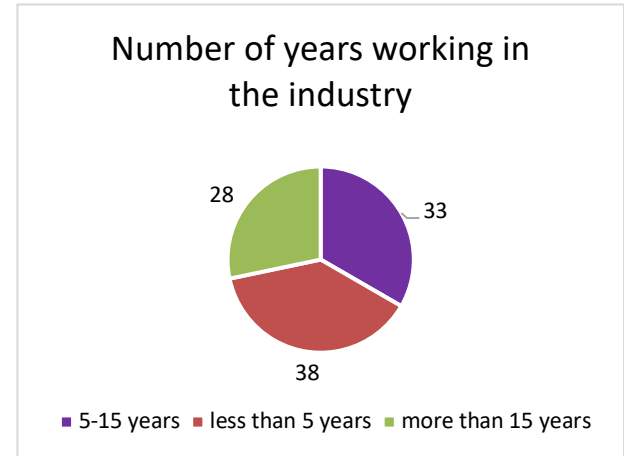
(Figure 4: pie chart to show the number of respondents with higher education qualifications in a STEM subject)



Number of years working in the industry

The question posed here was "how many years of experience do you have working in your role or similar?" and respondents were given three options to choose from. 28 respondents have been in the industry more than 15 years, 33 between 5-15 and 38 less than 5 years. The lowest represented category here is the 15 years plus, which could be argued to support the themes presented in the literature related to the leaky pipeline, that see women leaving the industry to pursue other routes. The highest proportion is the less than five years category, with 5-15 years in the middle, this correlates with the leaky pipeline literature which shows women progressively leaving at intervals during their career (Cabrera, 2009).

(Figure 5: A pie chart to show number of years working in the industry)



Are you full time or part time?

Out of 99 responses to the survey 100% of participants work full time - a low response to this survey was expected from part time employees, however not to this extreme. Literature suggests that women are more likely to want and need flexible working conditions and it has been cited that part of the solution to the leaky pipeline is to provide these opportunities (Williams & Multhaup, 2018), given this, it is disappointing to report no cases where this has happened in this research. There are a number of reasons why this result can be seen.

- Despite literature stating that implementing flexible working can help with the recruitment and retention of female employees in STEM (Williams & Multhaup, 2018 and Baruch, 2007), organisations may not be implementing these strategies.
- Due to stereotyping of the industry there may be a lack of women looking for these flexible part time roles in STEM because of the misconception that they don't exist.
- It may be that these roles are uncommon in these organisations and the scope of this research may have been too small.

Q2 I would consider leaving a job if progression opportunities were hard to come by.

A pattern was found in the experience level the participants had in their role and their level of

agreeableness with the above statement. The pattern is reflected in the regression analysis carried out on this data which highlights experience as the only variable factor that could be a predictor and which presented an R Squared value of .428 (figure 6). As seen in figure 7 the average response of the group with less than five years of experience was between agree and strongly agree, which suggests that progression opportunities are a big motivator for women just starting in their career as opposed to the other two groups (5-10 years and more than 15 years) whose average response was similar, between neutral and disagree. Research by Etzkowitz and Ranga (2011) on the vanish box suggests that women are likely to leave their jobs due to lack of progression opportunities and according to this study that is prominent in women starting their careers and less so further down the line.

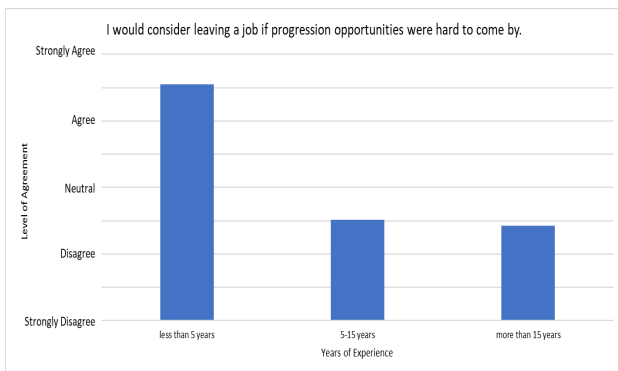
(Figure 6: regression analysis model summary for question 2)

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.654 ^a	.428	.422	1.052	1.136

- a. Predictors: (Constant), How many years of experience do have working in your current role or similar?
- b. Dependent Variable: I would consider leaving a job if progression opportunities were hard to come by.

(figure 7: a graph to show the agreement with the statement “I would consider leaving a job if progression opportunities were hard to come by” (experience)



Q5 I achieve self-fulfilment more through home life rather than work

The regression analysis presented a fairly low R Squared figure of .289 (figure 8) for this question however, when looking at the average response from an individual without a qualification it appears this group generally agree with the statement whereas those with a qualification are more neutral on the subject and even swaying towards disagreement (figure 9). Henry and Henry (2006) proposed the idea that some individuals are dependant on a mixture of home and work life to determine their self-fulfilment goals, more neutral responses to this statement could be in support of this idea. Another explanation for the heavily neutral responses could be that people aren't consciously aware of what causes them to feel fulfilled - if participants were encouraged to think about this before taking part in the study, this result may have come out differently.

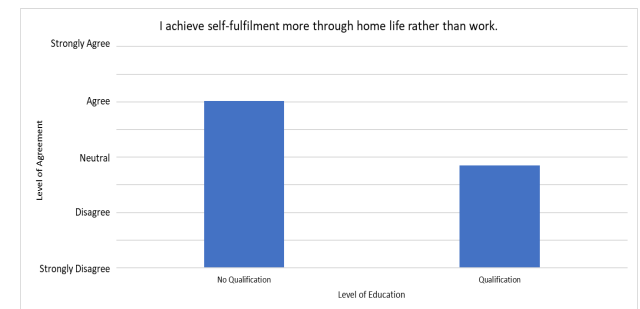
(Figure 8: regression analysis model summary for question 5)

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.537 ^a	.289	.282	.925	2.144

- a. Predictors: (Constant), Do you have a degree or qualification above A-level in a STEM subject?
- b. Dependent Variable: I achieve self-fulfilment more through home life rather than work

Figure 9: a graph to show average agreement with the statement “I achieve self-fulfilment more through home life rather than work” (education)



Q7 I am motivated by power, for example running a project or team.

A regression analysis was run on the results and produced a low R Squared value of .064 (figure 10) and respondents on average disagree with the statement given. This data supports the notion that women may not be looking for the top positions

because this is simply not a motivator in a lot of cases (Schuh et al., 2014).

(Figure 10: regression analysis model summary for question 7)

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.254 ^a	.064	.055	.978	1.521

a. Predictors: (Constant), Do you have a degree or qualification above A-level in a STEM subject?

b. Dependent Variable: I am motivated by power, for example running a project or team.

Q8 I have left a job, or would consider it, because I wanted a change or for home life reasons.

A regression analysis on the results for this question produced an R Squared figure of .123 suggesting that there was little in terms of correlation between the responses to the statement and the earlier demographic questions (figure 11). The response average of the collective of all responses was around neutral. However, when looking into the average response when split into those with a higher education qualification and those without, there was some difference (figure 12). Those without a qualification are, on average, more likely to agree that they would consider leaving their job for home life reasons or for a change whereas those with a qualification lean more towards disagreeing with the statement. One of the themes cited in leaky pipeline literature is that women are often leaving for the reasons mentioned (Mainiero & Sullivan, 2006 and Baruch, 2007), the neutral results from this study don't support these themes but also don't explicitly disprove them either.

(Figure 11: regression analysis model summary for question 8)

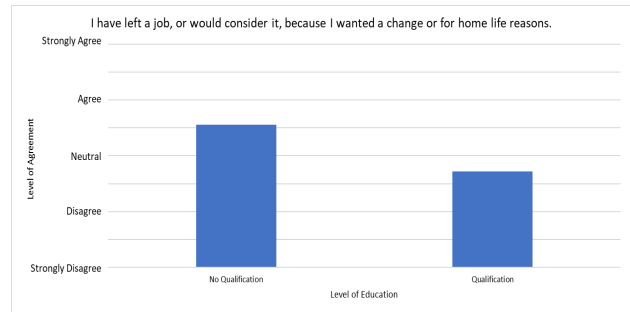
Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.351 ^a	.123	.114	1.123	.786

a. Predictors: (Constant), Do you have a degree or qualification above A-level in a STEM subject?

b. Dependent Variable: I have left a job, or would consider it, because I wanted a change or for home life reasons.

Figure 12: a graph to show average agreement with the statement “I have left a job, or would consider it, because I wanted a change or for home life reasons.” (education)



Q9 I would consider leaving my job if I felt like my full capabilities were not being utilised.

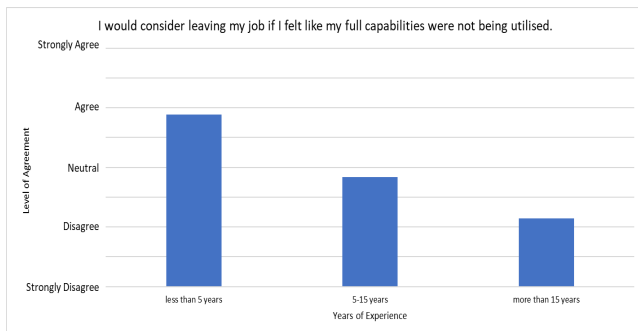
A regression analysis was run on the results to this question, returning an R Squared figure of .395 which supported the question to have presented useful results (figure 13). There was a small correlation with the results from the perspective of those with a higher education qualification, however the most significant results were in the level of experience. Those with less than five years' experience working in their role on average agree that they would consider leaving their job if their capabilities were not being utilised, the group with 5-15 years experienced on average gave a neutral level of agreement and those who had 15 plus years disagreed with the statement (figure 14). These results support literature that claim that many of the women who are seen to leave the industry are doing so as they feel as though they are not being used to their full potential (Etzkowitz & Ranga, 2011).

(Figure 13: regression analysis model summary for question 9)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.581 ^a	.337	.331	1.015	
2	.607 ^b	.368	.355	.996	
3	.628 ^c	.395	.376	.980	1.514

- a. Predictors: (Constant), How many years of experience do have working in your current role or similar?
- b. Predictors: (Constant), How many years of experience do have working in your current role or similar?, Do you have a degree or qualification above A-level in a STEM subject?
- c. Predictors: (Constant), How many years of experience do have working in your current role or similar?, Do you have a degree or qualification above A-level in a STEM subject?, Which area of STEM do you work in?
- d. Dependent Variable: I would consider leaving my job if I felt like my full capabilities were not being utilised.

Figure 14: a graph to show average agreement with the statement “I would consider leaving my job if I felt like my full capabilities were not being utilised.” (experience)



Q10 I feel more motivated when I am working towards communal goals

The statement given to participants here was “I feel more motivated when I am working towards communal goals” to which 85% of respondents stated they either agreed or strongly agreed with the statement given (figure 17). The results were run through a regression analysis which returned an R Squared value of .031 as there was only minimal variation between responses given for this statement (figure 16). Despite the analysis deeming the question unsuccessful, it does prove that the majority of women are seeing communal goals as a motivator within STEM. With the common misconception that STEM fields are not direct contributors to communal goals (Boucher et al., 2017), there could be a collection of women avoiding the industry as they do not believe it will fit their motivational needs.

(Figure 16: regression analysis model summary for question 10)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.175 ^a	.031	.000	.624	1.230

- a. Predictors: (Constant), How many years of experience do have working in your current role or similar?, Which area of STEM do you work in?, Do you have a degree or qualification above A-level in a STEM subject?
- b. Dependent Variable: I feel more motivated when I am working towards communal goals.

Figure 17: a graph to show volume of agreement with the statement “I feel more motivated when I am working towards communal goals.”



Q11 I know what will help me achieve self-fulfilment in work and this motivates me

The vast majority of participants disagreed with the statement above however there was an even level of response for every point on the scale (figure 18). A regression analysis was carried out on the data and returned a very low score of .007 meaning there were no trends seen between the level of agreement and the demographic questions at the beginning (figure 19). The majority of participants disagreed with the statement, meaning they in fact do not know what helps them to be fulfilled at work and this supports the literature that states many individuals find it difficult to track their fulfilment, and therefore are not consciously motivated by it as they have no specific long term goals to be working towards (Henry, 2006).

Figure 18: a graph to show volume of agreement with the statement “I know what will help me achieve self-fulfilment in work and this motivates me.”



(Figure 19: regression analysis model summary for question 11)

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.086 ^a	.007	-.024	1.026	.909

a. Predictors: (Constant), How many years of experience do have working in your current role or similar?, Which area of STEM do you work in?, Do you have a degree or qualification above A-level in a STEM subject?

b. Dependent Variable: I know what will help me achieve self-fulfilment in work and this motivates me

Q12 I am likely to contribute more in a team with equal amounts or more female members than male.

A review of the data shows no correlation between the opinions of those with a higher education qualification in STEM and those without. However, there is a strong correlation when looking at opinions across varying levels of experience. A regression analysis was carried out and resulted in an R Squared value of .395 supporting the success of this question (figure 20). Figure 21 shows that those with less experience are much more likely to agree with the statement meaning they are more likely to contribute in a team with equal or more female members than male, this was the opposite result for those participants with more than 15 years of experience. Literature suggests that embracing the use of microenvironments helps to support women entering the workforce by encouraging and motivating them in environments with a high male population This statement is supported by the response given to this question.

(Figure 20: regression analysis model summary for question 12)

Model Summary^d

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.581 ^a	.337	.331	1.015	
2	.607 ^b	.368	.355	.996	
3	.628 ^c	.395	.376	.980	1.514

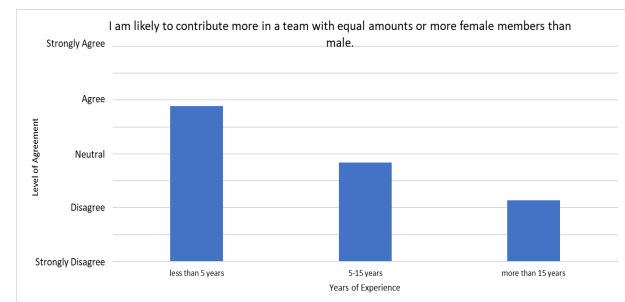
a. Predictors: (Constant), How many years of experience do have working in your current role or similar?

b. Predictors: (Constant), How many years of experience do have working in your current role or similar?, Do you have a degree or qualification above A-level in a STEM subject?

c. Predictors: (Constant), How many years of experience do have working in your current role or similar?, Do you have a degree or qualification above A-level in a STEM subject?, Which area of STEM do you work in?

d. Dependent Variable: I am likely to contribute more in a team with equal amounts or more female members than male.

Figure 21: a graph to show average agreement with the statement “I am likely to contribute more in a team with equal amounts or more female members than male.” (experience)



Discussion

Based on the regression analysis carried out on all of the questions only three of the twelve questions have an R Squared value of .3 and above meaning these three can be deemed ‘successful’ questions from the perspective of the regression analysis. Despite the return of only three positive results there can be impactful conclusions drawn from ‘unsuccessful’ questions and the negative analysis results indicate that there can be improvements made for further research.

Looking at the theme of communal goals and particularly the stereotype attached to the STEM industry, it would be expected that the respondents to this survey, who have broken into the industry, would not rate communal goals at high importance when considering career decisions. The results to the question somewhat reflect this hypothesis but with a fairly neutral average response the results do not explicitly do so. However, based on results from the questionnaire it would appear that working

towards communal goals is a strong motivator for these women, which supports the literature (Le et al., 2013). There is also a mixture of opinions, however, on whether the STEM industry is associated with communal goals. The literature cited previously would suggest that women tend to follow the trend of thinking STEM industries are not related to communal goals (Boucher, et al, 2017) and because they deem working towards communal goals to be a strong motivator it is questionable as to why they stated in the survey that, on average, they do not consider communal goals when making career lead decisions. From this the conclusion to be drawn is that, although communal goals can affect motivation of women working in STEM, it is not the most powerful motivator.

Using ideas from Henry (2006), it is understood that self-fulfilment is a difficult concept to track in a personal sense, the primary research carried out supports this as the majority of women in this study claimed they do not know what affects their self-fulfilment and therefore are not motivated by it. Etzkowitz and Ranga (2011) claim a contributor to the progressive loss of women in the STEM industries is that they feel fulfilled when their capabilities are being utilised and in the absence of this, they lose motivation and seek it elsewhere. It is unclear as to why women feel more that their capabilities are not being used as much as men or that this is a factor more harmful to motivation in women. From this research it is clear that women who are new to the industry agree that the feeling of using their full capabilities affects their fulfilment so strongly they would consider leaving their job, thus contributing to the 'vanish box' affect and leaky pipeline. It is unclear from the literature why it is the lesser experienced participants who feel more strongly about this as the other categories had more of a neutral stance. It can be suggested that home life fulfilment should be considered when assessing work life motivation from the self-fulfilment perspective (Elliot et al., 2000) and this opinion is reflected specifically in the responses from the participants who do not have a qualification in a STEM subject. Varley (2019) states that many women in STEM stumble into their roles, and it is fair to assume these are the ones without qualifications in the subject and may be a reason why this group of participants responded that they feel fulfilled more so from home life than work.

Workplace opportunities, or in this case the lack thereof, is an element named as being attributable to the leaky pipeline. Indeed (2018) conducted a study which found that a high volume of women leave their jobs in technology because the

progression opportunities were scarce - the primary research carried out in this study shows that on average participants with less than five years' experience strongly agree that they would consider leaving their jobs if progression opportunities were hard to come by whereas those with more than five years' experience were less likely to agree. Another proposal made is that the leaky pipeline is occurring as women leave their jobs to create change in their lives as well as for family reasons, more so than men. This proposal is supported in this study primarily by women who do not have a qualification in STEM, and this can potentially be linked to the theme aforementioned regarding the less qualified women are the ones Varley (2019) referred to as 'stumbling' into roles in tech. As expected, the study reflected a high response rate to a supportive organisational culture being important, reinforcing the need for this to be a priority for organisations.

While we can see that the STEM workforce exhibits a huge gender imbalance in general, this is even more amplified at management level with just 9.8% of STEM managers in the UK being female (IET, 2015). A reason presented in literature, and backed up by this research, is the psychological difference between men and women in that women are not motivated by power, and therefore do not have the urge to become management. Having little female representation in senior positions has follow on consequences further down the hierarchy however, and 92% of participants in this study deemed it important to have a diverse team at the top of the organisation as this affects the overall culture (LSE, 2018). A proposed solution to help women in organisations to develop their confidence is microenvironments - in this study participants with less than five years working experience agreed that they feel more comfortable working in teams with more or equal amounts of women to men - this would support the use of microenvironments as a method to retain employees. On the other hand, women with more than five years' experience disagreed with the statement meaning this could actually create negative impacts in the cases of more experienced women.

Conclusion

In conclusion, this article aims to provide an exploration into the opportunities women in the technology and engineering sector are receiving and the effect this has on their motivation. A number of influences and concepts have been discussed, including the factors contributing to gender imbalance in the industry coming from the lack of opportunities as well and the opportunities

being offered to women to form a solution to the same problem of gender imbalance.

This study has used previous research and literature to highlight factors of motivation that are more prominent in women than men, psychological factors as well as those factors created by the working environment have been discussed. The use of microenvironments is a new concept that creates artificial mini cultures within the larger organisation with the aim of making women feel more included, as literature states the feeling of not belonging can be a self-inflicted product of adhering to harmful stereotypes (Miyake et al., 2010), this study provides data to support the use of microenvironments particularly in aid of women in their early careers.

This paper has addressed key themes connected to gender imbalance in STEM, including both the glass ceiling and leaky pipeline models. Looking deeper into the contributors that combine to create these issues we can see links to the opportunities and motivation of women in the workforce. Societal norms and industry stereotypes are a demotivator for, when looking through the lens of leaky pipeline model, girls/women who are more susceptible to harmful stereotypes than boys/men (Lang, 2010 and Fisher & Margolis, 2002). A contributing factor to the imbalance, from the glass ceiling concept, is the idea that women are less motivated by power than men, a theory supported by the primary research in this study. The psychological difference between men and women mean have less of an urge to reach senior management levels (Schuh et al., 2014), this unfortunately has follow on effects whereby organisational cultures suffer from the absence of women as senior leaders and the recruitment and retainment of women further down the organisation as a result (Joshi & Kuhn, 2007), this is supported through the primary research carried out showing women value a diverse head of organisation and a supportive organisational culture.

A theme often cited in literature to provide a solution to the gender imbalance seen in STEM, and indeed other industries, is the increased need for flexible working (Jones, 2018). Flexible working, to improve the work life balance, is a way of accommodating female employees who have these needs usually for the purpose of childcare (Kramer, 2017). This research also supports the notion that flexible working aids motivation at work as well as being a practical tool. This research supports previous literature stating women are often found to feel more fulfilled by home life than by work life, flexible working allows employees to optimise their

home life fulfilment and in turn improves workplace motivation.

Limitations and Recommendations for further research

There was limitation to this research, namely the time constraints. The small window of time the questionnaire was live meant that the number of responses was limited, due to the method of distribution being the forwarding of emails by other participants, there would have been significantly more responses if time constraints weren't as tight. If the research were to be carried out again it would be beneficial to extend the time frame, this would also help to increase the range of organisations with representation in the research.

As mentioned previously as part of the questionnaire, respondents were asked if they worked part time or full time, and there were no respondents to represent the part time workforce. For further research this area should be looked into and perhaps specifically seek the responses of part time employees.

The results of this research have, in some cases, supported the literature. However, some results have brought up more questions and the need for further study. Looking specifically at the use of microenvironments to help the retainment of female employees, this research indicated that the lesser experienced new employees would find benefit from the implementation of such programs, but the more experienced female employees would feel less comfortable. For a deeper understanding for some of the subjects, a qualitative analysis could be beneficial - or a study with the mixture of both. Some would argue they could not accurately represent their opinion on the statement using the five-point Likert scale and so interviews could help to collect more in-depth information.

Appendix 1:

Theme	Question	Literature being tested
Communal goals	I consider communal goals when making career decisions.	Women tend to have a high communal orientation and seek to achieve communal goals, and this is reflected in their career choices (Boucher et al., 2017).
	I associate the engineering and technology sector with contributing to communal goals.	There is still the perception that STEM subjects don't fit in with the altruistic personalities that many women have (Boucher., et al, 2017).
	I feel more motivated when I am working towards communal goals.	Individuals with high communal orientation motivation tend to opt out of STEM subjects (Brown et al., 2015).
Leaky pipeline	I would consider leaving a job if progression opportunities were hard to come by.	Indeed (2018), 28% of women in tech left their last job in the industry because of the lack of career growth.
	I have left a job or considered it because I wanted a change or for home life reasons.	Women are likely to experience career interruptions, changes in career and other disruptions such as family responsibilities (Baruch, 2007).
	A supportive organizational culture is important to me. (This can be support with home life struggles as well as work life struggles.)	(Joseph, 2016) study suggests the loss of female professionals in technology can be linked to ineffective supervisory relationships. To implement strategies in organisations to retain female employees requires a supportive organizational culture (Baruch, 2007).
self-fulfilment	I achieve self-fulfilment more through home life rather than work	(Elliot et al., 2000). Self-fulfilment can come from somewhere other than the working environment
	I know what will help me achieve self-fulfilment in work and this motivates me	Self-fulfilment for some individuals changes constantly so working towards self-fulfilment is difficult because there are no clear goals (Banaji and Prentice, 1994; Sirgy, 1982).
	I would consider leaving my job in the technology industry if I felt like my full capabilities were not being utilised.	A popular phenomenon in science, engineering and technology (SET) is the reinsertion of female professionals into an alternative context in which their value may be realised- "the vanish box" an extension of the leaky pipeline (Etzkowitz & Ranga, 2011).
Glass ceiling	I am motivated by power, for example running a project or team.	Power motivation may be stronger in men than women so where men are motivated by being in power positions this doesn't necessarily have the same motivational drive in women - this could be a reason the glass ceiling still exists (Schuh et al., 2014)
	I am likely to contribute more in a team with equal amounts or more female members than male.	microenvironments encourage women's active participation in teamwork and preserve their confidence and career aspirations in engineering despite masculine stereotypes of the field (Dasgupta et al., 2015)
	It is important for me to see a diverse team at the head of my organisation.	Female mentors and role models improve the retention of female employees (Wood, 2017) Having female role models as professionals working in senior positions provides motivation for younger ones to follow (Liu and Wilson, 2001, p. 413)- also connects to leaky pipeline (Joseph 2016) study suggests the loss of female professionals in technology can be linked to ineffective supervisory relationships.

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