The Study of Diverse Personalities that Hinder Harmony across Engineering Team

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Abstract- Working together harmoniously in an engineering team is crucial to achieve success and is essential to the team members' wellbeing. This study examines what types of personalities hinder the harmony across engineering teams and explores how to maintain harmony across engineering teams with diverse personalities. Consequently, the data is collected from experienced engineering team leaders as well as an experienced psychologist. This study shows that in the engineering industry personalities are looked at from a different perspective and their characteristics are perceived from a business point-of-view as opposed to the literature in which judgments are made upon the personality description.

Keywords Team Harmony, Engineering Teams, Diverse personalities, The big five model

1. Introduction

A crucial part of managing engineers is getting them to be as positive as possible while working as a part of a team. Working in teams is common in engineering environments, whether it is a maintenance team, academic team, or a manufacturing team (Boyatzis et al. 2017). Within any engineering team it is important to have lots of different contributions and to have different styles so that any problem or issue can be addressed from various angles, however many contributions sometimes can create friction, particularly when the dark side of some personalities with strong and extreme characteristics emerges which often lead to situations where people reach an impasse that they are no longer being effective or productive (Messarra et al. 2016). Accordingly, this study examines the impact of having diverse personalities within an engineering team by using the Big Five Model which is comprised of five personality traits that are seen as the core of personality; (1) Openness to experience, (2) Conscientiousness, (3) Extraversion, (4) Agreeableness, and (5) Neuroticism (Baay et al. 2014).

The significance of investigating personality impact on engineering teams is that they are commonly overlooked as engineering organisations in general mainly focus on engineers' technical skills and education, not their interpersonal skills. As noted by Yeager and Nafukho (2012), technical skills are necessary and of significant importance to engineering but not sufficient enough to ensure team harmony over time. In essence, personality is a critical factor that can sway the team in either a harmonies or frustrating direction (Balmaceda et al. 2014).

In an ideal organisation, engineering teams would work in an environment that promotes collaboration, positivity and acceptance in which perfect harmony is the norm. But in reality, this is often different as teams regularly witness disagreements and disputes (Huff et al. 2016). Although these incidents often fade quickly and are forgotten with time, the harmony across teams will be weakened and negatively affected over the long term (Balmaceda et al. 2014; Huff et al. 2016; Boyatzis et al. 2017). Accordingly, harmony can best be seen as the willingness to listen, respect and understand others in their differences (Chow and Yau 2010). In other words, this view indicates that harmony can be achieved by having a mutual agreement and trust between team members

regarding ideas, viewpoints, and any other aspect that requires collaborative efforts. As noted by Ergüna and Balçın (2017) engineers are problem solvers; they provide alternatives, technical insights, and build complex systems. Hence, engineering teams often find themselves flooded with different ideas, perspectives and viewpoints due to each team member personality type (Keaveney 1997), which is essential in engineering as brainstorming with diverse personalities leads to creating a wide range of innovative solutions and ideas.

With regards to diversity, a recent study by Weeks et al. (2017) found that diversity has a positive effect on teams, thus organisations can benefit greatly from such variety as it brings different skills and ideas to the table. On the other hand, according to Clark and Polesello (2017) non-diverse teams are likely to apply a more uniform approach to discussions and problem solving which ultimately dampens innovation and limit the solutions. There are various prominent types of diversity in the workplace; such as race, age, gender, culture and personalities which is a major area of interest within the field of diversity (Ravazzani 2016). Accordingly, personality diversity has long been recognised as a potential problem in the workplace that deserves serious attention (Brown 2008). Moreover, a strong relationship between personalities and team harmony has been reported in the literature (Bradley and Hebert 1997). In general, there are many different ways to think about and conceptualise personality and that is evident in various models for personality types (Balmaceda et al. 2014).

1.1 The Big Five Personality Model

A considerable amount of literature has been published on personality traits. These studies have long attempted to define exactly how many personality types exist. One of the most well researched and respected personality models in the field of psychology is The Big Five personality model. According to Myszkowski et al. (2015), this model is considered as the most comprehensive, general and robust personality model, and most importantly it is well recognized as an organisational framework for understanding personality traits in the workplace. Likewise, Arora and Rangnekar (2016) hold the view that this model is well recognised for its stability and validity across various industries and cultures. This model evaluates personalities on five different axes; Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (Baay et al. 2014).

Openness to Experience refers to open-minded individuals who are willing to venture into new experiences, share information and ideas, as well as undertake challenges as opposed to individuals with low scores in openness who are consistent and cautious (Balmaceda et al. 2014). In the same vein, Myszkowski et al. (2015) found a correlation between creativity and openness to experience which identified personality as a key predictor of divergent thinking and innovation, flexibility, tolerance to ambiguity and sensation seeking. Therefore, openness could be a major personality that affects the harmony across engineering teams, in essence, that the field of engineering requires innovative and broad-minded individuals. However, in an investigation into Six Sigma projects, Nesterkin and Porterfield (2016) suggested that openness to experience can only be beneficial when the project is highly complex and a lot of new learning is required. Moreover, in reviewing the literature, Yilmaz et al. (2017) reported that software engineers with high levels of openness to experience are highly productive and sociable as a result of them being good communicators and innovative as well as for having a detail-oriented mindset. But, it was also argued by Yilmaz et al. (2017) that if the tasks become repetitive the software engineers will become uninterested and unmotivated.

The term Conscientiousness has been used to refer to individuals who are punctual, hardworking and orderly (Balmaceda et al. 2014). Also, it is the personality trait of being responsible and dependable (Borges 2013). These definitions are in accord with recent studies that described individuals with high scores in conscientiousness as self-motivated and task-oriented. For example, according to Agyemang et al (2016), highly conscientious individuals tend to perform better as opposed to individuals with low scores in conscientiousness, also they are known for being initiative in taking responsibilities and activities beyond their role including solving problems and sharing knowledge. However, this outcome is contrary to that of Bhatti et al. (2013) who argued that having high levels of conscientiousness is not correlated with knowledge-sharing, in fact for individuals who are responsible and hardworking sharing knowledge is expected of them and they consider it as a part of their responsibilities. Another important finding was that highly conscientiousness individuals are deliberative, neat, systematic, and thorough (Arora and Rangnekar 2016). It is possible, therefore, that having highly conscientiousness engineers in a team can greatly benefit team harmony. On the other hand, individuals with low scores in conscientiousness are argued to be careless and inefficient making them less driven by success and motivation (Balmaceda et al. 2014). Agreeableness can broadly be defined as the willingness to cooperate and it has come to be used to refer to individuals who are sympathetic, kind, and affectionate (Agyemang et al 2016). Similar to openness and extraversion; individuals with high levels of agreeableness are known to be good communicators who can establish and maintain healthy relationships with their team members. It is therefore likely that a high level of agreeableness can reduce stress related to work as individuals are willing to build relationships to support their professional life. Hence, according to Wolff and Kim (2012) agreeableness is positively related to internal networking and maintaining social alliance within the workplace. Moreover, Ramalu et al. (2011) pointed out that highly agreeable individuals compared to individuals with low levels of agreeableness are more flexible and adaptable in terms of being less offensive to others in arguments and discussions and can easily adjust to new settings and get along with new team members. In other words, it seems that highly agreeableindividuals are more capable of developing mutual understanding with their peers to resolve and prevent conflict, but individuals with low levels of agreeableness tend to be reluctant when it comes to establishing relations with team members. This view is supported by Bhatti et al. (2013) who argued that agreeableness is an important predictor for individuals work adjustment, interpersonal relations with their peers, and performance.

Extraversion is an interpersonal personality that describes individuals' feelings, social energy, and reactions. Individuals with high scores in extraversion have an outgoing, energetic, talkative, and assertive nature (Capretz et al. 2015). On the other hand, individuals with low scores in extraversion are considered to be independent and quite (Yilmaz et al. 2017). Software engineering is a good illustration of how extraversion impacts individuals. According to Capretz et al. (2015), software engineers who are high in extraversion are outgoing and they acquire their energy from the people they work with through interactions. Conversely, low extraverted engineers acquire their energy internally and prefer to work individually rather than in a team. In the same vein, Boyatzis et al. (2017) analyzed data from 40 engineers working in a manufacturing company and concluded that there is a significant correlation between extraversion and engineer engagement within the team. This finding has important implications for maintaining harmony across engineering teams, due to the significant shift in engineering roles from being independent to more relational team-based roles that require working with organizational clients internally and externally (Farrukh et al. 2017). Accordingly, Bhatti et al. (2013) asserted the importance of

engineers having the ability to initiate and foster relationships as it plays a key role in keeping them motivated and dedicated to their team.

Neuroticism has been described as a prominent trait in the big five personality model, as a consequence of its presence in nearly every personality (Judge et al. 2006). There are several attributes commonly associated with neuroticism such as excessive worry, anxiety, insecurity, and low self-esteem (Farrukh et al. 2017). Thereby, an individual with low levels of neuroticism has the tendency to be calm and comfortable in situations that require emotional reactions. However, at the other end of the spectrum, individuals with high levels of neuroticism have the tendency to easily experience negative emotions in stressful situations (Esmaeelinezhad and Afrazeh 2018). These results are similar to those reported by Shang et al. (2016) who argued that individuals with high levels of neuroticism tend to experience tension, low confidence, and embarrassment. Also, as noted by Farrukh et al. (2017) the negative nature of neuroticism, can lead individuals high in this trait to express negative attitudes and emotions towards their team members. Therefore, neuroticism could have a major impact on harmony across engineering teams. Hence, Boyatzis et al. (2017) argued that today's engineering roles are more interpersonal focused wherein engineers work in diverse contexts with diverse people, and thus, they are required to be competent at a behavioural and emotional level.

1.2 Personality types that hinder the Harmony across Engineering Teams

As mentioned before personality diversity has a pivotal role in providing the richness necessary for team success. But, if it is not carefully managed it will create conflicts, clashes, and tensions that hinder the harmony across engineering teams (Clark and Polesello 2017). Engineering teams are made of individuals in which each one is different from another. An example of this is the study carried out by Yilmaz et al. (2017) in which five teams of software engineers with 12-20 members each were studied, and it was found that the most productive team of the organisation was the team with the most extroverted members as a consequence of the team being given tasks that require social interactions. Likewise, teams working within settings that require cooperation and customer-facing such as service delivery and stakeholder engagement were found to be higher in agreeableness, conscientiousness and openness. Similarly, teams working within settings that involve innovation and verbal communication were observed to be high on openness to experience. On the other hand, the research and development team specialised in developing prototypes for projects, showed low scores in agreeableness, extraversion, openness to experience and conscientiousness. Hence, a clear lack of direction among the team members was observed alongside strong disagreements (Yilmaz et al. 2017).

Moreover, It has been shown in (Yilmaz et al. (2017) study that if the engineering team is working on tasks that require decision-making and risk-taking such as the development of products, individuals with high scores of neuroticism and extraversion will most likely hinder the harmony across the team. This view is supported by Ayub et al (2017) who argued that extraverted individuals are known for their impulsive and deviant personality, and despite them having an outgoing and assertive nature, they are recognised to be dominant in social encounters and often engage in risky situations that contradicts with the team standards and values. Likewise, Dant et al (2013) pointed out that due to the hostility of highly extraverted individuals, they become easily dissatisfied and angry. In view of all that has been mentioned so far about highly extraverted individuals, one may suppose that when these traits are high on the individual's spectrum, they can negatively impact any situation that requires

problem-solving and patience which would inevitably impact complex engineering problems that require attention when approached. However, Arora and Rangnekar (2016) suggested that highly extraverted individuals strive for career progression and have the ability to effectively solve complex problems and career challenges using their strong interpersonal skills.

Furthermore, Boyatziset al (2017) used a survey to assess 143 engineers from a multi-national manufacturing organisation based in two different locations USA and Northern Europe using the (NEO) Personality Inventory; a self-report that examines the Big Five personality traits. According to the obtained results, engineer engagement and job engagement are positively affected by the personality traits of extraversion and conscientiousness. Thereby, engineers with low scores of extraversion and conscientiousness can potentially hinder the harmony across their teams as they will not be effectively engaged with their team members and tasks. By way of illustration, Litchfield and Javernickl (2015) conducted a series of interviews with 165 engineers working at the Engineers without Borders organization (EWB-USA) and found that engineers with higher extraversion scores are more satisfied and engaged with their careers than engineers with lower scores. Consequently, this could be attributed to their talkative and sociable nature that usually results in greater communication and friendships with their team members. Surprisingly, a comprehensive study comparing personality traits of engineers and non-engineers by Williamson et al (2013), in which 4876 engineers were examined, showed that engineers have lower extraversion scores compared to non-engineers, which potentially can be attributed to their preference of working in quiet settings to focus and concentrate more on their work.

For neuroticism, Esmaeelinezhad, and Afrazeh (2018) argued that neurotics in managerial roles have the tendency to adopt a dominating management style with their team members, because they lack rational judgment, and, thereby they may adopt a dominating style, to take charge and establish their authority and credibility. These results reflect those of Posthuma (2012) who also found that task conflict is more likely to evolve into relationship conflict for individuals with less effective emotional regulation. Therefore, highly neurotics engineering managers could be a major factor hindering the harmony across engineering teams. Mainly because the existing conditions of engineering projects are known to be associated with high level of stress and pressure especially that engineering managers are responsible for almost every aspect of the project. This is exemplified in the study undertaken by Sinesilassie et al (2017) which listed the responsibilities of an engineering manager as follows: ensuring the completion of projects in budget and on time, conducting regular meetings 'with team members and stakeholders, conducting budget updates and most importantly understanding and communicating the scope of the project to the team. In general, therefore, it seems that neurotics are most likely to vent their frustration on others letting their emotions drive their decisions when under stress and pressure.

All together, the above discussions suggest that due to the complex nature of engineering projects, the five personality traits can either impact the team harmony in a positive or a negative way depending on the team settings, tasks and requirements. Hence, in a recent investigation into Six Sigma projects, Witt and Baker (2018) identified personality traits as major indicators of team harmony. The results show that agreeableness influences team productivity, neuroticism and extraversion influence communication effectiveness, openness influences team creativity, conscientiousness influences project uncertainty, and the five personality traits combined influence the team leadership effectiveness and the overall team performance. Thus, the above discussion points that each personality influences team harmony in a different way. Firstly, team communication is significant in any

engineering project for sharing information, accomplishing tasks and establishing mutual trust (DeFranco and Laplante 2018). Secondly, as noted by Nesterkin and Porterfield (2016) team productivity is necessary to identify the key outcomes of projects and how to accomplish them. Thirdly, team creativity is correlated with innovation and the team ability to think out of the box (Williamson et al. 2013). Finally, Witt and Baker (2018) pointed that project's uncertainty is the team inability to completely understand or accurately predict some aspects of a project. Furthermore, these personality influences can best be seen in the case of two of the most substantial engineering practices in today's modern world: Sustainability and Lean production. One of the critical factors for a successful implementation of lean and sustainability is ensuring that everyone is involved and committed to the process, and most importantly has the flexibility and acceptance to change, thereby, individuals being low on openness and agreeableness and high on neuroticism are most likely to hinder the transition (Dombrowski and Mielke 2014). Hence, Jones et al. (2017) argued that a major transformation like lean depends on the individual perception of continual improvement and change. However, as noted by Uhrin et al. (2017) due to the complexity of implementing lean most of the research has been dedicated to the technological aspects of the process neglecting the equally important human aspects of the transformation process. Similarly, Kumara and Kumar (2015) argued that the majority of the reported challenges regarding lean are human-related. A possible explanation for this might be the fact that lean and sustainable practices are influenced by individuals' commitment and openness to change (Uhrin et al. 2017). Taken together, these results suggest that a high level of openness, conscientiousness and agreeableness, as well as low-level in neuroticism are key for a successful implementation of these practices.

Ayub, et al. (2017) suggested an association between neuroticism and being under pressure, the association showed that neurotics are most likely to exaggerate their emotions and are prone to become stressed easily, due to their irrational judgments and sensitivity. But, being under pressure and stress is inevitable when managing such transformation, which can play a significant role in affecting the harmony across engineering teams working towards these practices. This is exemplified in the work undertaken by Jones et al. (2017) who used a survey to assess how neuroticism can influence sustainable practices, the Forbes insights survey targeted 106 executives working in engineering industry trying to achieve sustainability transformation. The participants were unanimous in the view that due to the complexity and requirements of such transformation, accomplishing the transition is challenging, in essence, the engineering managers were under the pressure of balancing between the organisation profits and the responsibility of influencing their team members to change deeply ingrained practices. These results provide important insights into how important it is to have a low score in neuroticism (e.g. balanced personality) to be able to delegate tasks to engineers and influence major changes such as sustainability transformation without showing negative emotions (Hwang and Ng, 2013).

1.3 Maintaining Harmony across Engineering Teams with Diverse Personalities

Maintaining team harmony is becoming a critical element in today’s competitive world that cannot be underestimated. Whether it is a manufacturing, electrical, or any other type of engineering team, as long as humans are involved in running the projects, not robots, there are going to be conflicts and relationship problems. Hence, it is recognised that well-structured and committed teams are crucial to achieve team success and growth. But, given that personality traits influence individual's behaviours and perception Dant et al. (2013), it is necessary to investigate how to maintain harmony across engineering teams with diverse personalities. Team harmony

embodies respecting and understanding our differences (Chin 2014). Accordingly, due to the inherent similarity of engineering projects in terms of scope changes, the large volume of requirements, and the fact that they are executed by teams. Also, with respect to the big five personality traits and team harmony, conflict management and understanding team personalities were found as essential pillars to maintain team harmony with diverse personalities.

1.3.1 Understanding Team Personalities

Previous research has suggested a weak correlation between personality traits and team harmony, and it has been demonstrated that the understanding of such relation remains underdeveloped (Bradley et al. 2013). Conversely, Zhou et al. (2015) reported that matching between personality traits and tasks allows for better results. Accordingly, when there is an understating of personality traits, managers will able to listen and observe team members from a different angel (Cardon and Bribiescas 2015). Also, it can be useful when using the supplementary and complementary fit approach. According to Hollenbeck et al. (2002), the Supplementary fit means that team members are more comfortable and productive when they are joined with individuals similar to them. On the other hand, complementary fit means that individuals fit more within a team where they bring something new. In the context of the big five personality traits, Zhou et al. (2017) argued that the most appropriate traits for the supplementary fit are conscientiousness and openness as they indicate how individuals perceive team goals and tasks, in essence that highly conscientiousness and openness individuals have the willingness to take responsibility and act as a leader when needed especially if the team is facing challenges. Hence, it is a pivotal initiative in engineering projects due to their complex nature that is filled with unexpected challenges. Additionally, they have the ability to build a mutual agreement of purpose and team goals and consequently inducing their team members with motivation and empowerment (Bhatti et al 2013).

Bhatti et al (2013) view is supported by Myszkowski et al (2015) who reported that team members high on openness and conscientiousness can stimulate new ideas, unconventional trends, and create friendly working environment. In contrast, extraversion, neuroticism, and agreeableness are argued to fit most with the complementary fit approach (Zhou et al. 2017). Although low scores in extraversion and agreeableness alongside high scores in neuroticism might have significant implications for team harmony, high scores of extraversion and agreeableness and low scores in neuroticism can bring clear benefits to the team. Firstly, as noted by Esmaeelinezhad and Afrazeh (2018) the most notable benefit that high extraversion individuals bring to their team is their transformational leadership style that encourages risk-taking and taking initiatives to help those in need, on the other hand, extraverts with low scores tend to delve into issues rather than moving on and explore alternatives. As for team members high on agreeableness they play a key role in building trusting relationships among them, but, members low on agreeableness tend to break and harm relations due to their nature of expressing concerns and rejecting other ideas. Moreover, team members low on neuroticism can help their team members with identifying threats (Yilmaz et al. 2017). Together, these studies indicate that it is essential having a trusting team that accept other ideas and perspectives.

1.3.2 Personality Conflict Management

There are relatively few studies in the area of team conflict in engineering projects, but the subject itself is not new, in fact, a considerable amount of literature has been published on the matter subject. These studies suggested

that conflicts, in general, are common and can be either destructive or constructive and are caused by various elements; one of them being Personality. Even though the studies are scarce a recent investigation into conflict in engineering projects by Naismith et al. (2016) found that personality traits influence conflict escalations and the way they are handled. The study primary data was collected by interviewing 6 highly experienced engineering managers with an average of 20 years relevant work experience, wherein all agreed on that conflicts within engineering teams are inevitable due to highly challenging nature of engineering projects. Accordingly, Messarra et al. (2016) listed the main styles of conflict management as follows: (1) collaborating style is a win-win approach where individuals seek novel solutions; (2) accommodating style is when individuals cooperate on a high level even if it's against their goals ;(3) competing style is a win-lose approach where individuals use an assertive way to achieve their goals without cooperating; (4) Avoiding style is when individuals simply avoid issues by not helping others or even themselves to reach to their goals; and finally (5) the Compromising style which is a lose-lose approach where neither party's get what they want as it involves give-and-take scenarios.

With respect to personality traits, Anwar et al. (2012) argued that researchers have attempted to evaluate the impact of conflict management styles on personality traits for decades. This outcome is contrary to that of Barbutoet al. (2010) who reported that studies regarding this matter are inconsistent as some found a strong correlation between conflict management styles and personality traits, while others considered the relationship between the two is weak. On the other hand, some studies reported a correlation between the big five personality traits and conflict management styles. Accordingly, Wang (2010) pointed out that the collaborating style is beneficial when used with individuals high on openness but might have negative outcomes when used with individuals high on neuroticism. As for the accommodating style, it is useful with team members high on neuroticism, but not with team members high on extraversion. Moreover, agreeableness has a positive correlation with the compromising style, but not with the competing style. In the same vein, Ejaz et al. (2012) found that openness, agreeableness, and conscientiousness are positively correlated with both the collaborating and accommodating styles, while the compromising and competing styles were found beneficial on both extraversion and openness. Also, the avoiding style was found useful with individuals high on neuroticism. However, the key problem with Ejaz et al. (2012) study is that the data is based on call centre representatives, not engineers.

This study set out with the aim of investigating the different types of personality and their effects on team harmony. Although this study focused on engineering teams, the findings may well have a bearing on other team collaborations outside the engineering industry. The reason for that is because the big five personality model used in this study describes human personality, not engineers' personalities (Balmaced et al. 2014). Moreover, according to Shang et al. (2016), the big five model is one of the most popular personality models used in hiring processes, academic research and most importantly in the field of psychology, which gives it the validity to be used in any domain. On the other hand, the generalisability of the model presented some limitations to this study in essence that the model assesses the human personality in general and not in a focused angel in terms of occupations for instance. Hence, these limitations have been reported in the literature as well. For example, Bartone et al. (2009) reported criticism on the model from 25 years ago which described the model as too global to provide a solid understating of peoples actual behaviours or predict life outcomes.

In spite of these limitations, the literature provided a reasonable amount of meta-analytic studies that capture the relationship between the big five personality model and team harmony from different aspects such as employee

engagement, productivity, leadership and conflict. Furthermore, these studies provided a solid understating of the types of personalities that might hinder the harmony across engineering teams. Taken together, the findings suggested that engineers high on openness, conscientiousness, extraversion, and agreeableness create a positive impact on their team (Williamson et al. 2013). These results may be explained by the fact that team members high on these traits are open-minded, hardworking, cooperative, talkative, and outgoing (Balmaceda et al. 2014). On the other hand, team members high on neuroticism create a negative impact due to their emotional instability (Ayub et al. 2017). Accordingly, it is important to bear in mind that the studies provided an idealistic view of the personalities meaning that the advantages and disadvantages of each personality depend on the context of where and when they are applied. For example high on extraversion is seen as an advantage for engineering teams but as presented in Yilmaz et al. (2017) study, the engineering team working on research and development were all low on extraversion so having individuals high on extraversion on the team might hinder the harmony as the team prefer a setting that is quite which will also impact individuals high on extraversion as they might feel unwanted in the team.

This draws back to one of the pillars in maintaining harmony mentioned previously which asserts the importance of understating team personality in order to effectively delegate tasks and form teams. Hence, researchers also listed conflict management as an essential pillar to maintain harmony across teams as conflicts are heavily influenced by personalities. Regarding conflict, studies asserted the importance of choosing the appropriate conflict management style when dealing with personalities (Wang 2010). Overall, the investigation of the existing literature has shown a strong relationship between personalities and team harmony. Although very little was found in the literature on engineering teams' harmony, several studies have shown that certain personalities such as neuroticism could hinder the harmony across engineering teams. However, other personalities like openness and agreeableness could have a positive impact on the overall harmony of the team.

2. Research Aims

The purpose of this study is to explore the relationship between personality traits and team harmony in engineering. Hence, the main aim of this study is to investigate the different types of personalities that hinder the harmony across engineering teams, and the second aim of this study is to investigate how to maintain harmony across engineering teams with diverse personalities.

3. Research Method

The research methodologies commonly used to draw data from reliable sources are broadly categorized under quantitative or qualitative (Murshed and Zhang 2016). There are a number of important differences between quantitative and qualitative methods. For instance, quantitative methods are composed of variables and numbers meaning that they are particularly useful for creating and analyzing statistics (Chatha et al. 2015). Conversely, Guercini (2014) reported that qualitative methods are more useful for identifying and characterizing informant's opinions and views in a natural setting. Moreover, it has been demonstrated that the two methods are mutually exclusive, whereas qualitative methods are used to understand human behaviour; quantitative methods are used to explain it (House 2018). Considering all of the evidence regarding qualitative methods, they were the most reliable and effective approach to meet the study aims mentioned earlier.

4. Data collection and Data analysis

Since people management and personalities are the main focus of this study it is important to choose a methodology that offers a deep understanding of the impact personalities have on team harmony in practice. According to a recent study by Axelrod (2015) on managers with a proven record of exceptional leadership for their team members; reported that adopting a psychological approach that navigates and bolsters each team member personality traits that hold back their performance can help establish and maintain a harmonic team environment. Therefore, it was necessary to choose a methodology that gathers data based on practical experiences and perspectives within the engineering sector. For this study, the data is collected using semi-structured interviews with ten participants working within the field of engineering. In addition to an evolutionary psychologist who is specialised in dark personalities and individual differences. The participants labeled as P1 to P10 as shown in Figure 1. All participants have led engineering teams ranging from four to hundred members. Moreover, it can be seen from the data in Figure 1 the participants' years of experience range from eighteen to forty years from multi-national organisations such as BEL Engineering, Nissan, Armstrong, as well as research and academic institutions. Moreover, the participants' line of experience includes engineering education, facilitating engineering teams, engineering management, advanced maintenance, operations management, as well as manufacture engineering. The interviews were recorded upon interviewees consent, and then the data was transcribed into written form, categorized and displayed to showcase the key arguments and information. As noted by Rowley (2012), recordings should be used to extract the important points and any other practical details that might be used in subsequent interviews.

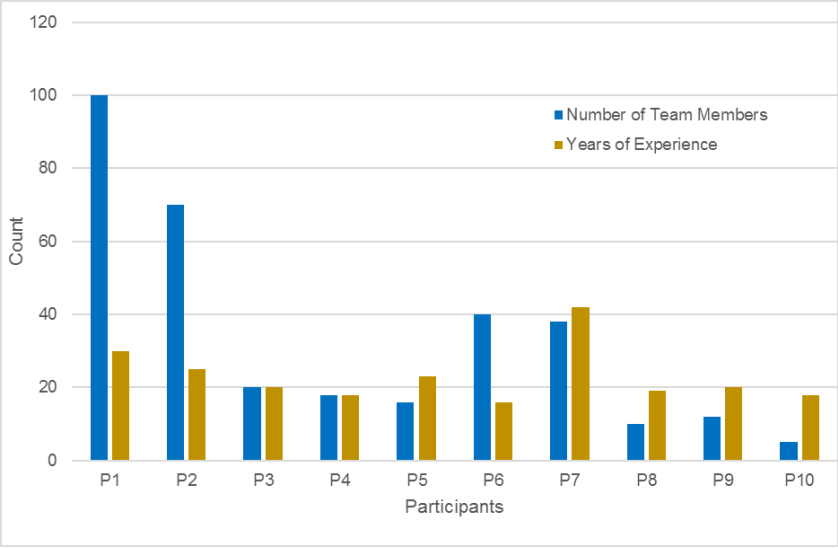

Figure 1: The data used for this study.

5. Ethical Considerations

Since interviews deal with personal and professional information, ensuring appropriate transparency, confidentiality and trust for the participants should be a priority for any researcher. Hence, a great deal of previous

research into qualitative research has focused on ethical issues. As noted by Alshenqeeti (2014) interviews are practically a portal into participant's private and professional lives that need a great deal of sensitivity when approached. Therefore, ethical considerations should be implemented at all stages of the interview process. These considerations include mutual agreements on every aspect of the interview in terms of how the data will be used, who have access to it, and how it will be presented. Additionally, Allmark et al. (2009) suggested that the intimate nature of interviews might cause ethical challenges to researchers as some participants may disclose information that is not supposed to be shared. Consequently, all participants of this study were assured confidentiality and anonymity.

6. Findings

6.1 Personality traits and team harmony in engineering

It has been proposed that team harmony is about establishing perfect unity and satisfactory agreements (Chin and Liu 2015). Hence, the first set of questions aimed to explore participants' views regarding team harmony. Interestingly, some participants who work within the same organisation expressed different perspectives. For instance, one interviewee argued that ***'working within harmonious environment is the norm rather than the exception'***. Another participant, however, from that same organisation suggested with a laugh implying uncertainty that ***'team harmony is something that has never been seen'***. Whilst a minority mentioned that team harmony is elusive, all agreed that it is essential to getting things done and that it needs work all the time. Accordingly, the participants were unanimous in the view that team harmony is everybody in the team working together towards a common set of goals, and therefore team harmony is about ensuring everybody has an understanding what the tasks are and how they are going to achieve them, and how much time they have in the day to achieve them, and most importantly people passing information in an effective and efficient manner. This view is supported by DeFranco and Laplante (2018) who reported that team harmony is determined by the level of synergy and cooperation within a team who have a mutual goal to achieve.

Unquestionably, these views indicate that when information is not passed engineering teams will face clashes and conflicts because people will start getting agitated and confused and as a result will end up going off in a disharmonious direction. Consequently, in all cases, the informants reported that the challenging nature of engineering projects requires a high level of team harmony, asserting on the essential role of good information pass between team members as it is vital for the team to perform their tasks efficiently. Furthermore, the psychologist noted that team harmony is about having a team where there is not too much conflict. However, the psychologist reported that ***'there will always be disagreements in teams about how they do things or how to make decisions and that is fine'*** and therefore harmony is more about how teams deal with disagreements. For example, Messarra et al (2016) pointed out that some teams resolve disagreements in a quite harmful way, and they put each other down and use criticism. On the other hand, some teams will accept that they have disagreements and will find useful ways in which to resolve them. The six pillars of team harmony in engineering extracted from interviews are as follows: working together towards a common set of goals, task understanding, effective communication, sharing information, less conflict, and effective conflict resolutions.

6.1.1 The Big Five Model

The current study found that the Big Five model is a suitable model to assess people in the workplace as it is based on a huge amount of research. According to the psychologist, the theorists who developed the Big Five model measured people on many aspects of personality probably hundreds of possible personality traits and accordingly created the model. Moreover, the psychologist pointed out that team leaders who use the Big Five model to measure their team members can have a fairly good understanding of who they are and it can allow them to predict how they will behave. These results reflect those of a recent study by Esmaeelinezhad and Afrazeh (2018) who also suggested that the Big Five model is one of the most widely used personality models that can strongly predict work behaviours and intentions. However, there were some negative comments about the model in which the psychologist suggested that it doesn't fully capture the dark side of personality. For example, the Big Five model can capture dark personality to some extent in terms of someone being less agreeable and less neurotic and more extrovert but that doesn't really capture true darkness in the sense of sadism and psychopathy. In the same vein, Paulhus (2014) argued that team members with dark personalities fail at getting along with their peers but they succeed in getting ahead and they usually score low on agreeableness and conscientiousness. As mentioned in session 1.1, individuals who score highly on openness to experience bring many benefits to their team in terms of flexibility and originality (Ayub et al. 2017). Moreover, Williamson et al. (2013) suggested that openness to experience is among the most important traits for engineers since engineering projects constantly require the acquisition of new knowledge and developing new solutions. Consequently, the participants, on the whole, demonstrated that engineering is all about ideas, innovation and taking something to the next level and finding that right solution for a particular problem. Additionally, one interviewee said that ***'people who are creative and have an artistic flavour are going to have a positive impact on any engineering team as they will bring many good (out of the box) ideas****'*. However, the personality trait openness to experience has a different side that is argued to be less beneficial to team harmony. As noted by Balmaceda et al. (2014) individuals who score low on openness to experience are described as cautious, unimaginative, and consistent. Hence, such individuals prefer familiar surroundings and are more likely to pass up on opportunities, and adhere to set routines and schedules (Myszkowski et al. 2015).

Therefore, it can be argued that individuals with low scores of openness to experience might hinder the harmony across engineering teams due to their structured personality. However, the participants were all supportive of such personality. For example, one interviewee argued that if an entire team was made up of people who have only that creative side and not the cautious side, it would probably bring limited value to the team. In essence, that in engineering a balance of those two personality types can bring significant benefits to the team. For example, the creative people feed in the ideas and the cautious people test their validity. As noted by one participant having a team with the same personality traits will hinder the chances of success as everybody will be trying to do the same role and the same things which will potentially affect the harmony across the team. This view is supported by Clark and Polesello (2017) who reported that diversity increases team's competitive advantage over those who lack diversity. Consequently, the informants reported different cases that justify the importance of having a blend of openness to experience within an engineering team.

For instance, one participant suggested that in maintenance, cautious and consistent people are needed to solve and think through certain problems as for creative and curious people they are needed to innovatively fix urgent

problems. In the same vein, an interviewee from a manufacturing organisation suggested that an ideal team of production engineers would be a combination of creative and cautious people wherein the latter will take on the quality assurance role at the end of the chain to make sure that the features and dimensions are of quality and the more creative people can deal with tasks or problems on the shop floor that requires finding solutions. Conversely, one interviewee argued that in the education sector one of the problems engineering schools face is keeping the curriculum up to date which is can be hard to achieve if people are cautious and consistent as they might teach the same thing for years and that will definitely have a negative impact on others who might be developing new programs and looking at what's new in the engineering industry and trying to bring it from the outside world into the curriculum.

Considering all of these views, it seems that both sides of openness to experience can either hinder or maintain the harmony across an engineering team depending on what the engineering team is focused on and how team leaders deal with both sides of the personality. Hence, all participants agreed that neither high nor low in openness to experience does hinder the harmony across an engineering team; in fact, team leaders should coach and nurture their team members who have this personality to bring the best out of them. Consequently, the participants pointed out several explanations for this view. A small number of those interviewed suggested that being cautious, shy and constant usually comes from lack of knowledge, while others suggested that due to the mixture of different traits within people it would be difficult to assign tasks according to everyone's personality thereby team members need to be trained to adapt to all possibilities. Overall, the findings suggest that there can be some clashes between the two sides of the personality, but that is up to the team leader to facilitate that relationship and acknowledge the importance of each side.

There are various different types of engineering, each with very distinct skill sets, but there is no doubt that conscientiousness is central to the entire discipline of engineering (Borges 2013). The participants on the whole demonstrated that any engineering team absolutely needs orderly and hardworking people who can take responsibility and are able to meet the team objectives and deliver clear outputs. Additionally, the participants agreed that engineering can be challenging, unpredictable and sometimes unreliable so not having these traits can negatively impact the team success and ultimately the team harmony. Moreover, all participants agreed that highly conscientious team members help create a harmonies team in the sense that they have attention to detail and that enable them to understand each other working style and personal preferences. However, some participants expressed concerns regarding highly conscientious individuals arguing that sometimes they get too involved in perfectionism and detail. Hence, all agreed that this side of the personality can be a hindrance and very problematic. This result reflects those of Wagner and Causey-Upton (2017) who also reported that perfectionists develop high levels of stress that cause anxiety and mood disorders which make them less favourable by their peers.

Consequently, one participant argued that ***'sometimes the job needs to be done and the objectives need to be met and team members who fall in the loop of endless refining can hinder the team harmony especially if the team is up against the time pressure'***. Furthermore, when asked about team members with low scores in conscientiousness who are described as unpunctual, disorganized, impulsive, and unreliable (Agyemang et al 2016). A small number of those interviewed suggested that both team leaders and members should try to cope with their personality and even suggested that sometimes you need to have team members who are impulsive

that can take risks. Additionally, the same informants reported that everybody has a little element of being disorganized in the sense that when people are under pressure they might become unsystematic, especially when they are bridging more than one role wherein it becomes harder to have full control. On the other hand, the majority of participants argued that one's personality should not be an excuse for being disorganized as someone's work can have a big impact on somebody else's work and being disorganized would absolutely have an impact on the team harmony as it will cause many conflicts. This also accords with Ayub et al (2017) study, which reported a strong relationship between conscientiousness and conflict escalation.

In addition, the participants agreed that team members low in conscientiousness can be a hindrance as they will create tensions all over the place; especially within an engineering setting that has high standards. Moreover, the participants argued that working with unpunctual and disorganized team members can be very frustrating and significantly affect others because things aren't getting done properly. Conversely, one participant suggested that it should not be considered as a hindrance if the team leader or team members did not communicate the team expectations and standards. Furthermore, one participant suggested that anybody who is impulsive and disorganized wouldn't able to fit in an engineering environment as quality is critical, and such environment cannot afford having team members who work on random things and don't follow procedures and critical processes. Taken together, as noted by Williamson et al (2013) there are some aspects from both sides of conscientiousness that can hinder the harmony across an engineering team. For example, in terms of conflict, team members that have low scores in conscientiousness will most probably be unprofessional due to their impulsiveness and unreliability but can be beneficial in urgent situations. As for conscientious team members they are more likely to tackle conflicts, stay focused and support others, but can be problematic when they get too involved in detail that cause frustration to others.

The important role of extraversion in team performance and team harmony is unarguable, as it has been shown to have a positive impact on team performance and engagement especially for roles requiring social interactions (Bhatti et al. 2013). Since extraversion is mostly considered with social relationships having too many or too few in an engineering team can both be inefficient. According to Ayub et al. (2017), a team with a very low or a very high level of extraversion will most properly struggle in terms of harmonies functioning. In order to assess the impact of extraversion on team harmony; the participants were given the different characteristics of highly extraverts as opposed to those who score low in extraversion. Accordingly, one participant argued that highly extraverts thrive for recognition and status and usually seek leadership roles, which is "fine as long as its balanced" the participant stated. This finding was also reported by Arora and Rangnekar (2016) who also found that extraverts actively seek career advancement and attention. However, the participant suggested that some disruptive extraverts can cause disharmony within teams as they have the tendency to become dominant in order to reach their goals even if it causes discomfort to other team members.

These results are in accord with the psychologist views indicating that extraversion is a double-edged sword. In essence that it is a really good personality in the sense that team members who are extroverts tend to be more confident, outgoing, and good at making relationships with others, also they often make good leaders. On the other hand, extraversion can be associated with darker traits meaning that team members who are incredibly extroverts can take all of the attention and people who are more introverts can be overlooked by the team leader. Hence, this finding broadly supports the work of Williamson et al. (2013) who found a strong relationship between

extraversion and career satisfaction. The study reported that extraverted engineers have higher levels of career satisfaction as opposed to introverted engineers. A possible explanation for this relationship may be the fact that highly extraverts are known to be talkative, outgoing and confident which results in effective connections and friendships with team members and team leaders. However, some participants felt that being "over the top salesperson" would probably be very annoying to other team members. Moreover, they argued that having highly extraverts in some engineering roles can be a problem as engineers need to keep a clear head while working.

Furthermore, there were some suggestions that highly extraverts can cause transformative discomfort in some situations thereby it is important to keep it in its proper perspective or it will become problematic causing disharmony across the team. As for introverts, the participants were informed that the literature classified them as team members who tend to work more independently and methodically as well as have troubles making and building relationships (Yilmaz et al. 2017). Hence, one could argue that introverts don't hinder the harmony as engineering requires a methodical and focused approach. Also, as mentioned in the literature review, Williamson et al (2013) examined 4876 engineers and found that the majority scored low in extraversion. However, some interviewees argued that engineering is not about one person needing to be focused or needing some quiet time, and at the present time all types of engineering require having a team of people who can brainstorm ideas and find solutions together. In the same vein, one interviewee argued that general engineering can be a noisy and busy place and if someone who is introvert wants to go down that route they should be certain that they are going to be working in a noisy environment with a mixture of lots of different people even if the job is in an office or a factory.

Overall, the participants demonstrated that both extroverts and introverts are not necessarily to cause disharmony and both types can be beneficial in an engineering team. For example, one participant suggested that extraverts can work as sales engineers or engineering managers as for introverts they are ideal for quality assurance that includes reviewing documentation, specifications, and the compliance and traceability certificates, however, the participant reported some negative comments about introverts suggesting that ***'They should not be given a role that requires communicating with customers as they probably wouldn't give a good profile of the business'.*** Other participants, however, argued that just because someone is quiet and prefer to work individually doesn't mean they wouldn't be a good sales engineer or a good team leader. Accordingly, all participants agreed that harmony can be achieved when a combination of both sides of the personality is balanced and failing to do so can cause disharmony. In essence that creating a team with only solitary, independent and quiet people would create a dull setting and therefore teams need a mixture that keeps the morale and spirit alive.

Previous research findings into the personality trait agreeableness demonstrated that team members high on agreeableness have a cooperative and productive nature, also identified as sympathetic, kind, and affectionate (Williamson et al. 2013). Moreover, Wolff and Kim (2012) noted that social harmony is very important for highly agreeable individuals as they have the tendency to put aside their interests for other team members. Together, these qualities indicate that highly agreeable team members influence a harmonies team environment. However, the findings of the current study do not support the previous research. Hence, some participants expressed that highly agreeable individuals can hinder team harmony if they are not knowledgeable enough of what they are saying they are going to do. For example, if they are asked to do certain tasks and the tasks build up over time because they agree to do everything, they will get stressed because people will just give them more work, and

that can leave a negative impact on the team as well as the team leader, because eventually the job will not be done or it will not be done correctly thereby, the aim is not going to be achieved, which will add more workload on the team members and that can hinder the harmony across the team.

On the other hand, other participants considered highly agreeable team members as an advantage. These views surfaced mainly in relation to the sympathetic side of highly agreeable individuals. According to Bhatti et al. (2013) individuals that score high on agreeableness are good communicators who can establish and foster healthy relationships with their peers. One participant suggested that being sympathetic is very important for team leaders as they need to be approachable and able to tell if somebody within the team got a problem. In contrast to highly agreeable team members, individuals with low scores of agreeableness are less flexible and can be problematic in a team environment and have the tendency to offend others in arguments and discussions (Ramalu et al. 2011). What is surprising is that low in agreeableness was the psychologist first choice of a personality that mostly hinders the harmony across an engineering team. The reason for this choice according to the psychologist has something to do with individuals with low scores of agreeableness being very rude, suspicious, and insensitive, which, in turn, create conflict which is one of the main reasons that cause disharmony across teams. This finding is consistent with that of Messarra et al. (2016) who reported that conflicts are a very common issue found in teams that are likely to arise between team members because of differences in personalities.

Consequently, a variety of perspectives were expressed regarding individuals with low scores of agreeableness. One interviewee reported that ***'although it is not ideal it is only one facet of their personality and does not get in the way of the value they add'***. In the same vein, some interviewees argued that it is a fact of life that teams will have people who are rude and ruthless and even though there are not ideal team leaders should offer them guidance and deal with them rather than just letting them go or passing them after somebody else. These results are in agreement with Williamson's et al. (2013) findings which suggested that managers of engineers should have the knowledge of their team members' personality traits and accordingly assign tasks to them. Conversely, a minority of respondents suggested that team leaders shouldn't employ those people and if they got through the interview and joined the team, the team leader should look into ways to get them out of the team as engineering teams shouldn't have people who are suspicious and insensitive because such traits will just ruin any kind of team harmony. A possible explanation for this might be that the former view reflects those who manage small teams between four to ten people; however, the latter view reflects those who manage bigger teams which consist of fifty to two hundred people as it would be difficult to understand each member's personality.

Furthermore, there were some suggestions that suspicious team members can lead to disharmony because there's that lack of trust and trust is really important in any team setting as team members should establish mutual trust between each other in order to complete tasks and create a supportive working environment. These results are in line with those obtained by Krasman (2014) who found that trust between team leaders and team members is of crucial importance and is critical to creating a harmonies team environment also, team members who trust their team leaders have higher productivity, collaboration and job satisfaction. In summary, for the informants in this study, agreeableness can be a double-edged sword meaning that it can be beneficial when highly agreeable people are knowledgeable and can complete the responsibilities they agreed on. Moreover, being sympathetic, kind and having the willingness to help others are essential traits to maintain team harmony. Additionally, whilst a minority mentioned that people with low scores of agreeableness hinder team harmony an should be dismissed

from the team, all agreed that it is one facet of their personality and can be monitored by using effective communication, training and guidance and most importantly it should not be considered as a personality that hinders the harmony across an engineering team unless people are extremely rude and suspicious.

Previous studies have demonstrated that neuroticism is a problematic personality as it is associated with negative feelings and reactions such as excessive worry, anxiety, insecurity, and shyness (Farrukh et al. 2017). Like all other all personality traits, neuroticism exists on a spectrum, meaning that people can be highly neurotic, little neurotic or in between. As indicated previously and broadly known engineering is classified as a high pressure challenging occupation so having team members with high levels of neuroticism would probably affect team harmony. The literature also suggested that highly neurotic individuals will most likely struggle and affect team harmony; especially for teams working within engineering sectors like manufacturing and maintenance due to breakdowns and machine faults (Martens and Carvalho 2016). Hence, the collected opinions differed as to whether neuroticism hinders the harmony across engineering teams or not. One participant suggested that ***'neuroticism hinders the harmony if it is combined with a dominant personality'*** as dominant people have the tendency to make quick decisions without considering others' ideas or solutions when they are under stress and that can cause a lot of conflicts. Similarly, another participant said *that '**highly neurotic team members can be a hindrance when they constantly linger in negative energy and complain when they are under stress'.***

On the other hand, the majority of participants, as well as the psychologist, agreed that neuroticism is a double-edged sword. According to the participants having team members with low levels in neuroticism means that they are confident and not afraid to take a few risks which can be very helpful in urgent situations. Moreover, having team members with a bit of neuroticism and anxiety can be useful as they will be more vigilant to detect issues which might be risky or harmful. Additionally, the psychologist suggested that an engineering team with a combination of some people who are high and some people who are low on neuroticism will probably be a quite good team. For example, one participant that works in a manufacturing organization suggested that this combination can be utilized in a logistics team wherein people who are high in neuroticism can do the planning and the team members who are low in neuroticism can do the execution part. Moreover, the participants pointed out that people low in neuroticism have the tendency to help and support highly neurotic team members when they are anxious and stressed out.

A possible explanation for why the majority of participants disagree with the literature in terms of neuroticism being a hindrance is that dismissing people because they are anxious and insecure is neither ethical nor professional especially if they are perfectly good at the job. Moreover, one participant argued that the days of terminating people because their personality clashes with other team members are long gone. Hence, a study by Wolff and Kim (2012) suggested that there is no correlation between neuroticism and networking behaviours. Furthermore, all participants agreed that a good team leader should be able to identify with that personality type and recognize if a team member is nervous or anxious and doesn't want to tackle complex situations. It was also suggested that team harmony depends on how the team leader deals with neurotic people and their capability to bring them slightly out of their shell and make them feel more confident in themselves. In addition to that, the participants demonstrated that a good team would have people who would probably fit into every single category and it is the team leader responsibility to identify what positions each team member fits mostly in.

In summary, these results show that neuroticism should not be considered as a hindrance because it is a fact of life that everybody has insecurities and it is rare to employ people with perfect personality and skill sets. However, neuroticism can be a hindrance if the engineering team is full of people who are highly neurotic or if the team leader is Incompetent. Moreover, the majority of interviewees agreed that It is not the personality that hinders the harmony it is how people perceive team members who are nervous and anxious as they might perceive them not to be doing their job or strong enough to be part of the team. Therefore, having a solid leadership that offers support and guidance to highly neurotic team members who are nervous, insecure, shy and anxious is very important to maintain team harmony. These results reflect those of Cardon and Bribiescas (2015) who also reported that even though, managing highly neurotic team members can be challenging for team leaders, it is their responsibility to make sure everyone on the team is being as comfortable as possible and most importantly as productive as possible even if it requires treating everyone differently.

6.2 Maintain Harmony across an Engineering Team with Diverse Personality

The second aim of this study is to explore different ways to maintain harmony across an engineering team with diverse personalities. As discussed in the literature review, prior studies that have explored team harmony and personality suggested conflict management and understanding team personalities as essential principles to maintain team harmony. Accordingly, the participants were asked to share their opinions on these principles as well as share other principles that can be employed to maintain a harmonies environment across an engineering team with different personalities. The five principles identified by the participants as well as the pre-defend principles are as follows: understanding team personalities, personality conflict management, balanced teams, equal and fair treatment, and autonomy and ownership.

6.2.1 Understanding Team personalities

With respect to the existing literature, it was found that team harmony depends on many elements but one of the critical elements is the composition of the team members. Harmonious teams are comprised of team members that understand each other personality types (Zhou et al. 2015). However, it is not easy for someone who is not specialized in psychology to recognize personality types and their effects on team harmony. Moreover, Bradley et al. (2013) reported that the understanding of how personality affects team harmony remains underdeveloped. Accordingly, the participants were asked if it is possible to understand team members' personality types. Whilst a minority mentioned that it is difficult and not possible, all agreed that it is feasible and very important. These differences could be attributed to the different number of team members each participant is involved with. For example, participants that work in big engineering organizations suggested the best approach is to have clear policies around how teams operate and how they are valued as well as by conducting team briefs on a quarterly basis where team members are given the opportunity to interact with each other on a personal level and explore their peer's personality.

Regarding the participants who reported that understating team member's personality is possible. They all agreed that due to the small size of their teams they are able to guide their team members according to their personality type. Moreover, one participant argued that team leaders who don't understand the personality traits of their team members are not doing a very good job with their role suggesting that they can easily use personality tests. A serious weakness with this argument, however, is that not everyone has the ability to identify others personality

types especially if they are not experts in psychology and questioning one's leadership skills based on their ability to identify personality traits is quite unfair. This view also accords with a recent study by Lundgren et al. (2017), which reported that non-psychologists team leaders with few years of experience in team management tend to have a very limited understanding of psychological testing; also forcing team members to take personality traits can make them feel uncomfortable especially after sharing the test results with their team leader and peers. Moreover, it is argued that using personality testing without a clear understanding of personality types and psychology could raise ethical concerns regarding inappropriate use of tests results and confidentiality (Donner et al. 2008).

Commenting on personality tests and understanding people's personality, one of the interviewees said ***'I am not an expert in psychology; I am just an engineer who's worked with a lot of people over the last 20 years'***. Accordingly, the majority of participants agreed that understanding everyone personality on the team is not always possible or easy, especially in large teams. However, the informants reported that understanding team member's personality can be achieved when working with them constantly over a period of time and through observation it is possible to understand their personality and how it affects the way they work and communicate. These results reflect those of Clive (2013) who also found that team relationships do not happen instantly or even over a short period of time, they need to be nurtured and time needs to be invested wherein team members are given the time to express themselves in the team. However, it is important to bear in mind that this might not work with large teams. As one interviewee suggested in bigger teams team leaders need to pick that very quickly by communicating with the team members on a holistic base, looking at all angles to gain knowledge on their personality and what is going to work best for them.

Therefore, it can thus be suggested that in order to maintain a harmonies environment for non-psychologists is by acknowledging the importance of personality and communicating that between the team members which can be achieved in the development process and coaching like mentoring and workshops and most importantly from the daily interactions. This view was also echoed by one participant who argued that the starting point for any team leader is to recognize the importance of understanding the personality and what switches people on and what works with people in terms of management style as well as getting everybody else in the team to understand how important personality is for team harmony and how it affects their peers working style. However, it appears that not everyone has the ability to understand someone's personality. According to Li et al. (2016) team leaders with a high level of emotional intelligence are quite good at understanding their team members and they are good at interacting with them and getting the most out of them. But, team leaders who are low on emotional intelligence struggle with that and they might not be very good at reading personality. Hence, that can hinder the harmony as they won't be very good at recognizing the difficulties and conflicts in someone's personality and they might not have the ability to resolve them.

6.2.2 Personality Conflict Management

As was discussed in the literature review, opinions differed as to whether there is a relationship between the big five personality traits and conflict management styles. Anwar et al. (2012) found that researchers have attempted to investigate the correlation between conflict management styles on personality traits for decades. Other researchers, however, who have looked at the same subject, have found that studies are inconsistent, Barbuto et

al. (2010),for example, reported that some studies reported a strong correlation between the two while others deemed the correlation to be weak. Hence, it could be suggested that the differences between the two views are due to the time gap between the two studies. Commenting on this subject matter, the psychologist argued that they have never seen any particular research linking personality traits with conflict management styles nor there is a specific approach to manage personality conflicts. Accordingly, the psychologist suggested that it is about intuition and emotional intelligence and understanding that what works for one person may not work for another person. For example, the sorts of things an extrovert is going to respond to will be quite different from that of an introvert, in the sense that introverts might not like being the centre of attention in a conflict while an extrovert will probably find that really comfortable.

Furthermore, some of the participants agreed that the best way to resolve personality conflicts is by dealing with them straightaway before they become a bigger problem, rather than letting them go out of control. Also, they all agreed that it is the team leader responsibility to spot any problematic personality traits that might cause conflicts. Moreover, one participant argued that the best way to resolve personality conflicts and understand why a team member behave the way they have is by listening more rather than talking. These views are in agreement with those of Saundry et al. (2015) who suggested that conflict management must become part of the job requirements for team leaders and should be incorporated into the training and development process. Nevertheless, there was some sort of hesitancy and uncertainty among the majority of participants in terms of personality conflicts being a major cause disharmony. This is evident in the strategies the participants suggested as they are all very general and can be used in any type of conflict. Additionally, none of them mentioned any of the conflict management styles discussed in the literature review that were reported by Messarra et al. (2016) in which it was argued that there are five different conflict management styles that can be used with the big five personality traits.

In spite of the uncertainty of the majority of the participants, a minority did suggest that if the team members are high in openness to experience, agreeableness, and extraversion the best possible way to manage the conflict is by to talking quite bluntly with them. But if they are high in neuroticism and low in extraversion the best way is by comforting and supporting them. On the other hand, one participant suggested that when it comes to personality conflicts it is important to be fair across people and treat them with equivalence regardless of their personality type. Overall, these results corroborate the ideas of Ayub et al. (2017), who suggested that conflict resolution depends on how the conflict is perceived by the team leader and the leadership style. In general, therefore, it seems that, the best way to handle personality conflicts is by trying to reason with people and see things from their point of view, give them some options of where they may not be to harmonious and give them some words and options to make it better for themselves and for the rest of the team and sometimes it is just important to plainly tell them what they are doing is kind of upsetting the rest of the team and is affecting the team harmony.

6.2.3 Balanced Teams

Too often, team leaders focus more on the functional aspect of any prospective team member. But building productive and innovative engineering teams is not just about having people with technical skills and experience (Yeager and Nafukho 2012). It is also about building a diverse team where everyone works together cohesively and harmoniously. And the team diversity will depend on the team members' differences and personalities (Weeks et al. 2017). Accordingly, one interviewee argued that the best way to maintain team harmony is by building a

team with a mixture of personalities. In the sense that a team won't survive if it has people who are all introverts or people who are all extroverts. Also, it was suggested that the success to any engineering team depends on its diversity and achieving that depends on the team leader making sure that the team is balanced and has a mixture of personalities. Conversely, some participants argued that if everybody is professional then having the same personalities won't hinder the team success or its harmony, and that can be achieved by having a procedure-driven system where people's personality is monitored by the organization rules, policies and deadlines. Therefore, it seems that having a bit of realism is important as building a diverse requires dedication and determination.

In spite of the variety of perspectives towards building a team with a mixture of personalities, there were some suggestions regarding the cons and pros of building an engineering team with different personalities. Accordingly, it was suggested that bringing people high in openness to experience and agreeableness is one great way to maintain a harmonies environment as they will lift everybody else in stressful situations and boost their productivity due to their positive and outgoing personality. For example, one interviewee said: 'we have got this project manager who is quite negative and because of his personality he drags everybody down'. Moreover, A common view amongst interviewees was that engineering teams can have people that are pessimistic, e.g. (high in neuroticism), as long as the teams got somebody that is optimistic, e.g. (high in openness to experience and agreeableness), to balance things out. In other words, if an engineering team has to too much of pessimistic people they will struggle. In the same way, if an engineering team has too many optimists they might overcommit because they will agree to take extra load and that would properly disappoint customers because they might not have a full understanding of the task for being too positive and as result things will go wrong and machines will break down causing delays in delivery.

6.2.4 Equal and Fair Treatment

Another suggested principle to maintain harmony is treating team members equally and fairly by implementing an open and fair reward system for teams which recognize the work of individuals and encourage people to work harmoniously in teams. In addition to getting the teams together on a regular basis and having an open and fair conversation about people's concerns and issues, as well as for sharing information across the group so that no one is left out. It seems possible that these suggestions are due to the participant's organization struggles with the concept of teams because it was observed that there is an existing dichotomy within the organization as of whether people work as a group of individuals or as a team. Accordingly, one participant talked about how team members high on extraversion and openness to experience, climb the corporate ladder faster, and get more recognition than those who are less confident, independent, and quite even though if the latter are more deserving of that promotion and recognition. Furthermore, another participant suggested that ***'The harmony within the team is influenced very much by the leader believe of whether everybody can prosper or there could only be one winner'***. In accordance with the present results, a recent study by Lin et al. (2015) have demonstrated that treating team members with fairness and dealing with everyone based on facts and not personality are two essential requirements for success as a team leader.

6.2.5 Autonomy and Ownership

Some interviewees argued that when an engineering team has a mixture of personalities, the best way to maintain team harmony is by making the team environment as flexible as possible so that everyone can have the opportunity

to express their personality in the way they see fit and make them feel comfortable. Moreover, one participant suggested that not doing so will make people bored and they won't have as much determination, and most importantly they won't bring their own personality to their work whether it is a new and creative idea from the engineers who are high in openness to experience, or a solid and structured idea from the engineers who are high in conscientiousness. These views are consistent with those of Williamson et al. (2013) who found that engineers compared to other professions are more: introverted, flexible and visionary in their working style and therefore they need to be offered a flexible environment which accommodates their diverse traits to optimize their contributions. Additionally, few participants suggested that the best way to maintain a harmonious environment is by not having strict rules of how things should be done and letting the team members take ownership of their projects to allow them bring out the best of their personality and reflect it back on their projects and work. Although spreading this energy and allowing that kind of flexibility and autonomy to explore all the options is inspiring and is entirely needed, it is difficult and not entirely possible for all teams because engineering projects never goes straight forwardly as problems always arise and especially that there are usually constraints in place such as budgets and time.

7. Conclusion

The purpose of this study was to determine personality types that would hinder the harmony across an engineering team. The second aim of this study was to investigate practical principles to maintain harmony across an engineering team with diverse personalities. This study has identified the meaning of team harmony in engineering from the perspective of the literature in which it was argued it is about respecting and understanding others in their differences. On the other hand, this study found that it is mainly about team members working together towards a common set of goals, effective communication and sharing of information, as well as effective conflict resolution. The most major finding to emerge from this study is that some of the personalities that are considered a hindrance in a team environment are not necessarily problematic or a hindrance in an engineering team. For example, in the literature, highly neurotic team members are considered as a hindrance due to their association with excessive worrying and anxiety. However, this study found that engineers with these traits are important for team harmony as they are more vigilant to detect issues that might be risky or harmful and they are very beneficial for planning as they take extra attention of important details.

Furthermore, this study found that engineers who score low in openness to experience are also beneficial to team harmony as they take their time to solve and think through a problem and are ideal for quality assurance as opposed to the literature in which they are considered a hindrance in engineering teams due to their cautious, unimaginative, and consistent nature. As for highly conscientiousness engineers, the literature argued that are vital for engineering teams due to being hardworking and orderly. However, the results of this study show that they can be a hindrance if they are too involved in perfectionism and detail. This study has also shown that extraversion is associated with darker traits meaning that engineers who are incredibly extroverts can be dominant and take all of the attention and thus people who are more introverts can be overlooked by the team leader which can cause disharmony. Finally, this study shows that even though highly agreeable individuals are considered key for team harmony due to their cooperative, sympathetic, and kind nature, in reality, they can be a hindrance as they have the tendency to agree to do everything even if they are not knowledgeable or capable enough. On the whole, this

study strengthens the idea that team leaders should not rely on appearances to make judgments as there is more to every personality than simply what it looks like.

This is also evident in the principles identified in the literature to maintain team harmony across engineering teams with diverse personalities. Hence, this study found that understanding team members' personality is difficult and not always possible especially in large engineering teams and more precisely that not everyone is specialised in psychology to be able to identify personality types. Also, the study found that there are no set formulas to deal with conflict based on personality type. Notwithstanding these findings, the study offers valuable insights into how to maintain harmony across engineering teams with diverse personalities. Overall, this study critically examined the existing literature and built arguments based on its primary data that was collected through semi-structured interviews with experienced engineers as well as an experienced psychologist who validated the study.

8. Opportunities for Future work

A further study can assess team members' views in terms of what personality types can hinder engineering team harmony and what principles can be deployed to maintain team harmony. Finally, a recurrent theme in the interviews was a sense amongst interviewees that both individuals "Cultures" and "Values and beliefs" influence their personalities and team harmony, but to maintain the essence of this study those elements were not investigated. Therefore, in the future it would be very interesting to examine their impact on engineering teams' harmony and their relationship with personalities.

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Appendix 1

Interview questions used for this study:

- Define team harmony?
- How do you achieve team harmony?
- What hinders the harmony across engineering teams?
- A lot of information circulates in engineering projects, but some people tend to hold information as a form of power. do you think withholding information is influenced by one's personality?
- Do you engineers who strive for leadership and like to be on top can somehow hinder the harmony across an engineering team?
- If you were asked to form an engineering team, what would be the ideal personalities to have in the team?
- As an engineering manager, do you try to understand your team members personalities and accordingly delegate tasks to them and is that feasible do?
- While leading a large number of engineers were you able to understand each engineer personality?
- Is sharing information with your team members influenced by your personality or because it is expected of you as their manager?
- In the literature, personality traits influence conflicts escalations and how they are handled, do you use a conflict management style when dealing with different personalities?
- What types of personality hinder harmony across an engineering team?
- Engineering is complex and challenging. Do you believe engineers who are introverts hinders team harmony as they might get easily stressed?
- Have you ever encountered engineers with certain personalities that helped you develop professionally and personally?
- Can you give me an example of an incident where the engineer personality had a negative influence on team harmony?
- When you encounter a conflict do you tend to use a conflict management style according to the personality?
- For someone with an engineering background is it possible for you to understand each one of them in terms of their personality?
- Engineers high on agreeableness tend to agree with everyone and on everything. Do you think that is a good personality for an engineering team does it like have a good influence on the team harmony or hinders the team harmony?

- Engineers high on openness to experience tend to be fixable, curious, creative and open-minded. How do think they impact an engineering team harmony?
- Highly consciousness engineers are known to be hard-working, orderly and responsible. On the other hand, engineers who score low on consciousness are the opposite. In both cases how does consciousness impact an engineering team harmony?
- Engineers who score highly on extraversion tend to be energetic, talkative and assertive. How do you they impact team harmony in your opinion?
- Do you believe highly extroverted *engineers hinder the harmony across engineering teams due to their* talkative and outgoing nature because in the literature it is argued that engineers need a quiet environment to operate?
- Are you able to understand each person's personality when you work with them? Is that feasible to do to understand their personalities.
- What types of personality do you think hinder the harmony across engineering teams?
- What do you think of engineers who are flexible, curious, creative and open-minded as opposed to engineers who are consistent and unimaginative?
- Tell me about your experiences in the field of engineering and the number of engineers you managed within a team?
- Do you believe engineers who are disorganized, impulsive and unreliable hinder the harmony across the team?
- How is team harmony affected by cooperative, sympathetic, kind and efficient engineers and how it is affected by rude, cold and insensitive engineers?
- How do you feel about engineers who are independent, quiet and solitary?
- In an engineering team having a balanced mixture of personalities is good to maintain a harmonious team but having an extreme can hinder that harmony like having people who are just outgoing, energetic and talkative. How do you feel about that?
- Since engineering projects involve a lot of pressure and challenges. How do you feel about having nervous, insecure and sensitive engineers who tend to get anxious when under pressure in your team?
- Can you think of an example of engineering practice that personality might affect it negatively?

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