

# Impact of Personality and Gender Diversity on Software Development Teams' Performance

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**Abstract**— Human aspect is considered as one of the success factors for software development. Besides, diversity is labeled as the most effective element for creating effectiveness in team performance. Thus, this study has aimed to find the effects of gender diversity on team performance based on personality types. The personality types' variations were found effective on team performance based on genders. For instance, male-lead groups were found convenient with both genders but female-lead groups looked much comfortable with only female members. Moreover, female-gender looked uneasy in male dominant teams especially when their personality is E (extrovert). Whereas, male-gender was observed as digestible in female-lead teams if the I (introvert) personality is dominating.

**Index Terms**— gender diversity, software development, personality types, team composition

## I. INTRODUCTION

The tasks of software engineering project are most often shared among different teams to reduce their burden and simultaneously enhance the quality of software. Overall, the human aspects (opinions, perceptions, experiences, personalities) in software development play key roles to make any project successful. The interaction of the human elements in software development comes up from problem solving to communication, and from analytical thinking to cognitive reasoning. In the same vein, Capretz & Ahmed [1] emphasized that an ideal software staff possesses qualities of both types of skills (hard skills and soft skills). Additionally, the isolation of either social component (i.e., personality) will never ensure the best and desired results of development, for the lack of either component does not ensure the effectiveness of a software team [2].

Considering the personality types for composing an effective team, the efforts of team managers are creditable (in terms of recruiting developers possessing the sound knowledge of hard skills and favorable soft skills). Many team composition models have been researched and managers have been advised to implement them to create an ideal team for the development of software, but the validity of these team composition models for an effective team is still being questioned [3].

Muchiri & Ayoko [4] asserted that gender diversity effects cognitive task performance and its solution can lead to generate the most effective problem solving tasks. Keeping in the view,

Kang [5] mentioned that future research can include the demographics (i.e., culture and gender) characteristics with personality for better outcomes in software development. In the same vein, Rehman et al. [6] and Karn & Cowling [7] encouraged the researchers of software engineering to conduct the future research on personality by focusing the various cultures and gender, especially including from different countries. Therefore, this research is paved to find the moderating factors on effectiveness of team performance based on personality with gender.

## II. RELATED WORK

The abundant amount of research on personality and gender, either separately or collectively, has been conducted in social science studies. But unlike social science, the software development research on personality and gender is not reached on maturity level [6], [8]. Furthermore, Trauth [9] also mentioned that theoretical work in software research is lacking too.

Karn & Cowling [7] conducted their follow up research work on personality in software engineering teams. The ethnographic approach was used to achieve one year study results (2004-2005). The positive results were observed from personality-heterogeneous teams. The study further reveals the negative impact of one-man show on team, means the teams were found ineffective if any member tried to control the whole team all alone. In the end, authors also recommended the gender and different culture study for future. Moreover, Rehman et al. [6] conducted their research of software team composition based on possible job requirements of software developments roles. Authors proposed a conceptual model that was based on Big Five personality traits. The same type of work was also taken by Capretz and Ahmed [1] on MBTI personality types. Both studies results showed the importance of personality in software team composition and impact of diversity.

According to the study of Cruz et al [19], the personality type of a team member is major source to gain favorable outcomes in software development than process, tools, and technology. They further mentioned that the job satisfaction, project success, and conflicts resolution can be conceived with composition of team with effective personality types. In the research of effective team composition of personality types based on the team roles, Martinez [10] has also mentioned that

team success can be achieved when the team members are assigned to appropriate software role.

Richards & Busch [8] comes in only few studies on gender and culture effects on performance of team in IT workplaces. In this study, the diversity was discussed as an effective parameter on team performance. They further emphasized that culture and gender can help to reduce knowing and doing gaps in IT workplaces. These validated results cannot be generalized, as one of the gaps and limitations. However, inclusion of personality in software development can make these results generalized.

### III. METHODOLOGY

In order to investigate the impact of gender diversity of team member on the performance of a team, two data sets were collected from two settings, i.e., Academic and Industrial setting. These data sets are secondary data and have already been used [11]. In the academic setting, data sets were collected from experiments that were performed on the final year university student of Universiti Utara Malaysia (UUM). These students were required to develop client-based projects in a team of four to six members for two semesters.

This research objective is to explore the impact of gender diversity on the team performance based on team member personality type. Focusing the main objective, it was observed that there are two different thoughts exist in psychology research regarding the relation of personality types and participants' age. First, personality type doesn't change and second, claims that personality type has group of ages, but 20-50 age group is stable [12]–[14]. Therefore, in this study, the groups' composition was examined based on their (students) age limits that were 20 years. Thus, the age restriction of team members can make both claims of psychology into the account.

Moreover, total 46 teams were composed based on gender and personality types in academic field. Groups were composed in all possible ways i.e., only males, only females, majority males and minority female, or majority female and minority males. In which majority and minority terms refer to have the number of particular gender in teams. Furthermore, the team leader gender effects or changes were also examined in composed groups. Whereas, the personality types was outlined by 16 personality types into four main distinct pairs (four different categories: Introvert (I) or Extrovert (E), Sensing (S) or Intuitive (N), Thinking (T) or Feeling (F), and Judging (J) or Perceiving (P)) based on Myers-Briggs Type Indicator (MBTI) personality types. The MBTI personality type was a common tool used for personality measurement in both fields i.e., academic and industries.

Secondly, the experiments on industrial population were performed from two different industries (two software companies and one oil and gas company). Industries population was also composed based on gender distribution (as academic population) i.e., males only, females only, males majority, female majority. Small – medium team size was focused while composing the team, in which from 4 to 6 members were involved for one project. Total 13 teams participated from

industrial experiments from three different software companies.

### IV. RESULTS AND DISCUSSION

#### A. Team lead Gender Diversity from Academic and Industrial Results

In academic data, among total 46 groups of student, only 17 groups performed on requirements of project, and those were shortlisted as successful projects and teams. Therefore, only those 17 groups were discussed in results to produce effective output. Initially, it was seen that performance of team lead based on gender was, probably, found equally effective for male gender lead and female gender lead. For instance, total 28 teams were led by a female gender out of 46. But only 10 groups were able to produce high quality software. Whereas, the high quality software refers to software that met client's needs. On the other hand, male leaders led 18 groups out of 46 and just 7 were come in the list of quality projects. So, based on these results, only 36% projects were successful in all female-lead groups' projects, and 39% success was obtained from male-lead groups. The Figure-1 is representing the team success and failure based on gender of team-lead.

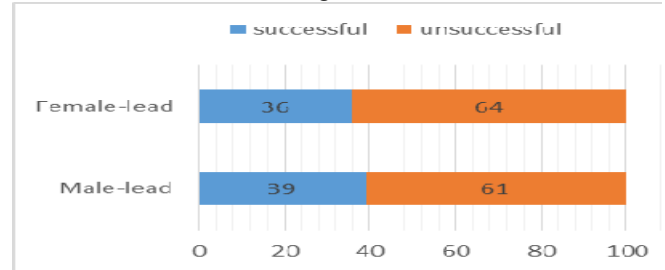


Fig. 1. Success and failure of team based on gender of team-lead

Furthermore, while analyzing the failure and success facts based on team-leader personality. It was observed that successful team-leader, from both genders i.e., male-lead or female-lead, mostly own the intuitive (N) trait rather sensing(S) in their personality, which is the second pair of MBTI. In fact, a leader has to be intuitive because leader has to believe only what he gets and what results are being extracted from his team. The TABLE I represents the results of team leader personality in which “Role 1” is indicating the team-leader and gender 1 for male and 2 for female. Similarly “IE” refers to introvert and extrovert and 1 represent introvert personality traits and 2 extrovert and likewise all pairs of MBTI. Last column represents 1 as quality software.

TABLE I. SUCCESSFUL TEAM LEADERS' PERSONALITY (EXPERIMENT WITH ACADEMIC DATA)

Role	Gender	IE	SN	TF	JP	Quality
1	2	2	2	2	1	1
1	1	2	2	2	1	1
1	2	2	2	1	1	1
1	1	2	2	1	1	1
1	1	2	2	2	1	1
1	1	1	2	2	1	1

1	2	1	1	1	1	1
1	2	1	2	2	1	1
1	1	1	2	2	2	1
1	2	2	2	2	1	1
1	2	1	1	2	1	1
1	1	2	2	2	1	1
1	1	2	1	1	1	1
1	2	2	1	1	1	1
1	2	1	2	2	1	1
1	2	2	2	1	1	1
1	2	2	2	1	1	1

On the other hand, the industrial experimented data showed eccentric results than academic data. First of all, as mentioned total 13 teams were composed while experiment and evaluators just selected 5 software project in quality project list based on requirements. Only 4 projects were led by a male-leader and 9 projects were led by female-leader. The results showed the major factor of failure in leaders' personality was their introvert behavior. For instance, 6 out of total 8 failure projects' leader were introvert in their personality traits, which is, of course, dangerous for the team performance. Likewise, Capretz and Ahmed [1] and Wang [15] also maintain that inclusion introvert personality type of team leader in team cannot be lucrative mean since it can likely to dissuade members and clients. Among 9 projects led by female-leader only three were quality projects. On other hand, 2 projects were resulted with quality out of 4 led by male gender.

Here results come in controversy that in all 5 successful projects' leader personality, from industrial data, four leaders were sensing (S) despite intuitive (N) as in academic data. But one similarity was found in both datasets that extrovert kind of personality trait gender is successful leader. In available industrial data, one can say that female-leader with introvert personality are unsuccessful. So, in such kind of situations gender-diversity is required for team better performance. The TABLE II shows the successful leaders' personality description in industrial data.

TABLE II. SUCCESSFUL TEAM LEADERS' PERSONALITY (EXPERIMENT WITH INDUSTRIAL DATA)

Role	Gender	IE	SN	TF	JP	Quality
1	2	2	1	2	1	1
1	1	2	1	2	2	1
1	1	2	1	1	1	1
1	2	2	2	2	1	1
1	2	1	1	2	1	1

#### B. Gender-Diversity and Team performance in experimented Data

After analyzing the team leaders' gender and impact on the performance of team, then overall gender-diversity was evaluated and discussed based on several factors in successful and unsuccessful teams. In order to discuss the results the main themes of distribution of gender, i.e., Male only, Female only, Male majority, and Female majority teams, were grouped into

two main categories: 1. Male dominated (i.e., male only and male majority) and 2. Female dominated (i.e., female only and female majority).

##### 1) Male Dominated Group

Starting from academic data in which overall 46 teams were experimented and only 17 teams' projects were shortlisted as quality software projects. And 7 projects, led by a male-gender, were shortlisted as quality software in which Male-gender dominancy occurred. Moreover, it was found in academic experiment dataset that if the leader was male and team was composed with equal number of male and female then team could perform well enough. On the other hand, if a team was distributed equally in gender but the leader was female then the software quality was not found in academic data.

Furthermore, it was also observed in academic data that minority of a female-gender in introvert dominant team with male-lead team is shown to be less-lucrative. For instance, in TABLE III, team 2, 9, and 12 were composed with one female-gender with introvert dominant personality type. Therefore, the quality of software project was not achieved. On the same time, when team is composed of the same number of gender with male-lead but extrovert personality (see team number 11 in TABLE III) then the quality of software project is obtained.

TABLE III. MALE-DOMINATED TEAMS AND PERFORMANCE (ACADEMIC DATA)

Team No	2	9	11	12
Leader Gender	1	1	1	1
Total Male	3	3	3	2
Total Female	1	1	1	1
Total Intro (I)	2	3	0	2
Total Extro (E)	2	1	4	1
Total Sen (S)	1	0	3	0
Total Intui (N)	3	4	1	3
Total Think(T)	4	1	2	3
Total Feel(F)	0	3	2	0
Total Judg(J)	4	3	4	3
Total Perc (P)	0	1	0	0
Quality	0	0	1	0

In academic data, almost all only-male-gender teams outperformed when the number of intuitive (N) was greater than number of sensing (S) in the second pair of MBTI (i.e., team no 2,9,12 in TABLE III). So, it can be supposed that if a team is led by a male-gender and members are only males having intuitive personality can be better for overall results.

The industrial dataset showed sort of similar results with results obtained from academic data. For instance, in male-lead teams with minority of female-gender and majority of male-gender showed unqualified software project in quality. Moreover, male-lead team looked comfortable with female members, as far, if they are in 60%-40% ratio. This can be similar with academic dataset where equal number of gender ratio in male-lead team is attributed to the quality.

Furthermore, it was observed again that extrovert (E) personality dominant teams outperformed in male-lead teams. In the end, feeling (F) trait of personality was visible in common trait factor in male and female-lead teams in industrial dataset that was not found in academic dataset.

## 2) Female Dominated Group

In academic dataset, completely opposite results were found in female dominated groups than male-dominated. For instance, equal number of male and female didn't performed well if the leader is a female. Only two teams could provide the quality software in which male-gender was a member and rest all were female even with leader. It might be possible because majority of team members in those two groups were introvert. The TABLE IV shows the uneasiness of female-lead teams with male-gender members in academic dataset.

TABLE IV. FEMALE-DOMINATED TEAMS AND PERFORMANCE (ACADEMIC DATA)

Team No	16	17	20	27	28	35	36	45	46
Leader Gender	2	2	2	2	1	2	2	2	2
Total Male	2	1	1	1	1	1	1	1	2
Total Female	3	4	3	3	3	3	3	2	2
Total Intro (I)	0	4	2	2	1	3	1	0	1
Total Extro (E)	5	1	2	2	3	1	3	3	3
Total Sen (S)	3	1	2	4	4	2	4	1	2
Total Intui (N)	2	4	2	0	0	2	0	2	2
Total Think(T)	1	1	1	3	2	2	2	2	3
Total Feel(F)	4	4	3	1	2	2	2	1	1
Total Judg(J)	5	5	4	2	3	4	3	2	3
Total Perc (P)	0	0	0	2	1	0	1	1	1
Quality	0	1	1	0	0	0	0	0	0

Even in male-lead teams female were noticed uneasy if males are in majority and their personality is extrovert (see team no 28 in above table). But only-female-member groups looked more convenient other than any gender-diversity in female-lead groups. From overall 10 female-lead quality projects, 8 projects were only female group projects. It, completely, shows that female-lead projects doesn't accept gender diversity.

In industrial dataset, majority of female-lead projects were listed as unqualified. As mentioned, out of total 9 projects only 3 projects could achieve the requirements. The introvert (I) personality of, majority, members in female-dominant teams were found as a key factor for failure. In female-dominant teams only female-gender teams and female-majority teams didn't perform on criteria in industrial dataset. The team number 7, 11, and 13 were female dominated by all means but

couldn't achieve the quality results and that shows the contrary results than academic dataset. The TABLE V shows the details of unlisted quality projects led by female.

TABLE V. FEMALE-DOMINATED TEAMS AND WEAK PERFORMANCE PERSONALITY TYPES (INDUSTRIAL DATA)

Team No	6	7	9	10	11	13
Leader Gender	2	2	2	2	2	2
Total Male	2	1	2	3	0	1
Total Female	3	4	2	2	6	5
Total Intro (I)	4	3	3	3	4	3
Total Extro (E)	1	2	1	2	2	3
Total Sen (S)	2	2	2	2	2	5
Total Intui (N)	3	3	2	3	4	1
Total Think(T)	1	1	3	4	2	4
Total Feel(F)	4	4	1	1	4	2
Total Judg(J)	5	5	3	5	6	6
Total Perc (P)	0	0	1	0	0	0
Quality	0	0	0	0	0	0

Industrial experiments further reveal that female-lead teams or female-dominant teams can produce quality results with male members. Provided the members are feeling (F) in their personality and will be attributed if they are intuitive (N) and extrovert (E) too.

## V. CONCLUSION

It is a fact that members from different groups create issues and conflicts when they communicate. Number of researchers has shown their consent that diversity has robust effects on performance [16], [17]. This research has also identified the gender (surface level diversity [18]) effects on the overall performance of a team. Conclusion presents the summary in two dimensions where first dimension discusses the team leader gender and overall performance. Whereas, the second dimension represents the overall gender effects with team members' personality types including team leader gender.

Discussing the first dimension, the research found that in academic dataset the leader E (Extroverts) and N (intuitive) personality possessing leaders were virtuous leaders for the performance of groups. Whereas, in industrial dataset E (extroverts) and S (Sensing) personality traits leaders showed their best in performance. Moreover, leaders' personality from both datasets comes in unique response that E (extrovert) leaders are suitable for both kind of gender-leaders. But based on industrial dataset the conclusion can be made that I (introvert) female-leaders are clearly hazardous for team performance.

Focusing the second dimension in which overall team members' gender and personality type are discussed including team leaders' gender. Firstly, male-gender leader was looked comfortable with both genders. Teams showed effective results if team leader is male and team is composed of only males or equal number of male and female in team. Moreover, E (extrovert) dominant teams showed enhanced results in male-

leader teams and N (intuitive) personality traits considered favorable in male-dominant teams. Female looked uneasy in male dominant teams especially when their personality is E (extrovert). Even more, female-lead groups looked extreme comfortable with only female members in academic datasets. Whereas, male-gender was also observed as digestible in female-lead teams if the I (introvert) personality is dominating. It was further seen that F (feeling) personality owning teams are attributed to better performance in female-lead teams or female-dominated teams.

Based on results, this study states that gender diversity is a key element for team performance. Keeping in view, this research can further explore its better results if the data collected on large scale. As one of the limitations of this study is its sample size. Moreover, future work could also be conducted on various culture data (from different countries) in order to see the narrow spaces in details. Finally, the results of this research were descriptive whereas the future research can be predictive for developing some model.

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