RESEARCH ARTICLE

Practicing Equity Diversity Inclusion (EDI) in Software Development Teams: A Systematic Literature Survey

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ABSTRACT Human factors in successful software projects have always been a critical element in software engineering, however, it has always been overshadowed by focusing more on technology and underlying processes. This work is inspired by the recent increasing interest from the software engineering research community in human factors and software development by leveraging and understanding some examples of human factors such as Equity, Diversity, and Inclusion (EDI) which were not given due research consideration earlier. We performed a systematic literature review (SLR) to review the state-of-the-art literature on practicing EDI in software development teams despite of country or culture. We found that evidence of comprehensive research about practicing EDI in software development teams is limited, the up-to-date majority focus is on the topic of diversity, whereas research on topics of practicing equity and inclusion in software development teams is sporadic. It is expected that investigating the impact of human factors in the context of EDI's triangle will generate new knowledge. This will allow software practitioners to understand the benefits of practicing EDI in managing software development teams as well as provide opportunities to incorporate them into the core development process activities. In the end, future research directions for EDI practices in software development teams are also identified.

INDEX TERMS Equity, diversity, inclusion, software development team, software engineering, software process.

I. INTRODUCTION

The intangible nature of the software product has always made it difficult to understand the issues surrounding the humans who develop it. Software is developed by the people and it is for the people, however, studies investigating human factors in software development are sporadic and the primary focus had been the process side of software development. The human factor is important to achieve outcomes that are consistent and aligned with organizational strategies and values [1]. The software development workplace is not different from any other workplace, people in the workplace interact to achieve common goals. However, managing the people to develop the software is different from managing the people to do a construction project. Harizon [2] finds that increasing

awareness of human aspects of software engineering, in turn, might improve their understanding of software development processes. In a recent study by [3], a systematic literature review was performed for the perceived diversity only in software engineering. In this study, authors recognized perceived diversity as a high-value team priority and companies are willing to increase their efforts to create more diverse work teams, however, also highlighted the gaps in the current literature. Conversations about Equity, Diversity and Inclusion (EDI) are increasingly coming to the forefront within the software engineering world, and new research is taking strides to understand the impact poor EDI has within this domain [4]. Equity, diversity and inclusion work together, and any missing component has an impact on the efforts of others. Software development is technical and knowledge-intensive, but also human-centric and collaborative, benefiting from the social attributes of the people involved [5].

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Pinder [6] elaborates that equity theory postulates a relationship between a person's beliefs about the fairness of his treatment on the job and a variety of work-related attitudes. Equity involves the promotion of justice, impartiality, and fairness by recognizing the background of every team member [7]. It is quite often that people tend to mix up equity with equality which refers to accessibility, and availability of the same resources or opportunities. Whereas equity recognizes that every person is different, so it doesn't mean treating everyone equally but treating every person according to their unique circumstances. An equitable work environment provides everyone equal opportunities to excel and helps in managing bias and motivates professionals to be more productive. Software engineers always considered equity in software product design, for example, a software application that uses voice commands is preferably designed with compatibility to work with various languages. In an equitable software development team, the needs of every individual are considered, and all efforts are made to ensure that a level playing field is provided to team members and that they feel welcomed and valued for the various things they have to offer. Workload equity is always seen as a challenge in software engineering project managers because tasks have complexity, interdependencies, reusability, and time and resource constraints. Accommodation at the workplace is one of the essential elements in creating an equitable work environment, few examples are, some people have challenges in face-to-face meetings, environmental distractions, such as noisy workspaces, open concept offices, social gatherings etc., there any policies in place to provide accommodation to these challenges. In a recent study [8] to understand the challenges faced by neurodiverse software engineering employees, it is found that of the 17 employees who had disclosed their condition to management or HR, 94.1% said they had not either requested or received any workplace accommodations. Gender role in equity is about the norms and societal expectations that describe how people of different gender contribute, behave, and perform in a certain culture and society. In short, the research question for the investigation of equity in development teams is put forward for the SLR. By dismantling and challenging traditional gender roles we can strive for greater equity in all aspects of society. The research question investigates the factors that were studied by researchers in terms of practicing equity in software development teams.

Diversity refers to the variety of representations that exist within a group, based on a large range of facets and characteristics [9]. Diversity in the broader context addresses the representation of team members from various perspectives such as age, gender, race and ethnicity, culture, etc. The real challenge of diversity is not only to form software development teams that have a balance representation of various types of diverse entities but is to ensure that each team member is well engaged and productive, particularly those in the people of color. Although the software development industry understands that diversity in project teams is important and it is widely accepted that there are many benefits from ensuring diversity within teams, however, technical constraints coupled with a shortage of skilled workforce always override the motivations. Kohl and Prikladnicki [10] find that large technology companies have been creating annual reports of their efforts to have a more diverse workforce. Dieste et.al [11] report that seeking to innovate, increase profit margins and improve the quality of their products and services, many organizations have invested in diversifying their teams. According to Liang et al. [12] every software project faces team composition issues, and it has interested researchers whether bringing diversity in team composition would promote successful teamwork and further lead a project towards the fulfillment of its mission, vision, and values. The software development process is quite different compared to product development in manufacturing because the software product development process uses an iterative approach, is more knowledge-intensive and the technology to develop the product is fast changing in nature. To be more profitable and introduce cost-cutting measures, hiring people from countries with lower workhour has further developed the issue of how to manage people from these diverse backgrounds. A diverse software development team may have scenarios in which requirements collection, coding, and testing are carried out by individuals or groups of individuals with different cultural and social backgrounds, communication is a potential challenge and critical factor in the outcome of the project. For the investigation of diversity factors in the software development team for the purpose of SLR, research questions about the factors of diversity were included in the study.

An inclusive work environment acknowledges and values all employees' differences and contributions to the organizational culture. It includes inviting people of every race, religion, or group to take part in the organizational development [7]. Software development is a team effort, collaboration and task dependencies are essential, and an inclusive environment facilitates collaboration, shared vision and a common understanding of the task. It eliminates barriers that may hinder the progress of individuals. In a software development team that supports inclusiveness, everyone feels safe, supported, and encouraged to express her or his views and concerns in the decision-making process. Wanger and Ruhe [13] found credibility, respect and fairness are some of the factors that have an impact on the productivity of the software development process. Software processes should encourage collaboration among the various roles involved in a software project to achieve better productivity in development [14]. Although diversity has received much of the attention of the researchers in software engineering so far, however, inclusion which goes hand in hand with diversity the research appears to be limited in the context of software development. According to Vohra et al. [15], the pairing of diversity and inclusion at times leads to the misunderstanding that these are related and similar further explained that it is argued that while diversity can be achieved by hiring different people in the organization, inclusion is a process that involves

TABLE 1. SLR Related work and topics covered for EDI.

Paper #	EDI topic
Spichkova et al. [16]	Diversity in software architecture
Fazli and Bittner [17]	Cultural diversity for collaborative software efforts
Menzez and Prikladnicki [18]	Team diversity
Traylor [19]	Team diversity
Canedo et al. [20]	Gender diversity
Slivera and Prikladnicki [21	Diversity in agile methodologies

a change in the mindset of all the people in an organization. Software development is innovation-driven, new ideas and introducing changes to the processes are common, and an inclusive work environment allows people to speak openly, criticize ideas, and contribute to the discussion without any fear. For inclusivity factors in the software development teams were also investigated through the research questions.

A. RELATED WORK

Evidence-based software engineering prospects motivated the researchers to conduct a systematic literature review. However, the topic of EDI in software engineering is not studied in detail. Spichkova et al. [16] performed a literature review to investigate diversity in the software architecture field. Fazli and Bittner [17] also used the systematic literature review approach and studied the cultural factors of diversity and its impact on collaborative software development approaches. They analyzed 20 papers and highlighted the issues due to cultural diversity such as differences in communication, decision-making and interaction during collaboration. Menzez and Prikladnicki [18] performed a systematic literature review on team diversity in software engineering. They included only 11 papers in the study and conducted semi-structured interviews to observe the impact of diverse software development teams. They reported on the challenges and barriers faced by team members at the workplace. They concluded that the consideration of diversity and inclusion has a positive impact on software development. Traylor [19] conducted a meta-analytic investigation on the topic of team diversity-process relationships.

Previously, authors investigated gender diversity in software developments using systematic literature review only such as Canedo et al. [20] investigated the OSS communities for gender diversity and covered 24 papers. The study highlighted some factors that can increase female engagement and contribution to OSS. Slivera and Prikladnicki [21]

covered diversity only in Agile methodologies in SE. They used the systematic mapping approach to explore the types of diversity.

The related studies performed SLR on the very specific topics and Table 1 summarizes the related work papers for EDI topics covered in the studies. Most of the related work is only on the diversity topic and investigation is very limited. It is very important to investigate the EDI practices in the software development team not limited to diversity only. This investigation will help researchers and practitioners to identify approaches for EDI. It will also help them to address the evolving needs of an ever-changing industry and society.

II. RESEARCH MOTIVATION AND METHODOLOGY

A. RESEARCH MOTIVATION

Most recently, organizations are ensuring to introduce best practices of EDI due to many reasons such as potential benefits, new standards, compliance with regulations etc. However, there are many broader research questions related to EDI and the software development process which are sporadically explored. The focus of this literature survey is to study the impact of human factors in the context of practicing EDI's triangle in software development teams to extract knowledge to fill this research gap. It is expected that studying the impact of human factors in the context of practicing EDI's triangle in software teams will allow software practitioners to understand the benefits of practicing EDI in managing software project as well as provides opportunities to incorporate them into core development process activities. This leads to improvements in development methodologies which will eventually increase the success rate of software projects, resulting in possibly saving millions of dollars of public and private sector money. The outcome of this research will increase the understanding of the stakeholders in the software industry about practicing EDI and eventually helps in achieving some social advantages such as higher employee engagement, productivity, higher job satisfaction, lower turnover, increased creativity, and reduced conflicts etc.

B. RESEARCH METHODOLOGY: SYSTEMATIC LITERATURE SURVEY

A systematic review can be performed by following a series of well-defined steps. We performed a systematic literature review (SLR) to review the state-of-the-art literature on Equity, Diversity and Inclusion (EDI) in software engineering (SE).

We followed the Brerton et al. [23] SLR approach guidelines to conduct this study. The guidelines provide evidence that the SLR in SE is similar to the medical research SLR guidelines. However, the SE field needs a process to accommodate domain-specific characteristics as well as improvement in areas such as SE infrastructure and practices. In this study, we adopted the same guideline and ensure that for the selection of the articles we just not review the abstract only and infrastructure support for indexing the SE database is not
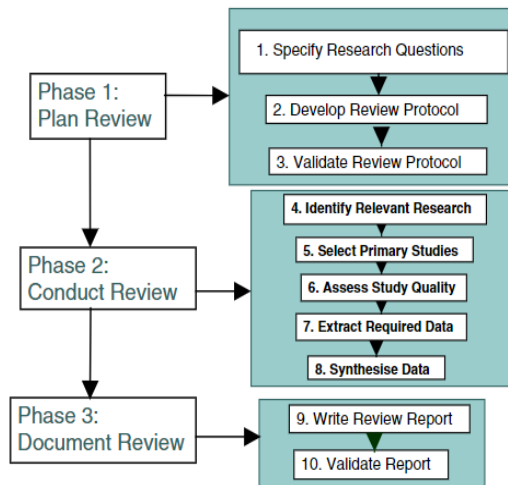
FIGURE 1. Systematic literature review.

enough. As a result, with the help of provided guidelines, we were not only able to identify the relevant articles but also the different dimensions of EDI in SE practices. Performing a systematic review involves several discrete activities, which can be grouped into three main phases: planning; conducting the review; and reporting the review. Fig. 1 illustrates the overall 10-stage review process. The first phase involves the planning phase which includes activities such as defining research questions, developing the review protocol, and evaluating the review protocol. The second phase is about conducting the SLR, and it includes activities such as pilot selection and extraction, primary study selection, data extraction, study quality assessment and data synthesis. The last phase is about documentation in which a conclusion will be drawn after considering threats and then dissemination of results follows:

1) PLAN REVIEW (PHASE 1)

In the planning phase of this SLR, we aim to include activities such as defining research questions, developing the review protocol and evaluating the review protocol.

a: SPECIFICATION OF RESEARCH QUESTIONS

The first step of an SLR approach is an appropriate research question. The research question must always be proposed first. Selecting a topic for SLR is critically important because many factors such as research gaps, research impact, and individual or community interests contribute to shaping this research question. The primary focus of this literature survey is to study the research about the human factor in the context of practicing EDI's triangle in software development teams to facilitate extracting knowledge to identify areas that require attention from the SE community. Studying human factors in the context of practicing EDI's triangle in software development teams provides useful evidence to software practitioners to understand the benefits of practicing EDI in

managing software projects as well as provides opportunities to incorporate them into core development process activities. This study provides a summary of existing literature related provides information about the state-of-the-art research in the areas of practicing EDI in software development teams and what are the main factors studied by the researchers in terms of practicing EDI in software development teams. Three main research questions are put forward namely "RQ1", RQ2" and "RQ3". To further elaborate on RQ2, three sub-research questions are proposed.

RQ1: *What is the research intensity of practicing EDI in software development teams?*

RQ2: *What are the types of EDI studies done by researchers in SE?*

RQ2 (a): *What factors were studied by researchers in terms of practicing equity in software development teams?*

RQ2 (b): *What factors were studied by researchers in terms of practicing diversity in the software development team?*

RQ2 (c): *What factors were studied by researchers in terms of practicing inclusion in software development teams?*

RQ3: *What is the impact of EDI factors on the overall success of the project?*

RQ1 deals with finding quantitatively relevant studies in software engineering in the context of practicing EDI's triangle and identifying the areas that are not been addressed by the SE research community. RQ2 further aims to find the classifications in terms of human factors that are associated with EDI. Moreover, RQ3 deals with identifying the impact of EDI practices on the success of the project.

b: DEVELOPMENT AND EVALUATION OF THE REVIEW PROTOCOL

In the activity of developing the review protocol, we outline the underlying process of selecting and define the conditions to apply when selecting primary studies, as well as the exclusion criteria. Inclusion criteria are everything a study must have to be included, whereas exclusion criteria are the factors that would make a study ineligible to be included [24]. In this section, the authors defined the below review protocol:

- Inclusion Criteria: Included studies in the review based on below inclusion criteria:
  - Studies that analyze any perceived EDI in SE.
  - Studies that explore Equity or Diversity or Inclusion in software development teams.
  - Peer-reviewed studies
  - English Written
  - Journal papers, Book Chapters, Theses, Conference and workshop proceedings
- Exclusion Criteria: The following criteria were used to exclude the studies from SLR:
  - Work in progress papers, Posters and theses that also published papers to avoid duplication.
  - The short version of long version papers
  - Discussion papers

- ○ Education papers that explore EDI in Academia
- ○ Papers that cover software development process diversity
- ○ Machine learning techniques that identify software process development diversity

2) CONDUCT REVIEW (PHASE 2)

a: PILOT AND EXTRACTION PROCESS

In this systematic literature survey, we aimed to find as many potentially relevant studies as possible to minimize bias. Identifying the relevant databases and keywords to search are two major steps. In step 1, we worked to define the keywords which are relevant to Equity, Diversity and Inclusion, which were used to create search strings, which are run against the selected publication databases. The structure of the search string for this study is based on the criteria proposed by Kitchenham [25]. We used an iterative approach to identify the keywords related to EDI. In the initial phase, relevant papers were identified, and appropriate keywords reflecting EDI were extracted. We also used thesauri to identify additional keywords based on the extracted keywords. The final keywords and the search string core concepts are listed in Table 2. We followed Rumsey's [26] guidelines for the related concepts, synonymous and alternative spellings. After identifying the key terms, we structured the search string based on the terms in Table 2. We used the below composite search strings using the 'AND' and 'OR' operators to find the tentative papers.

Equity OR Diversity **OR** *Inclusion*

AND

Software engineering **OR** *Software process* **OR** *Software* **OR** *Software development team* **OR** *human factor for software development*

Once the research questions have been formulated and search strings have been defined, we identified the set of databases to be used to find out research publications to conduct the systematic literature survey. Table 3 shows the selected databases and the total retrieved papers. We followed the example of Barney et al. [27] for the inclusion of databases that covers the domain of software engineering. After selecting the database, we run the search string using the keywords and also adapted the syntax of the particular database.

After retrieving the papers from the databases, we did several iterations to select the studies based on the inclusion and exclusion criteria as mentioned in the previous section. The total number of iterations is illustrated in Figure 2. We removed 451 duplicate papers in the first iteration after reading the title and the publication year. In the second iteration of the selection process, we removed 1591 papers based on our exclusion criteria. In the third iteration, we read the abstract of the paper and excluded further 86 papers from the retrieved papers and 33 papers marked as undecided. In the fourth iteration, we used the snowballing technique by investigating the references of the selected 179 papers

TABLE 2. Keywords for the search string.

| Core Concepts	Terms
Equity	Fairness; justice; righteous; impartiality
Diversity	Diversification; distinctiveness; diverseness; Heterogeneity; multiformity; difference
Inclusion	Incorporation; addition; admittance.
Software development team	Development group; workgroup; model team; Construct team; build team; coding team;
Factors	Element; part; influence; component
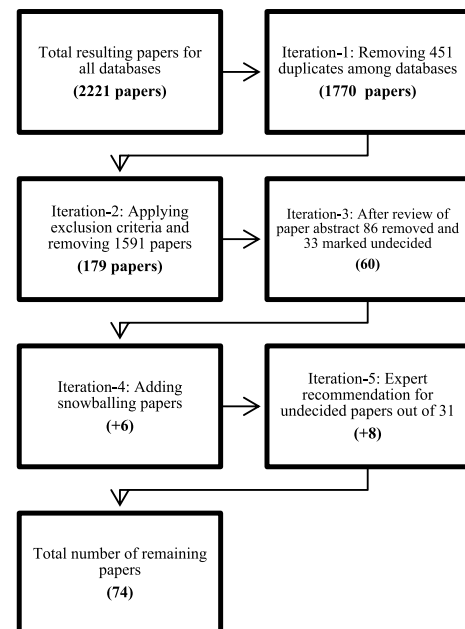
FIGURE 2. Number of iterations during the selection of relevant studies.

to find any missed papers and repeating this step until all missed papers were included. We added 8 papers in this step. In the last iteration, the first and second authors discussed the undecided papers and reach an agreement to include 8 papers in the SLR process from 31 papers. The iterations help to improve the reliability of the results. The total number of papers after five iterations were reduced to 74.

b: DATA EXTRACTION AND QUALITY ASSESSMENT

In the data extraction process, each article was assigned a unique identifier ($S_1 \ldots S_n$). We extracted information from each article such as the year of publication, authors, publication types (such as journal, conference, book, thesis etc.), type of study (such as descriptive, empirical, or exploratory), research methods (such as survey, case studies, experiments, action research etc.), and classification based on the study topics of Equity, Diversity and Inclusion. We followed the quality guidelines discussed in Kitchenham [28] and outlined in Assessing the Methodological Quality of Systematic

TABLE 3. List of Databases for SLR.

ID	Databases	Papers
A	IEEE Xplore(ieeexplore.ieee.org)	667
B	ACM Digital Library (dl.acm.org)	579
C	Google Scholar(scholar.google.com)	478
D	Taylor and Francis (www.tandfonline.com)	59
E	Springer Link (link.springer.com)	216
F	Sage Journals (journals.sagepub.com)	57
G	Science Direct (www.sciencedirect.com)	87
H	IGI global (www.igi-global.com)	45
I	Emerald Insight (www.emerald.com)	33
	Total	**2221**

TABLE 4. Quality checklist.

Quality Checklist	
Generic	
Are the aims clearly stated?	Yes/No
Was the study design appropriate with respect to its research aim?	Yes/No/Partial
Are statistical methods justified by the authors?	Yes/No
Are negative findings presented?	Yes/No/Partial
Are all research question answered?	Yes/No
Are the data collection methods adequately described?	Yes/No
Empirical Analysis	
Was population size reported?	Yes/No
Did the authors justify the sample size?	Yes/No
Is the sample representative of the population to which the results will be generalized?	Yes/No
Theoretical Analysis	
Does the author report personal observations?	Yes/No
Is there a link between data, interpretation, and conclusions?	Yes/No
Does the study cover all literature up to that point in time?	Yes/No
Is the focus of study reported?	Yes/No
Case Study	
Is the case study context defined?	Yes/No
Is the case study based on theory and linked to existing literature?	Yes/No
Is clear evidence established from observations to conclusions?	Yes/No/Partial

Reviews (AMSTAR 2) [29] and developed a detailed checklist shown in Table 4. Some of the checklist items could be answered by "yes" or "no" and they also included a "partial" option. A value of 1 was assigned to "yes," 0 to "no," and 0.5 to "partial"; then the sum of the checklist values was used to assign a quality score to the study to assess document quality.

A multidisciplinary team is needed to perform a high-quality scientific SLR. To enhance the thoroughness and minimize the potential bias of a study, and SLR is normally undertaken by more than one reviewer. The SLR team for this review was made up of three people. Two people were designated as principal reviewers. One person was also selected as the project leader to handle additional administrative tasks such as team communication, points of contact, meeting arrangements and documentation, task assignment and follow-up, and quality assurance. Table 5 details the tasks required for the SLR process and reviewer's involvement and the total time duration.

In this step of SLR, the data is extracted in terms of demographic from 74 papers. Figure 3 illustrates the number of papers relevant to the study retrieved from each database of IEEE, ACM, Google Scholar, Tylor & Francis, Springer, Science Direct, IGI Global and Emerald. The major portion of the papers was retrieved from IEEE, ACM and Google Scholar. Figure 4 highlights the distribution of study papers with respect to the publication year. There has been a significant increase in related publications from 2018 onwards. Figure 5 highlights the distribution of selected papers with respect to publication types. Most of the papers fall into the categories of conference (31) and journal (28) publications.

Glass et al. [30] described that research articles can be characterized based on their method and approach. A literature review and description of a toll or a system are classified as descriptive studies. Whenever, a problem is not clearly identified, an exploratory study is performed. The studies to extract findings based on observation of its subjects are known as empirical studies. Wohlin et al. [31] identified surveys, case studies, and experiments as three major empirical research methods to evaluate new methods or techniques. Dyba and Dingsoyr [32] also used the same type of empirical classification. A survey collects data using questionnaires which are answered by the subjects, and analysis of the answers provides answers to the research questions. In the case of experiments, specific tasks are required to be performed by a set of subjects under a controlled environment, and observations and evaluation of tasks provide answers to the research questions. Figure 6 highlights the types of studies, 32 studies out of 74 were descriptive, 27 are empirical, and 15 are exploratory. Figure 7 shows the distribution of selected papers with respect to research methods, the majority of the papers are survey papers (56).

3) DOCUMENT REVIEW- ANALYSIS AND RESULTS (PHASE 3)
The importance of equity, diversity and inclusion in an organization's culture is a growing phenomenon and many organizations are considering this a priority. Software projects dealing with intangible products are always very difficult

TABLE 5. SLR task assignment.

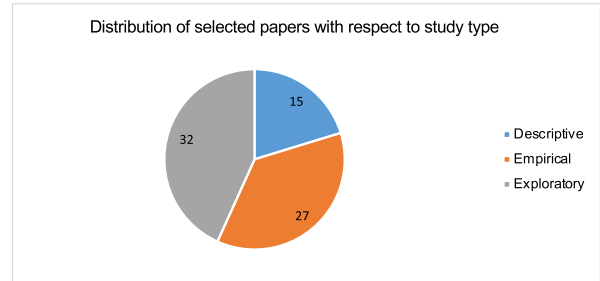| Task	Team members involved	Time Duration
Development of review protocol	Principal reviewers	Two weeks
Development of search strategy	All	Two weeks
Assessment of papers, including relevance and study design	Other reviewer	Four weeks
Data extraction	Other reviewer	Four weeks
Data analysis	Principal reviewers	Three weeks
Final SLR report	All	Six Weeks

FIGURE 3. Distribution of selected papers with respect to databases.
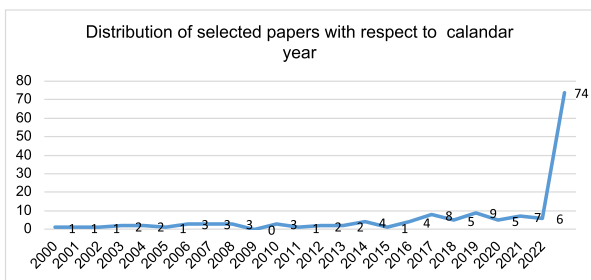

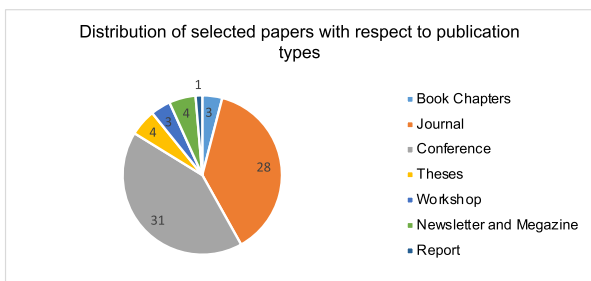**FIGURE 4.** Distribution of selected papers with respect to calendar year.

FIGURE 5. Distribution of selected papers with respect to publication types.

FIGURE 6. Distribution of selected papers with respect to study type.

FIGURE 7. Distribution of selected papers with respect to research methods.

to be on time, within cost and achieve quality. The human factor has been identified as one of the critical factors behind the failure of software projects. Creating an environment that is equitable, diverse and inclusive certainly has benefits to reducing the issues associated with the human factor in software development. Equity practice in an organization provides individuals with the same opportunities and resources, regardless of their differences which motivates the team members to contribute to the best of their abilities. A diverse software development team is important to

design more robust end products on the market because it captures a larger segment of the population who have varying skills and perceptions of the product. An inclusive work environment where all team members feel welcome, treated respectfully and considered valuable increases the chances to overcome the challenges associated with software projects. The study dataset table in the appendix enlists the distribution of selected papers with respect to E, D and I, years, venue, country and method and approach.

The primary objective of this study is to analyze how the software engineering research community is dealing with topics related to practicing EDI in software development teams, finding answers to RQ-1 provides an environmental scan of equity, diversity and inclusion. Figure 8 highlights the distribution of papers with respect to equity, diversity and inclusion. It reveals that the majority (58) of the papers address diversity (S1-S19, S21-S51, S53-S58, S61-S62, S67, S72-S74), whereas 15 papers deal with the topic of Inclusion (15) (S3, S20, S33, S37, S57-S66, S68) and only 5 papers study the topics of equity (5) (S37, S51, S69-S71) and Managing diversity in software development teams deals with the culture that allows for respect and appreciation of the difference among team members in terms of many factors not limited to age, gender, ethnicity, religion, disability, sexual orientation, education, and national origin. The intrinsic nature of teamwork in software development made the topic of diversity the primary focus of research in the software engineering community. Diversity is somewhat controlled through the hiring process and organizations tend to hire diverse groups; however, inclusion requires organizational commitments to ensure policies and procedures are in place to culturally and socially accept and welcome different groups or individuals having different backgrounds. Equity is coupled with
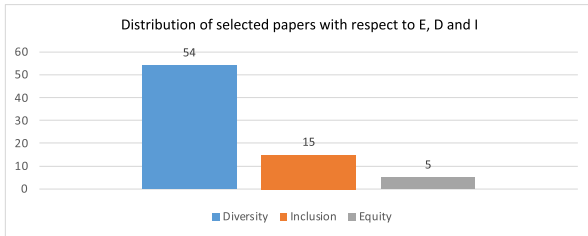
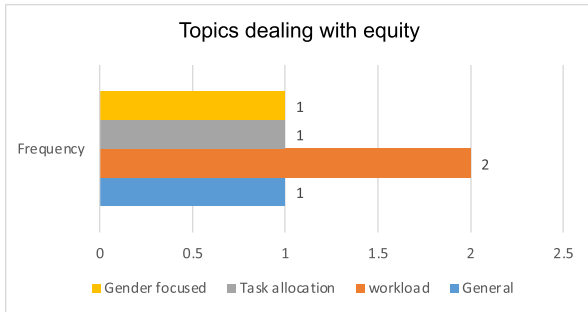**FIGURE 8. Distribution of selected papers with respect to E, D and I.**

FIGURE 9. Topics dealing with equity.

FIGURE 10. Topics dealing with diversity.

diversity, when we have a diverse group, equity deals with the work environment that the organization creates for these diverse groups of people, ideally creating fair access, opportunity, and advancement for all those different people.

RQ-2(a) provides an opportunity to drill further into equity and analyzed which topics are explored up to date by the software engineering research community. Research in software engineering is heavily skewed towards factors that affect project outcomes such as process, tools, and skill sets, however, the people who work on projects and policies and procedures that glue those people have not been given appropriate consideration. Equity defines the values and beliefs of an organization, a working group or a project team that plays a critical role in success and retention. Equity is not equality which deals with providing everyone with the same resources and opportunities. Equity deals with treating every person according to their unique circumstances because every person has a different background and starting point. It outlines specific requirements each person needs to succeed. For example, allowing employees to take time off according to individual cultural and religious events, and not only around Christmas. A software engineer who asks to work from home a few days a week because of his/her parent's medical condition may eventually be more productive. There are very few studies and topics of equity such as gender, task, and workload that have so far been explored and require much more attention from the software research community. Introducing the practice of equity in software development teams will allow ensuring that every team member of the project works on the same playing field, regardless of their ethnic background, physical or mental ability, gender or sexual orientation etc. The pressure of deadlines and budget had overworked software development team members, and this overworking caused issues of employee turnaround.
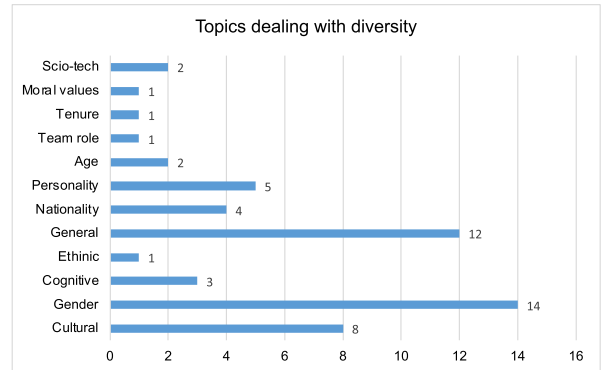
RQ-2(b) provides an opportunity to drill further into diversity and analyzed which topics are explored up to date by the software engineering research community. Diversity is a topic that has been mostly explored by the research community. Gender diversity is perhaps the main area that most of the papers dealt with. Out of 58, three studies S58, S72, and S73 only study gender diversity, while most of the other studies also cover gender diversity as a part of their study. Overall, researchers and practitioners consider diversity an important tool to create better teams to reflect better efficiency and productivity. Izquierdo et al. [33] reports that when it comes to gender, the field of software engineering is heavily skewed toward men, this is bad for the industry because diversity, in all of its forms, is essential in open-source communities and in the larger technology industry. Software development, in general, is not a solo performance, it is teamwork, and team members need to have tolerance, patience, respect and understanding that people are different in many respects which defines diversity. Global software development in various forms such as outsourcing, offshore development, and open-source software has increased awareness about diversity. Cultural diversity (such as studied by S40, S55 and included in others as well) is prominent in a software development team where the composition of team members is diverse in terms of many cultural differences such as ethnicity, race or national origin, beliefs, languages, customs, norms etc. The cultural aspect of diversity is widely studied by software engineering researchers. The majority of the studies directly studied the overall domain of cultural diversity, whereas some studies explored some of the specific aspects of cultural diversity such as moral values, age, nationality, ethnicity, cognition etc. Cultural differences and associated misunderstandings between software team members may cause conflicts and affect performance, it requires time for people from varying cultures to understand each other. Software development projects increasingly extend over the boundaries due to a shortage of skills, and development costs in high-wage countries, now challenge is how to create awareness that leads to respect and acknowledgement of such differences to create a productive work environment.

RQ-2(c) provides an opportunity to study further into inclusion and analyzed which topics are explored up to date
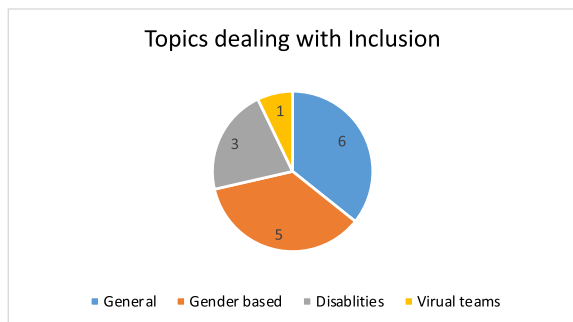
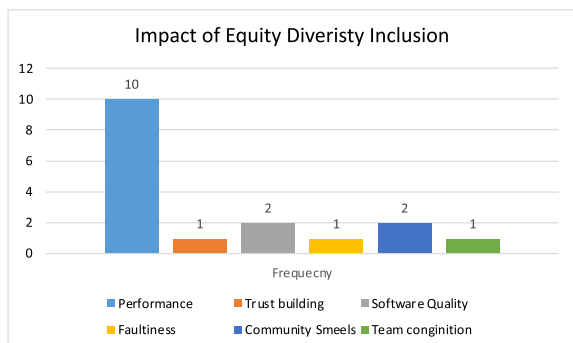**FIGURE 11. Topics dealing with inclusion.**

FIGURE 12. Impact of Equity Diversity and Inclusion.

by the software engineering research community. It highlights that some areas such as gender inclusion (e.g., S58-S60, S63, S68) seemingly receive some attention as well as the role of inclusion in virtual teams, however, there is a significant lack of research in this area which has a potential impact on the quality, cost and productivity in software development. The reflection of a socially acceptable environment which is inclusive to everyone in the society is significantly important for a healthy, productive, and responsible society. Software development is a team effort, the composition of the teams is normally diverse in many respects, and the outcome of it is heavily dependent on the working environment. Software engineering teams are not only multi-cultural, but they are also multi-disciplinary and multi-site often as well. An inclusive work environment is one in which individuals or groups having differences such as national origin, race, ethnicity, age, religion, gender etc. are accepted and welcomed to be part of the team. These differences are not considered a barrier to their abilities to perform their tasks effectively and efficiently. Team members who are in the people of color need to feel safe and comfortable in their working environment to thrive. There have been studies in software engineering focusing on the soft skills of the software engineers and the team dynamics, however, there has not been much focus on an inclusive work environment and its impact on a software project. Kent et al. [34] found that an engineer's impact on communities and society will be more positive when it represents and welcomes diversity, irrespective of their faith, race, ability, country of origin, age, gender or sexual orientation. O'Neill et al. [35] outlined the statement of values and mentioned that it is everyone's responsibility to educate them-

selves on gender identity, gender expression, sexual orientation, racialization, color, national or ethnic origin, religion or religious belief, age, marital status, disabilities, veteran status, the field of expertise, or any other reason not related to scientific merit that is different from them. da Silva et al. [36] concluded that some techniques to promote inclusion in agile teams, including Daily Meeting, Pair Programming, Review, Retrospective, Effort Estimating, Workshop, and Code Challenges show better results. Aydemir and Dalpiaz [37] the ethics-aware version of SE that fosters the elicitation and analysis of stakeholders' values and their inclusion both in the socio-technical process through which software is built, and in the resulting software product. It is hard to isolate humans from the software engineering process, product and it's use because people are the essential element in almost every phase of software engineering including requirements elicitation and specification, designing, development, verification and validation, maintenance and evolution.

RQ-3 provides an in-depth analysis of the impact of equity, diversity and inclusion on software development activities. Performance has been identified as one of the major impacts of practicing EDI. There are some other factors that have been identified as potential factors that create some impact such as trust, quality faultiness team cognition etc. According to Standish group's annual CHAOS report [38], 66% of technology projects (based on the analysis of 50,000 projects globally) end in partial or total failure. Only 40% of projects at IBM meet the company's three key goals – schedule, budget, and quality [39]. One of the reasons for software project failure is the human factor. According to Deloitte [40], diverse companies enjoy 2.3 times higher cash flow per employee. Gartner found that inclusive teams improve team performance by up to 30% in high-diversity environments. According to a report [41] companies that had higher-than-average diversity and employee engagement also had 46% to 58% better financial performance than companies that were below the median on diversity and engagement.

The fundamental goal of introducing the best practices of equity, diversity and inclusion in software engineering is to reduce errors and increase productivity and safety when humans interact with a system [42]. The overall performance of a quality management system and its processes ultimately depends on the involvement of competent people and whether they are properly introduced and integrated into the organization [43]. Completing a software project within the cost is a challenging task because there are many soft factors, which are very difficult to measure and estimate. For example, low team morale may lead to delayed milestones and further delay the project. Productivity, quality and schedules are underlying factors that can change the cost on the fly. It is expected that investigating the impact of human factors in the context of practicing EDI's triangle on the benchmarks of cost, quality, schedule and productivity in software projects will generate new knowledge which will allow software practitioners to understand the benefits of practicing EDI in managing software development teams as well as provides opportunities to

incorporate them into core software engineering development process activities. This leads to improvements in software development methodologies and will eventually increase the success rate of software projects, resulting in saving possibly millions of dollars of public and private sector money.

The key aspect to consider by companies and top managements to promote EDI and best practices in software development can start from hiring people from diverse backgrounds by implementing blind hiring techniques. Secondly, the project manager should foster inclusive team culture underrepresented groups such as LGBTQ+, LGBTQ+, mental health, racial minorities where everyone's contribution should be equally mentorship and training in the team can be helpful to raise awareness about implicit biases that may lead to biased decision-making and interaction in the team. The mentorship and training plan for promoting EDI practices for project leaders and management will also be very helpful. Top management can play a very important role in fostering the EDI best practices by introducing EDI metrics to see the effectiveness of the best practices on the performance of software development team. The management can introduce software development process with accessibility in mind. Integration of EDI practices into the software development process not only increase the team performance but at the same time enhance the quality and relevance of the software product for diverse user base.

III. THREATS TO VALIDITY

This section of the paper discusses possible threats to the validity of the systematic literature survey that we presented in this work, which is mainly selection bias during article review, and possibilities of inaccuracy in the review process. Some studies that do not have the words "equity", "diversity" and "inclusion" in the title of the article are not included in the primary studies set. Thus, there is a possibility that during the search process, we may have missed a limited number of studies that refer to these keywords just because they are not referenced in the title. Human errors are also one of the limitations which is embedded in any SLR process as we manually reviewed many papers. Although in some cases we kept a few papers as "undecided" and have them reviewed again to avoid errors of inclusion. Some indexing systems such as Scopus, Web of Science were omitted, which may result in the omission of papers from relatively less-known journals and conferences. However, since we extended our search to databases of IEEE, ACM, Google Scholar, Tylor & Francis, Springer, Science Direct, IGI Global and Emerald therefore we are confident that the vast majority of papers have been included in this study. In order to reduce the threats to validity, we are providing the list of selected papers of this study for replication purposes.

IV. CONCLUSION

Software development is a collaborative activity, each member of the team has a certain set of responsibilities and tasks allocated to them, success of the software project depends on how these individuals contribute to the project. The human factor associated with these individuals makes it necessary to have a working environment that is diverse, equitable and inclusive to be productive. An organization which is diverse, equitable and inclusive has some social advantages such as higher employee engagement, productivity, higher job satisfaction, lower turnover, increased creativity, and reducing conflicts etc. which ultimately have the potential to increase the success of software projects. The challenge with the software engineering community is that the focus is always on the process side of the development, and little focus on the people who do the process. This study also reinforces this notion that evidence of comprehensive studies about practicing EDI in software development teams is limited, up to date majority focus is on the topic of diversity, whereas research on topics of practicing equity and inclusion in software development teams is sporadic and requires more attention.

The future research direction for promoting best practices of EDI in software development teams is an investigation of software development processes that inherently promote equity and inclusion. The analysis of different development methodologies' impact on diverse teams can be s starting point. The development of metrics to measure diversity can also help to identify the EDI initiatives and their impact on the development process. The studying the developers' tools that can support diverse developers with different abilities. Exploration of ethical responsibilities for the software developers and mentorship concerning EDI practices and principles could help and promote best EDI practices in the software development teams. Also, an investigation of the impact of poor EDI practices on the quality of the developed product will also be interesting,

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