Teamwork in Software Development and What Personality Has to Do with It - An Overview

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Abstract. Due to the increasing complexity of software projects, software development is becoming more and more dependent on teams. The quality of this teamwork can vary depending on the team composition, as teams are always a combination of different skills and personality types. This paper aims to answer the question of how to describe a software development team and what influence the personality of the team members has on the team dynamics. For this purpose, a systematic literature review ($n = 48$) and a literature search with the AI research assistant Elicit ($n = 20$) were conducted. Result: A person's personality significantly shapes his or her thinking and actions, which in turn influences his or her behavior in software development teams. It has been shown that team performance and satisfaction can be strongly influenced by personality. The quality of communication and the likelihood of conflict can also be attributed to personality.

Keywords: teamwork · software · personality · performance · elicit

1 Introduction

Nowadays, software development is mainly done in teams [11,47,86], in order to cope with the growing complexity of IT projects [19]. Teams represent a combination of different people (here: software developers) who have not only professional but also human differences [14,63]. In addition, extra-personal factors such as the characteristics of the leader or the organizational structures of the company also have an effect on teams [17]. Despite this, the software industry has focused primarily on enterprise and development processes [10]. There is now a large body of evidence in the literature that the human characteristics of team members have a significant impact on team performance [55]. Personality traits are particularly important because they shape our actions and thus our

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behavior within the team. [49] For example, communication, conflict management, or team climate can be influenced by certain personality traits [75,81,91]. Team performance as a whole can be deliberately improved by taking personality into account. Thus, when considering team performance, not only professional but also said human factors of the team should be considered [15]. The purpose of this paper is to provide an overview of teamwork in software development. To this end, we will examine how software teams are formed and in what kind of embedded structures. In addition, we consider the factors that have been associated with high team performance and try to identify which measurable variables have a high impact. Finally, we look separately at the influence of the developer's personality on teamwork in software development. To this end, we answer the following research questions:

- RQ1: How are software development teams defined in the literature and what attributes are used to define them?
- RQ2: What impact do team members' personalities have on the team dynamics?

In contrast to other publications on this topic (e.g., [40,56,74]), our focus will not lie exclusively on the individual developer. Indeed, it has often been studied how the characteristics of a developer influence other developers or activities of the team. We want to look at the issue at the team level. Thus, we also deal with impacts on individuals discovered in the publications, but beyond that, we will identify additional variables that affect the team or arise from within the team.

The article's structure will be as follows: after having shown the relevance and our motivation, as well as deriving research questions in Sect. 1, we will introduce the research method in the Sect. 2. Section 3 contains the results, which will be evaluated in Sect. 4. Finally, Sect. 5 provides a summary and a description of future work.

2 Review Methodology

2.1 Search Strategy

This paper follows the search strategy proposed by [22], which consists of three stages (see Fig. 1): manual and automated searches are performed in the first stage, followed by a manual reference search in the second stage. Duplicates are removed in both phases. The third and final stage involves further deduplication, after which the search is completed. If additional literature is necessary for contextualizing specific research items, it can be added at this point in the process. The automated search was limited to the databases ACM Digital Library, Clarivate WebOfScience, Elsevier ScienceDirect and IEEE Xplore.

We excluded papers that meet at least one of the following criteria: (1) being written in a language other than English, (2) not being accessible on the Web, and (3) being incomplete documents, drafts, slides of presentations, or extended abstracts.

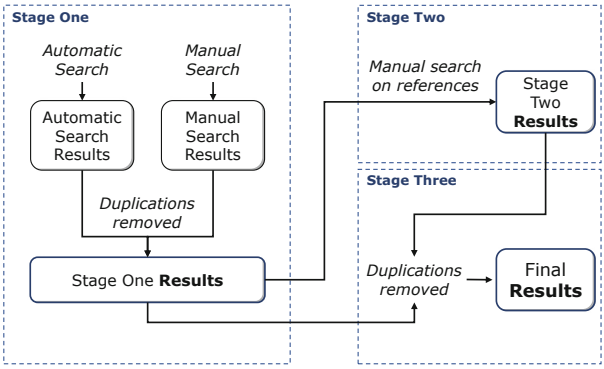

Fig. 1. Stages of search strategy according [22]

2.2 Search String Construction

A search string is created for the automatic search. Relevant keywords were selected for this based on the research questions. These are also extended by some synonyms or family terms for a higher sensitivity [22].

1. Primary search terms: software development, team
2. Secondary search terms: description model, information model, characteristics, formation, personality
3. Synonyms and familiar terms
   (a) software development: software engineering
   (b) personality: character trait

The primary search terms are linked by "And" and should always appear in the results. The secondary search terms, on the other hand, are linked as a whole by "And", but among themselves only by "Or". Thus, at least one of the secondary search terms is used in each result. Synonyms and similar terms complement the corresponding words and are trivially linked to them by "Or". This results in the following search string:

```
("software development" OR "software engineering") AND team
    AND ("description model" OR "information model" OR
    characteristics OR personality OR formation OR "character
     trait")
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The search string may vary slightly depending on the syntax of the respective database, but the specified keywords should be indicated at least in the title of the reviewed publication.

Figure 2 summarizes the search process performed.

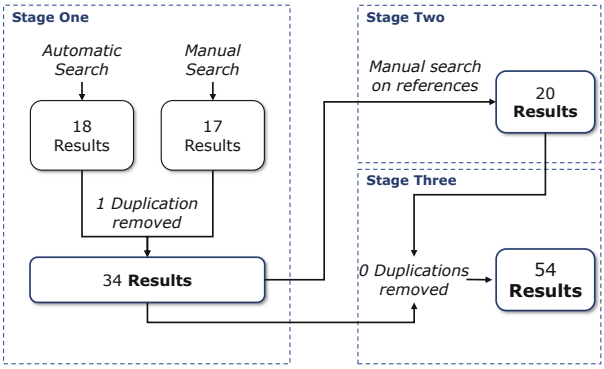

Fig. 2. Search strategy results

2.3 Literature Analysis

After the articles were checked again for suitability and quality, a narrative review was conducted [90]. The data extraction is done using the following scheme: Each article was reviewed section by section, extracting key statements and text passages relevant to our research questions. These were then summarized or at least shortened so that, if possible, the most important statements could be extracted for citation or aggregation. In this phase, another six papers were removed from the analysis due to insufficient data/literature base or because they had no relevance to our research questions despite the above selection criteria. The removed papers are from Stage 1A, where literature was searched exclusively by an automatic search string. Since the selected search procedure does not include a quality or content check, the actually usable literature can only be determined here during the analysis.

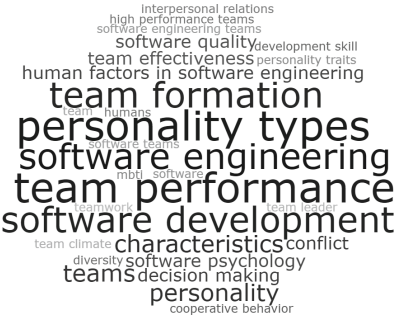

Fig. 3. Word cloud representing the keywords of the analyzed papers

In addition, the keywords of all reviewed papers were collected. If no keywords were available for a paper, key terms from the title or abstract were used

to fill in keywords instead. Thus, the range of contents of this research could be visually represented in the form of a word cloud. The word cloud allows highlighting many-mentioned keywords by increasing the font size [29,38]. Furthermore, in our opinion, the data can be presented in a more compact form than a bar chart would be with so many values. The resulting word cloud can be seen in Fig. 3. The smallest keywords have two occurrences, and the largest more than 10. Keywords with only one occurrence or methodological procedures (e.g. Systematic Literature Review) were ignored. The more often a term is mentioned (indicated by a larger representation in the word cloud), the higher we valuated its importance. Consequently, terms that appeared more often were given a higher weight in the analysis, thereby prioritizing them over items that were not used as often. This reflects the assumption that phenomena that were mentioned more often are also better studies and understood. Consequently, the word cloud not only shows the abundance of each term, but it also gives an impression of the priorities assigned by us to contents of this paper.

2.4 Extension of the Literature Sample with AI

We decided to conduct another more novel literature review in addition to the conventional approach of a literature review just presented. For this purpose, we instructed the AI research assistant Elicit (https://elicit.org/) to expand our literature sample with suitable literature. The Elicit results were limited to publication years from 2015. In addition, the number of results was extended three times, by using the "Show more results" button in order to reduce the number of less applicable publications. We then supplemented this dataset with information on whether and which personality model was used, and whether the study results indicated a direct impact of personality traits on team dynamics (see RQ2). Table entries no meeting these criteria were excluded.

Not only do we expect to gain more knowledge regarding our research questions, but we used this opportunity to explore the viability of this method for future literature studies. To ensure the possibility to compare both methods, we seperated the results. Thus, Elicit results are listed separately throughout the paper.

3 Results

3.1 Software-Engineering

This paper focuses on teams in software development, which involves the systematic and disciplined approach to the development, operation, and maintenance of software, commonly known as software engineering (SE) [12,54]. Software development requires technical and analytical skills as well as continuous learning to produce high quality results [4,21,31]. Due to the increasing complexity of software projects [19], a division of labor by teamwork has become essential, requiring a range of skills and roles [4] and involving negotiation and communication [26,31]. Effective teamwork is crucial for the success of software projects,

and has been associated with communication, coordination, balance of contributions, mutual support, effort, and team cohesion being key factors [28,47,79]. In addition, successful software development requires high organizational and interpersonal skills to manage interactions with customers and identify their needs [10,14]. Meeting budget, time, and quality requirements is critical for software project success, as exceeding the budget is a major reason for project failure [21].

Figure 4 shows the 44 factors and 170 subfactors [18,19] have found to influence the software development process. They created a model consisting of the eight factor classes: organization, business, application, management, requirements, technology, personnel and operation. These classes are assigned altogether 44 factors with again altogether 170 Sub factors.

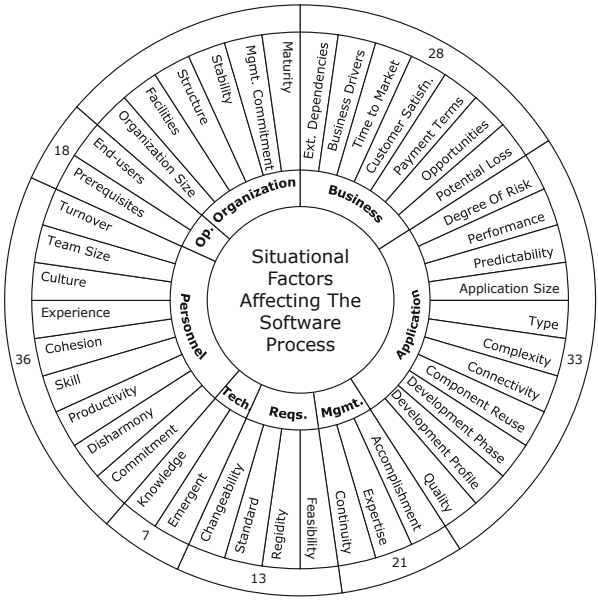

Fig. 4. Situational Factors Affecting the Software Process according to [18,19]

3.2 Teams

Following [6,41,67], we define a team as a group of two or more individuals working together to achieve one or more common goals directed toward a productive outcome. Teamwork is a complex and dynamic system that evolves and adapts based on the interaction of its members and situational requirements [11]. The activities of team members can be divided into task-related and teamwork-related behaviors [77]. It is important to note that teams can operate both inside

and outside organizations, as well as over an organizations boundaries. Their defining characteristic is not being part of the same organization but working towards a common goal. Teams are essential for accomplishing complex and difficult tasks, allowing *ordinary* people to achieve *extraordinary* results through a collaborative process [47,76]. Teamwork makes it possible to absorb differences in competence among group members and leads to higher commitment, fidelity and quality of work [28]. As already mentioned, it is not only more effective to work in teams, but also a necessity, due to the increasing complexity and size of software projects [26,43]. Moreover, due to the increasing requirements for knowledge, skills, and abilities, individual employees cannot achieve results independently. Thus the survival and success of software developing enterprises is determined by their ability to form and facilitate teams [28,52]. They can influence the organizational context by applying different team compositions and working methods [11,19,41,85].

Software development teams may have different roles, such as developers, architects, analysts, testers, and designers, depending on the process model used [67]. Some process models, such as Scrum, require cross-functional teams whose members have all the skills needed to achieve a specific goal [21]. New types of teams, such as distributed teams, work on software development across locations, cultures, and time zones [26,65,88]. Agile process models typically have self-managed teams that are smaller and where each member is responsible for both implementing and managing processes [26].

One source mentions High-performance teams (HPTs) and defines them as groups whose members are committed to each other's personal growth and success, resulting in performance that exceeds that of regular teams [28]. Table 1 summarizes the characteristics of HPTs, which include a focus on specific tasks, better organization, improved information sharing, and less conflict [28]. These findings also apply to regular teams [67], consequently, we will not distinguish between the two. The specific characteristics of HPTs will be treated as generally improving team performance.

The effective assignment of employees is a crucial process [4]. Different approaches exist to distribute the employees to the software development roles or to different teams (e.g. [32,71,89]). For example, it is possible to map the software development roles to recommended skills. People who have these skills can then be deployed more appropriately according to the roles. It was shown that this skill-based role assignment has motivated developers [1]. A number of other methods exist for allocating employees to teams or roles. Since this was not within the scope of our research questions, we will not introduce them here.

When putting together teams, the focus should not only be on the technical aspects [21]. Homogeneous teams may be more appropriate than diverse teams in some software development phases (e.g., requirements elicitation) [34]. In principle, however, many studies share the opinion that diverse teams are more advantageous overall: Diversity among team members has been shown to have a positive impact on team performance. This includes diversity in characteristics and perspectives, as well as in knowledge and experience [14,15,43,52,57,61].

Table 1. Characteristics of HPTs for Software Development regarding [28]

Organizational Characteristics	Contextual Characteristics				Technical Characteristics	
Team Diversity	Team Work	Communication	Motivation	Intelligence	Coordination	Managerial Involvement
Team size	Team Leadership	Team Cohesion	Unexpected Challenges	Analytic	Professional Orientation	Restriction of External Influence
Team's autonomy	Personality	Improvisation	Attitude	Less tendency to conflicts	Teamwork Orientation	Performance Evaluation
Work less hours	Organization	Respect	Passion to Teach	Socialization	Focus on Specific Tasks	Competencies of Management
Organizational Commitment	Coprehension	Empathy	Better sharing Information	Confidence	Experience in Propagation	Usage of Resources
Life quality at work	Accountability	Emotional Intelligence	Believe on own abilities	Awareness	Knowledge	Work Tasks Division
Low Turnover	Flexibility	Cognitive Work / Abilities	Tasks Participation		Less Decision Made	Goals Fixing

By having a wider range of perspectives, teams are more likely to come up with innovative solutions to problems. In addition, having a variety of skills and personalities among team members can help distribute work more efficiently and prevent conflict [50]. Depending on the country, the diversity-performance ratio may vary [36]. At the same time, care should be taken to ensure that not only highly qualified specialists are in a team, as this can lead to unproductive conflicts [35].

In conclusion, creating an appropriate team composition is challenging due to the increasing complexity with a growing number of candidates. This problem is classified as NP-hard, making it difficult to test all possibilities. While new research on this topic is emerging, it remains difficult to validate the approaches presented [21].

3.3 Team-Success

In our understanding, a team is successful when it is successful on a project level and on a personal level. We are guided by Hoegl's team effectiveness model [41], which is based on the variables of teamwork quality, team performance and personal success (see Fig. 5). According to this understanding, a successful team achieves quantitative and qualitative goals, provides its team members with satisfaction and learning opportunities, and is based on good professional teamwork.

Teamwork quality is essential to team performance and the personal success of team members. It includes open communication, goal coordination, cooperation, contribution, shared responsibility, and a sense of belonging to the group. [41,43] Soft factors play an important role in maintaining good teamwork quality. Even a mediocre or chaotic team can have good teamwork quality if its members feel they belong and contribute. Some studies define team effectiveness differently (e.g. [47]), such as combining quality and quantity of output with attitudes

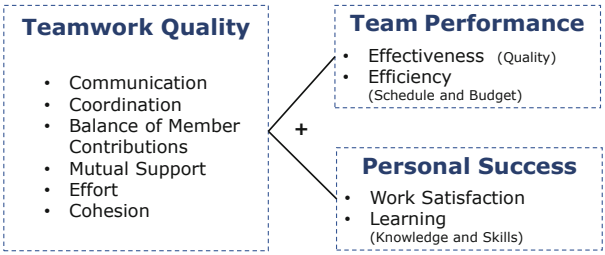

Fig. 5. Team success according to [41]

such as commitment. We do not see any contradiction in terms of content here, just a different perspective on known variables.

Team performance refers to the effectiveness and efficiency of a team in achieving its goals, including adherence to time, budget, and requirements, as well as communication among team members. Soft factors such as team climate, innovation, member competencies, top management support, and leader behavior strongly influence team performance. The performance of individual members also affects this metric. Project management metrics can objectively capture team performance, but if they are not available, subjective feedback from team members can provide a good impression of the project. [17,24,39,41,67,70] Further influencing factors are shown in Fig. 6.

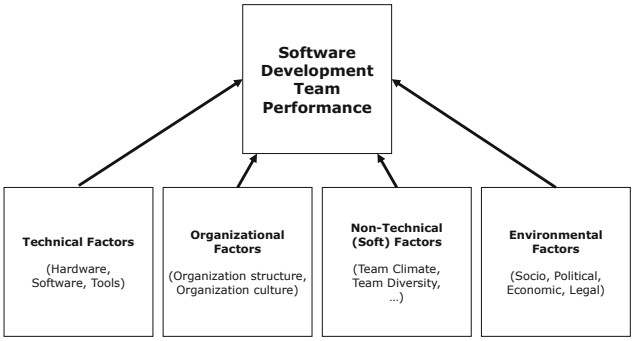

Fig. 6. Factors affecting the software development team performance according to [67]

The personal success factor refers to the success of individual team members, which can be achieved by maintaining satisfaction and providing learning opportunities. Satisfaction is a good measure because it takes into account all personal and subjective factors in the professional and corporate environment. Learning, on the other hand, is a challenging process that allows individuals to feel they are making progress, which requires motivation generated by the learning content or

some aspects at the project or organizational level. According to the definition provided for HPTs, inclusion of personal success is their distinguishing feature in contrast to ordinary teams [5,33,42].

3.4 Organization and Leadership

A team's success is influenced by the organization and its leaders, who can foster social relationships to enhance team quality. Effective time management is also critical to success, requiring a balance of formal direction, external control, and internal flexibility. In addition, leadership plays a critical role in team success, and it is important to involve team members in the decision making process to maintain the quality of teamwork and prevent sole reliance on the leader. [35,43,47].

3.5 Communication

Communication in particular has been cited in many studies as a success factor for teamwork [41,43,64]. This does not always have to take place in large quantities if the quality of the exchange is sufficient. Thus, even short, spontaneous, informal conversations can have an extremely positive influence on the team [41]. However, communication within the team becomes more difficult the larger the team [64]. Lastly, by facilitating exchange of information communication enables the formation of shared mental models - which again can be classified as a decisive success factor [41,72].

3.6 Conflicts

A variety of conflicts can arise during teamwork, including relationship conflicts, which involve personal differences between members, and task conflicts, which involve disagreements about the work. Relationship conflicts have a negative effect on productivity and satisfaction [11,36,65], while small task conflicts can have a positive effect [11]. However, higher levels of conflict can lead to better decisions, higher levels of understanding and acceptance, and more employee engagement [20,27]. When conflicts escalate, the positive effect on team performance disappears [27] and lack of conflict resolution due to time constraints or lack of motivation has a negative impact on team success [48]. Conflict is a common occurrence in team settings and is often caused by perceptions of limited resources, creative or multiple demand tasks, and interdependence among team members [11,67]. Lack of communication, individual differences, behaviors, and social pressures in teams can also contribute to conflict [65,67]. Virtual, diverse teams face particular challenges due to communication difficulties, which can lead to more unresolved conflicts and higher error rates in produced software [88].

Trust is useful in conflict resolution and is positively correlated with productivity and team satisfaction [11]. Trust can be divided into cognitive trust, which is confidence in the abilities of others, and affective trust, which is belief in the

trustworthy intentions of others. During stressful periods, mistakes and performance deficits can reduce cognitive trust, making affective trust more important for effective teamwork [11]. The interaction between the manager and the development team can also be improved by a high level of trust [77]. Conflict management can reduce the negative impact of conflict on team performance [67,75]. Social loafing is a motivation problem that can be avoided by emphasizing the importance of each team member [11]. Other factors that influence a team's potential for conflict include social differences, generational differences, personal priorities, and ideologies [36].

3.7 Developer Motivation

Motivation is an essential factor for team performance as it moderates the relationship between team input and output, resulting in a significant impact on team performance [17]. Motivation can come from various sources, including job satisfaction, professional and organizational commitment, which have a direct relationship with performance [17]. Employees tend to perform better when they believe their work is important, which provides them with a sense of purpose and intrinsic motivation [17]. Personality traits can also have an impact on motivation, as individuals with high levels of conscientiousness and openness to experience are more motivated to perform their tasks [62]. In addition, higher levels of productivity require higher levels of motivation, which can be achieved by setting clear goals and providing appropriate incentives [69].

3.8 Team-Climate

Team climate describes the ability of a team to create a shared mental model and the ability to obtain, process, and share information with each other, as measured by four dimensions: Vision, Participative Safety, Task Orientation, and Support for Innovation. A positive team climate leads to team satisfaction, better software quality, and higher productivity and team success, while learning and reflection are also important for developers to improve. [2,11,43,78]

3.9 Influence of Personality

The intention of this chapter is to examine what influence the personal characteristics, especially the personality, of software developers have on the team and the software development process. The model assumes that characteristics can be examined on two levels: Superficially based on demographic data (e.g. gender, age, education, origin) or deeply cognitive (personality, knowledge, skills, experiences) [47].

The personality is generally viewed as a dynamic organization of psychophysical systems within the person that produce the person's characteristic patterns of behavior, thoughts, and feelings [22,25]. And since software development processes involve people, the human aspects are a clear part of it [31,59]. Studies

show that personality influences the results of software development projects more than technologies, processes or tools [23,31,72]. Meanwhile, improvements in project success, code quality, and individual satisfaction have been demonstrated [22,24]. Project managers can take advantage of these insights to increase developer satisfaction and thus improve product quality [2]. In addition, awareness of other team members' personalities can increase team acceptance and understanding [22,55], as well as motivation [91]. Software project failures can also be reduced by taking the human factor into account [31,63].

In the previous chapters the shared mental model (SMM) was mentioned more often. The mental model is an knowledge structure that helps to describe, explain and forecast our environments [47]. At the same time, they enable information to be selected more easily and corresponding actions to be taken. Without SMM, information may exceed individual mental capacity due to its volume or complexity. [72] Such a mental model can arise at the team level if the team members have the same mental model, or at least same expectations, with regard to a context. In order for a shared mental model to develop, some motivation is needed among team members. However, once the mental model has been developed, trust, satisfaction, cohesiveness, group efficacy and commitment increase. [47] SMM thus has a strong influence on the quality of teamwork and thus on team performance [47].

In software development, the composition of the team is an important factor in the success of a project. Several studies have been conducted to investigate the relationship between team members' personalities and team performance. Several personality models have been used as a basis for exploring the impact of their constituent personality traits. One of the most prevalent being the Myers-Briggs Type Indicator (MBTI). Software developers with high scores in its categories of Agreeableness and Extraversion can have a positive impact on team performance. By taking these personality factors into account, software development teams can become more efficient [2,81]. Empirical studies have identified the ISTJ type as the most prominent among software developers. IS professionals are introverted, highly rational and analytical "thinkers" rather than "feelers" [87].

Moderately diverse teams consisting of members with different personalities reduce the risk of software project failure [79] and increase team success [34]. There is a relationship between team personality composition and team performance and climate [23,81]. Teams with different personality types perform better than the homogeneous ones [67]. Team characteristics, team member characteristics, and the level of intra-group conflict account for half of the variance between the best and worst performing teams [67].

Personal characteristics have a significant impact on team performance and attitude [79,81]. Software developers with low scores on the Five-Factor Model (FFM) of neuroticism have a high ability to handle stress. Teams with low variance in neuroticism have better team cooperation. Team members with high levels of Extroversion take on leadership roles and can improve teamwork. Teams with high levels of Openness have high levels of learning effectiveness. Team members who are too agreeable may avoid discussion. Similar values of Consci-

entiousness can distribute the burden fairly among team members, resulting in a better team [79]. Extroverted software developers are more effective in group decision making [34]. Teams with extroverted developers achieve higher software quality [61].

A lack of openness can lead to a lack of involvement of other team members, resulting in less knowledge and experience being shared [41]. A high level of openness in the team have been shown to lead to higher team performance [67, 81]. Cognitive differences can have a negative impact on teamwork as unconscious biases and beliefs can lead to coordination difficulties. Even subtle differences in perspectives or assumptions can have a negative effect [47]. Larger, more diverse teams in which team members are not subject to a rigid structure (e.g., in agile development) may increase the frequency of personal incompatibilities and thus the potential for conflict [52]. This finding is also supported by [11], as already mentioned in the chapter on conflict.

Finally, the leadership of software teams is also influenced by the personality of the leader. According to the FFM, the personality dimensions of Openness, Agreeableness, Conscientiousness, and Extraversion in leaders lead to higher project success rates [87]. It has been observed that certain personality types get along better with each other and thus achieve better team efficiency [31,52]. Personality influences the way team members communicate and thus the quality of teamwork [52].

3.10 Elicit-Results

As part of our literature search, we used Elicit to identify additional sources, which are listed in the Table 2, which also includes the main results for each article. The use of Elicit identified additional publications not found by either manual or automated searches, and the Elicit results are consistent with the results of the conventional literature search. For example, other significant personality correlates related to teamwork are listed. Job demands or job satisfaction are also related. We did not find any contradictions between the previous statements and the Elicit results.

Table 2. Elicit Results

Index	Main Findings
[13]	Project manager **personality** (MBTI) does not have a statistically significant influence on project effort deviation. Project manager teamwork behavior, assessed by Belbin's BTRSPI, has a statistically significant influence on project effort deviation
[60]	**Personality** and problem difficulty have a significant influence on the efficiency of pairs
[16]	**Personality** types have an influence on software development tasks choices

(*continued*)

Table 2. (*continued*)

Index	Main Findings
[53]	Top Members occupied critical roles in knowledge diffusion and demonstrated more openness to experience than the Others. No specific **personality** predicted members' involvement in knowledge diffusion
[58]	Conscientiousness is an important factor in the performance of student software engineering project teams. Team identification and the team's performance norms have a substantial influence on the team's performance
[32]	The RAMSET methodology had an impact on the **personality** preferences of Malaysian students. Personality preferences can affect the overall success of a software development project. It is important to consider effective **personality** preferences when creating software development team models and methodologies
[9]	Developers with MBTI type "INTJ" presented lower levels of depth of inheritance tree (DIT) and "slightly" smaller methods (LOC)
[30]	Combination of intuitive (N) and feeling (F) traits is not a suitable **personality** choice for programmer role
[7]	Consciousness, Neuroticism and Openness to Experience have a significant relationship with the Cyclomatic Complexity metric. Extroversion, Agreeableness and Neuroticism have significant relation with metric Coupling between Objects. Extroversion and Neuroticism have a significant relationship with metric Depth of Inheritance Tree
[83]	Personality has a significant relationship with task selection. Intuitive (N) and feeling (F) **personality** traits are primarily focused on the time duration of a project
[91]	Effective team structures support teams with higher emotional stability, agreeableness, extroversion, and conscientiousness **personality** traits. Extroversion trait was more predominant than previously suggested in the literature, especially among agile software development teams
[51]	Intuition and Sensing **personality** traits had an effect on programming performance. Intuition type students wrote more efficient code than Sensing type students. There was a significant linear correlation between Intuition and programming performance
[37]	Tester, team lead, and project manager are found to be ENFJs, which is the least common type in software developers. ISFJ is found to be the most preferable type for web developers and software engineers, with an edge over ENFJ
[8]	The Response For a Classe(RFC) and Weighted Methods Per Class (WMC) metric do not have a significant relationship with MBTI types. Depth of Inheritance(DIT) metric have a significant relationship with MBTI types

(*continued*)

Table 2. (*continued*)

Index	Main Findings
[44]	Productive software development teams can be formed by mapping the Big-Five Personality Traits with the software development tasks
[45]	Personality traits of software developers can be used to match their skills with the tasks associated with their job descriptions
[73]	40 discrete emotions have been reported in software engineering studies, with the most frequent being anger, fear, disgust, sadness, joy, love, and happiness
[3]	Higher levels of introversion are observed in isolated teams that have less contact with customers. Agile software development teams tend to have high levels of agreeableness and conscientiousness
[46]	Extraversion and feeling **personality** traits are the most suitable **personality** traits for requirements analysts/engineers who are assigned the task of requirements elicitation
[84]	A set of tools based on Myers-Briggs type indicators can be used to assess a candidate's natural disposition for a software development role. A mathematical coefficient was developed to evaluate the natural disposition of candidates during the allocation process
[80]	Personality type prediction can be applied in Turkish language. Social media posts can be used to predict MBTI **personality** traits
[68]	We proposed an improved version of Team Homogeneity Index called Weighted Team Homogeneity Index. We found that weights assigned to **personality** traits make a difference and Weighted Team Homogeneity Index is more strongly correlated than Team Homogeneity Index for almost all of the teams
[82]	Conscientiousness emerged as the strongest predictor of life satisfaction. Neuroticism and extraversion were found to predict negative affect and positive affect, respectively

4 Discussion

A three-stage search according to [22] was used as the methodological approach for the literature search. This approach facilitated the combination of manual and automated searches. Although the methodology is valid and reproducible, it could have been improved by adhering to the PRISMA procedure [66] to improve the transparency of the process.

The addition of the AI-based literature search has provided a selection of literature that complements this paper well. These findings suggest that purely Elicit-based studies may yield viable results. As our exploration was very promising, we suggest further research. In order to verify our positive conclusion, the completion of a research cycle is necessary. Based on our empirical findings, theoretical assumptions are possible, which in turn would inform experiments to verify these theories.

To answer RQ1, this paper emphasizes that teams as socio-dynamic systems are complex and cannot be fully described with infinite precision. The paper focuses on the level of teams transforming resources into value and presents Fig. 4 and Table 1 as the most relevant models to answer RQ1 based on the current state of research. In addition, we have presented various team metrics (team success, teamwork quality, team performance, personal success, team climate) that can describe or even measure team functioning. However, our literature review did not provide a holistic picture of personality or team characteristics and their specific impact on teams. Therefore, either our study design was not sufficient to find all relevant research, or further research on these phenomena is needed.

Regarding RQ2, personality was found to have a strong impact on individual processes at the team and product level. Our study demonstrates the benefits of considering personality when planning team-based software development processes. Furthermore, it suggests that certain phases of a software development project rely heavily on personality-based (emergent) phenomena, such as communication. This is because communication can be an output of a process (e.g., in the requirements phase) as well as a variable for various processes that have positive or negative effects. This suggests that future research on personality traits and their influence on communication would be particularly rewarding. In conclusion, we can say that regardless of the specific mechanisms, developers' personalities have been shown to have a strong influence on teamwork and team performance.

The following limitations apply to this study: (1) Some analyzed studies, which measured personality traits using national surveys, can only generalize their statements to the general population software developers to a limited extent. Alternatively, they could suggest that there is no general population and some findings will always remain specific to external circumstances. Thus, their conclusions for teamwork in software development must be treated with caution. (2) With more than 40 search results, the literature search carried out reached a high number of sources for non-automated analyzes. At the same time, only the basic chapters of many papers could be used - a number of papers even had to be removed manually. A specific search string or a topic-separated search might have been appropriate here.

Some studies in our sample (e.g., [86]) report skills such as creativity as important for software teams. The method used in these studies were surveys among software engineers. Thus, they represent the subjective perception of software engineers. Consequently, they did not provide information on how these characteristics correlate to team performance.

In contrast to most of our findings, one study suggested that including personality has little potential for optimization: According to [11], research should be focused in the area of processes and tools, since it is easier to achieve results here. This statement is in contrast to many other publications, that identified or mentioned much untapped potential in the field of personality research in IT [22,26,67,79,91]. The main contradiction found between [11] and other publica-

tions is based on a different perspective, as [11] consider the opportunity costs of focusing on efforts on personality-based approaches. We consider this a valuable finding.

It is not possible to clearly identify from the studies when a team can be described as diverse or until when a team can be described as homogeneous, precisely because diversity can be defined differently depending on the context. In the context of personality diversity, we see the greatest insight in the conclusion that it is sensible to record the personality of the team members in the first place. This would allow incompatibilities or even strengths to be identified earlier, and make controlled interventions possible.

5 Conclusion and Future Work

In this paper, we answered the question of what constitutes teamwork in software development and what impact the personality traits of developers have on the team. For this purpose, we conducted a three-stage literature search (n=48) according to [22].

Teams today are necessary constructs in which two or more people work together to achieve a common goal. As teams adapt and develop dynamically through interaction and changes of the environment, they meet the definition are a complex social system.

The personality of a person shapes his behavior patterns, thoughts and feelings. Especially in software development, where a high percentage of communication and work has to be done with people, the personality of the developers has a high, but often still unrecognized value. Although some studies have not been able to prove an effect of personality on programming results, personality does have a high influence on the team. For example, studies have measured an improvement in project success or developer satisfaction.

There are different approaches to assemble teams - but generally the goal is to optimize team performance. We have defined team performance as a metric to evaluate the effectiveness and efficiency in terms of results, but also the team's ability to work and communicate. One finding was that conflicts can have both positive and negative impact on team performance. The challenge is to combine teams in a way that enables more productive forms of conflict while reducing the probability of harmful ones. One finding was that an abundant number of small conflicts can increase understanding and acceptance within the team and thus sustainably improve team performance.

We see several opportunities for further research in this area. One possibility would be to examine the relationships between the team metrics presented here and personalities. Another possibility would be to "translate" one personality type into the type of another personality model, making the findings of different studies comparable. Additionally, it would be helpful to be able to determine which personality constellations have which influence on conflicts.

The contrasting views of [11] should motivate research into the efficiency of personality-based approaches to improve team performance, especially with regard to opportunity costs.

Most of the studies reviewed looked for relationships between individual personality traits and performance. In retrospect, our review revealed three perspectives: The influence of individual personality traits on individual function within a team - which most of the reviewed publications examined; the influence of individual personality traits on team parameters such as "communication" - which some studies focused on; and the influence of the abundance of certain personality traits in teams on team performance - which we tried to make accessible. As we found, the first two perspectives and the results of the publications that include them strongly imply correlations with team performance. However, they do not yet support the formulation of general statements. Further research on all three levels is needed. We suggest that future research should coordinate studies on these three levels. The goal would be to produce generalized findings about the influence of specific personality traits of individuals within teams, as expressed in team dynamics, which in turn determine team performance.

Overall, the resulting model linking performance indicators to personality characteristics could be used by practitioners to assemble teams.

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