

Team Topologies in Software Teams: A Multivocal Literature Review

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Abstract. Team topologies have been frequently associated with organization's success for effective software delivery in the shape of right product. Achieving excellence for software development highly depends upon the team's coordination and communication between them. Team topologies are methodology helping an organization deliberately think about different teams' purposes (fundamental topologies) and how and when they should interact with each other (core interaction mode). Authors aim to investigate the concept and the impact of team topologies. Using a Multivocal Literature Review we found significant impact of team's goals over the individual's goal in an organization. As expected organization formed using fundamental topologies and core interaction mode lead to high success rate.

Keywords: Multivocal Literature Review · Team topologies · Team topology · Software engineering

1 Introduction

In almost any human activity, teams are used to perform tasks, particularly the ones that are more creative and complex. In spite analyses have revealed the benefits of diversity for team creativity, these benefits carry several challenges linked to diversity in teams [1]. Many organizations are making teams to divide the work in small parts such as developing and improving IT products or services [2].

For the intricate tasks, process models are also aspects to analyze. In creative processes in which its complicated nature is a fact, knowing the team topologies and how teaming process affects the team performance is interesting [3]. In software arena, global software development is a common approach to tackle higher pressures in time [4, 5]. In practice, the success of software development projects is dependent on the successful completion of its requirements engineering activities, which is challenging phase in software development [6]. Shared understanding is crucial and helpful in resolving conflicts and clearing ambiguities, it occurs when all the individuals working on a project have the same understanding of every requirement.

A team is collection of different individuals working in different organizations, to carry out different tasks in different fields of study. In virtual teams, team members work in different locations and their interaction is based and enabled by technology. In these

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environments, communication can be intricate, but, on the other hand, this environment could lead to fewer distractions [7]. Team topologies describe how teams are organized in an organization defining their responsibility limits and how they interact or communicate among teams [8]. In this regard, two important aspects must be considered: group coordination and group cohesiveness. Coordination refers to the task coordination by allocating roles to the team members and denoting to individual abilities, knowledge, skills and experience. Group cohesiveness is related to members' willingness to pertain to a given group. According to [9], group cohesiveness can be achieved by three main communication acts: informal talks, confirmation and appreciation. Informal talks are non-task related communication; appreciation is unambiguous information liking towards a contribution of team member and, finally, confirmation is the appreciation of a contribution. Preceding works underlines that performance within work groups is determined by the groups social network topologies [10]. Team topologies as a concept provides a lens which can help to structure an organization for effective collaborations, autonomy, delivery focus and product alignment [11]. Authors are not proposing that increasing connections among team members can increase the performance, however, it is true that some network structures determine performance. In the current scenario in which the introduction of agile methods moved the focus from the individual developer to the team [12], and, on the other hand, automation [13] and continuous software engineering [14], the need to adopt forms that can be applied in such scenarios is of paramount importance. One of the approaches designed to improve collaboration and improve the delivery of products is Team Topologies. This work is aimed to study the impact of this method in the literature. Given the novelty of the concept, but also its importance driven buy the key role of software in the world, authors develop this study to understand the concept and its implications.

The organization of this paper is as follows. Section 2 depicts the research methodology adopted in this paper. Section 3 presents the results of the study. Finally, Sect. 4 present and discuss the answers to the research questions and further research is depicted in Sect. 5.

2 Research Methodology

The main objective of this paper is to study and present in an organized way the state of art of team topologies. Consequently, the aim is to determine its meaning, identify trends and also to detect future work opportunities.

In order to perform the study, a Multivocal Literature Review (MLR) was conducted following the guidelines provided by [15]. A MLR is one of the forms of systematic literature reviews which, in this case, allows us to include primary, secondary as well as grey literature, including in this set videos, white papers or blog posts [15, 16]. Given the novelty of the concept, the amount of relevant studies in scientific literature is very limited, leading to MLR as a valid tool to investigate the concept.

In MLR we use certain criteria to evaluate the search and evaluation method in order to identify the group of primary studies from different databases. As [17] established, there are three stages that should be followed in this review; first, planning; second, conducting and, finally, reporting. In the first stage the planning protocol will be defined

including the process for performing the review, including the definition of research questions (RQs), strategies regarding the search and assessment of studies, inclusion and exclusion criteria and other aspects.

2.1 Aims and RQs

In this section, authors will defined the aim of the study and from that, the set of RQs that will be answered in this work.

The main goal for this review is to review team topologies as a concept, examining its repercussion. Accordingly, the goals of this work are: (a) identify team purpose and responsibilities (b) to collect and analyze communication paths, and (c) to observe the perceived benefits of team topologies in software teams.

Inspired in these goals, authors defined the two RQs as follows:

- **RQ1:** What kind of teams and in which ways they operate under team topologies?
- **RQ2:** What are the different ways to communicate with other teams in team topologies?

2.2 Study Selection

In this section, authors outline search and evaluation strategies to discover and classify primary studies. In this regard, authors define search terms, based on them, build the search string as well as describe the process to guide study selection.

Databases: Authors used the set databases to identify scientific literature on the topic:

- ACM
- IEEE
- Springer
- Science Direct
- Google Scholar

The reason behind the selection of these databases is the popularity of the set in literature studies in the broad field of computing. Authors would like to mention that Google Scholar was selected as a source of scientific outputs that could be out of the previous four databases. Apart from this five databases retrieving scientific articles, Google Search was used to surf for relevant sources in grey literature.

Search Terms: Authors analyzed RQs with the intention of selecting general terms related to team topologies with the aim of gathering relevant works for this study. Therefore, as a results of this search terms will be "team topology" and "team topologies".

Search String Construction: Following Brereton et al. [18], in this work, authors tried in order to fine-tune the search string. The result of this process was a Boolean Expression " (A1 OR B1)" where search terms are is:

"Team Topologies" OR "Team Topology"

Inclusion and Exclusion Criteria: Our MLR identifies the studies that enlighten the importance of team topologies in IT sectors. So as to analyze the state of research of team topologies, authors decided not to limit publication periods.

Inclusion Criteria

- Studies that presents team topologies.
- Studies that explains the team topologies.
- Studies analyzing team topologies.

Exclusion Criteria

- Papers not specifically related to team topologies.
- Studies that presents the outcome of team topology but do not show any information about the IT sector.
- Papers with unobtainable abstract and the full text.
- Studies not written in English
- Duplicates.

2.3 Literature Retrieval

As stated before, authors selected the following databases: ACM Digital Library, Springer Link and Science Direct. These are the databases common in the set of published secondary studies in the field [19]. Also, in the search of grey literature, authors used Google Scholar, because its popularity and usefulness.

2.4 Scientific Selection Process

The search process allows us to select primary studies from the scientific literature in the previously presented databases. The process is comprised of four phases that follow a test-retest approach to reduce bias in the selection process. The same process was also con-ducted to identify grey literature on Google Search. The four phases are as follows:

Phase 1. Initial Search. The search string was applied to the search engines in order to identify the literature related to topic under review. Searches are limited to title, abstract, and keywords. In terms of timeline, our study was conducted in February 2021, and thus we included the papers published until that time.

Phase 2. Remove Duplicates. Studies identified during phase one of the selection process will be checked in order to remove the duplicates. If duplication is identified, papers providing detailed information such as an abstract or the full text of the paper, complete references of the publication will be selected.

Phase 3. First Selection Process. Studies selected in phase two will be evaluated with inclusion and exclusion criteria. In this phase, the title and abstract of each paper will be reviewed. If the papers are out of inclusion criteria papers will be completely discarded however if the papers fall under inclusion criteria, papers will be selected for the next phase.

Phase 4. Second Selection Process. Studies selected during phase three will be reviewed thoroughly. This stage will be done to ensure that publication contains the relevant information for the study under review. This approach helps in omitting irrelevant literature.

2.5 Grey Selection Process

The grey selection process allows selecting the primary studies from the grey literature. This process is composed of four phases that helps find the grey primary studies through a test-retest approach. The four phases of the grey selection process are the following:

Phase 1. Analyze References & Authors: In this phase, first forward and backward snowballing will be conducted on the scientific primary studies. Snowballing, in this context, refers to using the reference list of paper (backward snowballing) or the citations to the paper to identify additional papers (forward snowballing) [20]. Second, the researcher responsible of the searches will apply the search string to the list of works of each of the authors of the scientific primary studies. The aim of this search is to find all the works of each author related to the topic under review. At the end of this phase, a set of additional studies will be retrieved from the analysis of the grey literature.

Phase 2. Remove Duplicates: The studies retrieved during Phase 1 of the grey selection process will be checked in order to remove the duplicates, the studies that are clearly irrelevant to the topic under review and the papers that belongs to the scientific primary studies.

Phase 3. Second Selection Process: Once the duplicates have been removed, in this phase, the researcher responsible will carry out the same activities described in Phase 3 of the scientific selection process.

Phase 4. Second Selection Process: The work classified as possible selected papers (PS) during Phase 3 will be thoroughly analyzed by reading the full text. In this phase, the researcher responsible will carry out same activities described in Phase 4 of this scientific selection process.

In our MLR, we used Google Scholar for conducting the forward snowballing and the searches in the list of works of each of the authors of scientific primary studies.

2.6 Data Extraction

During the execution of the MLR, a substantial amount of data will be collected. There are two main sources of data: data collected during the search process and data collected during the extraction process. The data collected during search process allow collecting general data to identify the papers retrieved from both, scientific and grey selection process, support decision making of selecting the primary studies of the review and document the selection process. On the other hand, the data collected during the extraction process are the specific data needed to achieve the objectives of the study and answer the research questions under review.

2.7 Data Storage

All papers were organized in a systematic way in a reference manager namely Zotero. Additionally, an Excel sheet containing selected literature was employed to highlight the importance of each paper by means of a list of colors.

3 Results

This study was performed in February, March and April 2021. During this time, authors developed all aspects presented in section two and also conducted the study itself. The two researchers participated in the MLR: the first author conducted the MLR and the second author supervised the work, designed the approach, reviewed the process and verified the process and the results.

In what follows, authors present main results of this study, particularizing the explanation in scientific and grey literature extraction.

3.1 Scientific Selection Process Results

This process consist of four consecutive steps. In the first round, authors executed the query in the five selected databases. A set of 147 papers was identified. Subsequently, authors looked for duplicates. The result of this process was the removal of 6 duplicated papers. As a third stage, authors examined 141 title and abstracts assessing inclusion and exclusion criteria for each paper. The result of this process was the identification of 3 papers. In the last step, authors read the full text of the three papers in order to ensure the suitability of the set. One paper more was excluded leading to a final set of two papers in scientific databases. Table 1 depicts this four stage process.

3.2 Grey Selection Process Results

Authors followed similar approach on the grey studies selection process. In the first round, buy means of google search; we retrieved 865000 results.

The second round of grey selection process started with 865000 studies in Google search. Normally, the first pages in these search are relevant. Consequently, in this paper we adopted the approach in [21] to proceed further only if needed. So, $(n + 1)^{th}$ page

was checked just in the case the result on n^{th} page was found relevant. After removing duplicates, authors carried out a 3^{rd} round. At this stage, we analyzed the title and abstracts examining inclusion and exclusion criteria. Once the first selection process we excluded the 864999 studies from the set. Then authors faced the final step of grey selection process to analyze full text of the studies. At the end of this stage, authors identified just one study to take into account for the final set of studies.

3.3 Primary Studies

As the result of the four rounds, just 3 studies were found relevant. Figures for papers in each of the rounds are presented in Table 1.

Table 1. Papers analyzed per round

Database	First	Second	Third	Fourth
ACM	6	6	1	1
Springer	14	13	0	0
Science Direct	5	4	0	0
Google Scholar	122	118	2	1
TOTAL Scientific	***147***	***141***	***3***	***2***
Google search	865,000	864,991	1	1
TOTAL	***865,147***	***865,132***	***4***	***3***

4 Discussion

4.1 RQ1. What Kind of Teams and in Which Ways They Operate Under Team Topologies?

Within a team, the accent on accountability (individual and team) has turn out to be prevalent in the evaluation of task orientation factors [22]. A team's goal is a future state of affairs desired by enough members of a team to motivate the team to work toward its achievement. Tohidi [23] suggested that a team´s goal is more significant than individual goals. Still, it is also stated that the success of the company could be less important than team's success.

It is reported that modern complex systems require effective team performance. In the software arena, the complexity, diversity, speed and frequency of change needed for modern software tools means that different development teams in software development are vital [8]. In particular, a research by Google on their own teams found that who is on team matters less than the team dynamics; and that when it comes to measuring performance, team matters more than individuals [24]. We must, therefore, start with team for effective software delivery.

Systems that are built by organizations are always questioned by users based on the previous agreed upon requirements. Values are always measured on the basis of the product delivery, excellence, and fast paced-evaluation of the systems, rapidly changing environment, changing requirement of customers, pressure of shorter time to market, and speedily advancement of IT. To overcome this state of affairs, agility and its practices bring flexibility, efficiency and speed [25]. Team topologies refer to the organizational capability to develop, communicate and learn. This brings operation the chance to build, evolve and refactor the systems design, developing the functionality, satisfying customers, and getting instant feedback from users to inform the next development cycle. Furthermore, the tools employed in different software development phases (analysis, coding, deployment…) must be aligned with rapid cycles.

We found four different types of teams:

- **Stream aligned teams:** Present an end to end responsibility on a new functionality or change, including operation roles in production.
- **Enabling teams:** They empower the previous type to upsurge their competences for a given time (new technology, new process…)
- **Complicated subsystem teams:** They are skilled specialists that would be hard to place into stream aligned teams because their dissimilarities.
- **Platform teams:** Platform specialists aimed to fast-track or make straightforward software delivery for the first group.

4.2 RQ2. What are Different Ways to Communicate with Other Teams in Team Topologies?

Velocity and efficiency are aspects crucial for the survival of software industry software organizations in their release process and product shipping [26]. Undeniably, continuous delivery is impacting organizations and their organizational structures, given that release activities encompasses many units of these organizations, typically Development and Operations in DevOps settings, but also others like security or business areas. Consequently, organizations adopting these approaches must adapt their toolchain but, just that, they need to find a way to better orchestrate their teams. We found three different ways for team topologies to interact with each other [27]:

- **Collaboration:** Teams collaboration must be effective to meet challenges of balancing speed and safety of software development.
- **X as a Service:** The organization must not restrict to optimize for top/down or bottom/up communication and reporting. Decision based on organization chart structure tends to optimize only part of an organization ignoring upstream/downstream effects. Local optimizations help the team directly involved, but they do not necessarily help improve overall delivery of value to the customer. For example, assigning task of infrastructure as a service (IaaS) to software as a service (SaaS). Thus, the group of teams should work in one domain to have high quality product.
- **Facilitate:** Facilitate refers to informal and value creation structure (interaction between people and team). Empowering the teams for better outcome of software

delivery. Addition to this, treating team as a fundamental building blocks and trust between the teams.

As a result, these are three main interaction modes that not only encourage teams to deliver high quality product but also overall help to an organization.

5 Future Work

Authors present a study towards a more detailed understanding of team topologies. Four different teams were found within the topic under review. In addition to this we also explained three different interaction modes which are basis of team topologies. The results of our MLR, including the perceived benefits identified allow us to conclude that team topologies have potential for organizations to help them in their endeavors. Nevertheless, the use of team topologies is an emergent research field in which researchers will work in the next future. However, authors call for further research and, in particular, experimental works to document the full potential of team topologies in the scope of software work.

In the near future, to properly execute the conclusion and ideas shared in this paper, some additional work has to be done. We want to devote time to investigate the connections and interlinks of team topologies with the increasing importance of automation in software work (DevOps and DevSecOps) and the new roles in these teams.

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