

INTERORGANIZATIONAL & INTERDISCIPLINARY PROJECT TEAMS
A SCOPING REVIEW AND FUTURE RESEARCH DIRECTIONS
FOR AEC INDUSTRY

By

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ABSTRACT

The Architecture, Engineering and Construction (AEC) industry demands collaboration between multiple high specialization organizations. These complex interorganizational and interdisciplinary project teams are a unique set of project teams that are mostly contracted for a temporary time where collaborators in most cases have no prior or future work relations with one another. While the teams research is at the heart of this and is well established in organizational project teams domain, there exists an established need to study teams in the context of interorganizational and interdisciplinary project teams. In the past two decades, scoping review as a research methodology has proved effective in determining future research directions for advancement of various aspects of research on project teams. However, scoping review of project teams literature utilizing a citation network analysis (CNA) approach has not been used to find research directions specific to complex AEC interorganizational project teams while also evaluating their place in the larger spectrum of project teams research. In response to this need, this study carried out a scoping review on a sample of publications studying project team settings across multiple domains. The publications were analyzed through citation network analysis tools which included several types of networks where nodes in the network represented journals, publications, countries, and keywords while the links between them highlighted the collaboration relations. Deliverables included current state of research on project teams connected across multiple domains within the project teams literature and directions for future research specific to AEC inter-organizational project teams.

Keywords: Project Teams, Interorganizational Project Teams, AEC Project Teams, Scoping Review, Citation Network Analysis, Science of science

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Chapter 1 INTRODUCTION

1.1 Problem Statement and the Need

The Architecture, Engineering and Construction (AEC) industry consists of **complex interorganizational and interdisciplinary project teams** (Garcia et al., 2021; Korkmaz & Singh, 2012). These teams are formed amongst owners, designers, contractors, and various stakeholders to deliver projects (Solis et al., 2013). They are a unique set of project teams that are contracted for a temporary time where collaborators represent multiple organizations, disciplines, and backgrounds and in most cases, have no prior or future work relations with one another (Schexnayder & Fiori, 2021). In addition to this temporary nature of the inter-organizational and interdisciplinary AEC teams, with the constant increase in scale and complexity of AEC projects, these project teams struggle to achieve **efficient and effective communication to drive project success** (Cheung et al., 2013; Oliver et al., 2018; Senescu et al., 2013; Solis et al., 2013). With multiple factors affecting an AEC project team, trust and motivation play a crucial role in ensuring smooth working relationships, both at an organizational and individual level (Cheung et al., 2013; Rotimi et al., 2016). To increase productivity in such interorganizational collaborations, the AEC industry has investigated high performance teams that are driven to establish trust within team members, shared values and goals and open communication lines (Jørgensen, 2018).

Teams research is at the heart of this and is well established in organizational projects domain with a focus on how project teams are related to individual or project performance (Caniëls et al., 2019; Jørgensen, 2018). Considering the existing team literature's focus on organizational teams and/or disciplinary teams, **there exists an established need to study teams in the context of interorganizational and interdisciplinary project teams**. Teams research has also found its place in the context of **student project teams** with a focus on skills for future of work related to leadership, team culture, task planning, communication, and time management (Galbraith & Webb, 2013; Presler-Marshall et al., 2022; Weeks & Kelsey, 2007).

Further exploration of teams literature indicates that scoping review as a research methodology has proved effective in the past two decades in determining future research directions for advancement of various aspects of project teams (Kereri & Harper, 2019; Mathieu et al., 2019; Park et al., 2020). Mathieu et al. (2019) conducted a scoping review with a focus on team effectiveness in complex work teams, while Kereri & Harper (2019) used Social Network Analysis to identify the collaboration levels in construction project teams using social factors based on real-time data. The

valuable recommendations of the many existing scoping reviews out there have been embraced by many scholars in assessing the dynamic nature of project teams and its effect on project team performance. However, **scoping review of project teams literature utilizing a citation network analysis (CNA) approach has not been used to find research directions specific to complex AEC interorganizational project teams while also evaluating their place in the larger spectrum of project teams research.** (Leppink & Pérez-Fuster, 2019; Mathieu et al., 2019; Park et al., 2020).

In response to the above-mentioned gap, this study conducted a systematic scoping review of project teams literature to investigate and advance inter-organizational collaborations within project teams. Such a review can reveal the relations and evolution of research on project teams considering key differentiating concepts such as type of industry, student versus authentic project teams, virtual versus co-located team settings etc. (Carter et al., 2015; Kereri & Harper, 2019).

1.2 Goals and Objectives

The goal of this study was to carry out a scoping review of existing research on project teams and conduct a citation network analysis using SNA to explore and advance inter-organizational and interdisciplinary collaborations within AEC project teams. The specific study objectives are as follows:

1. **Objective 1:** Explore the trends and evolution of project teams literature differentiated by characteristics such as type of industry, authentic versus student teams, virtual vs co-located teams and organizational vs interorganizational teams.
2. **Objective 2:** Explore the evolution of prior works within project teams research with a focus to study:
 - a. State-of-research of AEC interorganizational project teams; and
 - b. Future research directions for interorganizational collaborations within the AEC industry.

The main **research question** that will direct this research study is as follows:

What is the state of practice for AEC project teams based on the literature and how has project teams research evolved and is connected across domains?

1.3 Overview of Methods

This study utilizes a **scoping review methodology combined with citation network analysis** using SNA of prior research on project teams (Leppink & Pérez-Fuster, 2019; McLaren & Bruner,

2022). The scoping review methodology was conducted using an online citation database called “SCOPUS” (Carter et al., 2015; Mathieu et al., 2019; Park et al., 2020). To ensure construct validity, a preliminary literature search was carried out to identify all the existing scoping review articles related to project teams to identify the relevant search strategy and methods of analysis for this study (Carter et al., 2015; Mathieu et al., 2019; Park et al., 2020). The citations covered in the study were reached upon through multiple independent systematic search paths (Mathieu et al., 2019). To ensure reliability, one of the starting points for the search was through an expert team working on project teams that helped this study identify key researchers who have made contributions to teams and project teams literature. Independent keyword searches with filters on source and type of articles led to multiple publications lists. For internal validity, the lists through different search paths were combined to finalize **a comprehensive publications list which serves as the sample** for this study. The final list of publications focuses on research on project team settings done within multiple industries (for e.g., AEC, manufacturing, healthcare, information technology etc.).

A citation network analysis using multiple node characteristics of these publications was conducted as it serves as an effective method to examine the overall state of a focus within a research field (McLaren & Bruner, 2022). The node in the network analysis varies from being a journal of the publications, country based on co-authorships, author keywords and the publications itself. Each network analysis was layered/explored through categorization into multiple categories:

Authentic versus student project teams, Type of Industry, Virtual versus co-located teams and Organizational versus Interorganizational (Carter et al., 2015; Kereri & Harper, 2019). The publications within the sample focusing on AEC interorganizational teams were further categorized based on single versus multiteam systems (Shuffler et al., 2015) and level of analysis (Chan et al., 2021; Luciano, Bartels, et al., 2018). The categorization of publications was also used to create visualizations of combination of multiple categories on a timeline on the same graph to capture the evolution and distribution of literature on project team settings.

The various methods of citation network analysis and evolution over timeline graphs helped this study derive useful insights into the state-of-practice of project teams connected across multiple domains. It also gave results related to evolution and potential future research areas specific to AEC interorganizational project teams.

1.4 Expected Results and Deliverables

The expected results and deliverables of the study are:

- a) Current state of research on project teams connected across multiple domains within the project teams literature; and
- b) Directions for future research specific to AEC inter-organizational project teams and future of workforce development.

1.5 Reader's Guide

In the following sections, Chapter-2 presents the literature review on various established aspects and evolution of teams literature and scoping review methods for defining the key methods used to carry out this study. Methodology for performing the scoping review on the sample of publications is discussed in Chapter-3. Chapter-4 highlights the various results, visualizations, and key findings from the analysis. Chapter-5 talks about the results and their respective theoretical applications on project teams research with recommendations for future research areas.

Chapter 2 LITERATURE REVIEW

2.1 Introduction

Through this chapter, the researcher conducts a literature review of established aspects and evolution of teams literature. From teams literature, the literature review transitions to project teams as a subset of the larger teams literature. The literature review then explores the current state of research of project teams with a focus on AEC industry and provides evidence on an established need to study teams literature in the context of interorganizational and interdisciplinary project teams. The chapter then covers scoping review and various methods of citation network analysis as an effective tool to study the current state of research to derive future research directions for both AEC project teams and future of workforce development. Hence, this chapter is organized in the following subsections: teams, project teams, interorganizational project teams in the AEC industry and literature review methodologies.

2.2 Teams

What is a Team? A team composition consists of members representing the company or different organizations (Schexnayder & Fiori, 2021). From the perspective of a system, teams are defined as “complex dynamic systems that exist in a context, develop as members interact over time, and evolve and adapt as situational demands unfold” (Kozlowski & Ilgen, 2006, p. 78). Keeping team member roles and responsibilities in mind, Kozlowski & Ilgen (2006, p. 79) define teams as “are two or more individuals who socially interact (face-to-face or virtually); possess one or more common goals; are brought together to perform organizationally relevant tasks; exhibit interdependencies with respect to workflow, goals, and outcomes; have different roles and responsibilities; and are embedded together in an encompassing organizational system, with boundaries and linkages to the broader system context and task environment.” (Katzenbach & Smith, 2005) state that shared commitment is the most crucial aspect of a team. Majority of the work done in any organization is successfully completed via teamwork and is driven by shared commitment (Katzenbach & Smith, 2005; Kozlowski, 2018; Marks et al., 2001). Marks et al. (2001, p. 236) define teamwork as “people working together to achieve something beyond the capabilities of individuals working alone.” Kozlowski (2018) elaborates that over the past two decades, as the organizations all over the world realigned work around teams, the character of teamwork and the various factors which influence has been the focus of teams and organizational literature.

The **organizational structure** of an effective team varies from team to team and typically has designated roles and responsibilities for each person on the team (Porter et al., 2003; Schexnayder & Fiori, 2021). Within the spectrum of hierarchal teams, teams have been looked at through multiple models over the years which are: (a) Individual decision-making model, (b) team lens model, and (c) multilevel theory (MLT) of team decision making” (Humphrey et al., 2002, p. 175). Humphrey et al. (2002, p. 184) elaborate that MLT of team decision making identifies four levels of analysis: (1) Decision Level, (2) Individual Level, (3) Dyadic Level and (4) Team Level. The various **characteristics of successful teams** have been researched by numerous researchers to develop theoretical models focusing on team effectiveness (Kozlowski & Bell, 2008; Marks et al., 2001). Kozlowski & Bell (2008) state that teams are often restricted in being viewed as means to cater to organizational demands and adaptability. Hence, clusters of individuals within teams play an important role in building effective and adaptable work teams (Dasí et al., 2021; Kozlowski, 2018). On the other hand, with the evolution in research in related to team structure and team & individual characteristics, Marks et al. (2001) focus on the **importance of team processes** that the team members adopt to collaborate within teams that will help the management align training and development of future teams. Additionally, research has also focused on **errors in teams** (Bell & Kozlowski, 2011; Maltarich et al., 2018). Bell & Kozlowski (2011) discuss the importance of identifying the origin and emergence of errors in teams. They further identified the factors that influence management of errors in teams but found a lack of representation of product & service and project teams to clearly define how workflow interdependence and boundary permeability affect error management.

Teams research is well established in organizational projects domain with a focus on how teams are related to individual or project performance (Caniëls et al., 2019; Jørgensen, 2018; Zhou et al., 2017). Cohen & Bailey (1997) defined **four broad categories of teams**:

- (a) Work teams: Work teams are the most generic teams that come up when discussing teams as they are ongoing units of work for producing goods and/or services.
- (b) Parallel Teams: Parallel teams are the teams that exist parallelly in cohesion with an existing formal organizational structure to perform functions that the organization itself cannot perform that well.

- (c) Management Teams: These teams provide directions to sub-units within an organization and ensure their integration with other interdependent sub-units across key processes of the business.
- (d) Project Teams: Project teams refer to a time-limited group of individuals working collaboratively on the development of a new product or service. The tasks undertaken by these teams are intricate and diverse, requiring a substantial application of knowledge, expertise and judgement. The activities performed by project teams tend to be simultaneous rather than sequential. Moreover, these teams often comprise individuals from various disciplines and functional units.

Hence, project teams represent a unique type of team which will be discussed in detail in the following section.

2.3 Project Teams

What is a Project Team? What are the unique features that make project teams different from other teams? “A project team is a team whose members and participants usually belong to different departments and institutes and are assigned to join the same project” (Jafari Navimipour & Charband, 2016, p. 731). Over the span of a project, participants come with different knowledge base, experience, and expertise to achieve a common overall goal (Dasí et al., 2021; Jafari Navimipour & Charband, 2016). **Project teams have also been defined as groups with high specialization** and low external integration (Sundstrom et al., 1990). On the other hand, Cohen & Bailey (1997) argued that external communication was a differentiating factor for project teams when compared with other work teams. They further elaborated on functional diversity and shared team understanding directly affect the performance of a project team.

With the ever increasing and continuously changing 21st century, project teams play a crucial role in contemporary organizations as they are flexible in nature that promote expertise sharing and knowledge building (Zhou et al., 2017). Jafari Navimipour & Charband (2016) studies **knowledge sharing within project teams** based on the following parameters: Culture, learning, creativity, knowledge management, organizational climate, knowledge exchange, the development of close relationships, performance, trust, communication quality, job satisfaction, attitude toward knowledge sharing, tacit knowledge sharing, and rewards.

Within the literature focusing on project teams, several variables have been explored which include:

1. **Team Composition:** The composition of project teams, including the diversity of skills, knowledge, and expertise among team members, are related to team performance and success (Belout & Gauvreau, 2004). Multiple studies have examined key factors such as team size, team member roles, and the balance between specialists and generalists within the team.
2. **Communication and collaboration:** Effective communication and collaboration are critical factors for successful project teams. Some important variables studied related to communication and collaborations are communication patterns, information sharing, coordination mechanisms, and the use of collaborative technologies and innovation within project teams (Caniëls et al., 2019; Kleinsmann & Valkenburg, 2005).
3. **Leadership:** Leadership plays a vital role in driving guidance and motivation within project teams. Studies have examined the impact of factors like leadership styles, leadership behaviors, and the role of project managers on team success. (Aryee et al., 2012; Shenhar & Dvir, 2007).
4. **Team Dynamics:** Team dynamics includes factors such as team cohesion, trust, conflict management, and decision-making processes, which have been explored as influential variables affecting project team success (Belout & Gauvreau, 2004; Buvik & Rolfsen, 2015).
5. **Organizational Support:** The support provided by an organization to its project teams can have an impact on project team success. Prior studies have explored factors such as resource availability, organizational culture, project management practices, and multi levels of hierarchy that exist within an organization (Aryee et al., 2012).
6. **Project Planning and Execution:** Variables related to project planning and execution include scope, of the project, goal clarity, task scheduling and risk management which have been found to be related to project team success (Pinto & Slevin, 1988; Svejvig & Andersen, 2014).
7. **Learning and Knowledge Management:** The ability of project teams to learn from experiences, share knowledge, and apply lessons learned are key variables related to project team success. This includes variables such as knowledge transfer, learning processes, and knowledge retention within the team (Ahlfänger et al., 2022; Kozlowski & Bell, 2008).

It is important to note that the various variables mentioned above vary across different industries based on the nature of the project or research focus of different studies. Project teams exist within

different industries such as healthcare, information technology, AEC, human resource development etc. (Carlson et al., 2018; Greetham & Ippolito, 2018; Hansen, 2006; Iorio & Taylor, 2014).

Student vs Authentic Teams: Project teams research has also found its place in the context of student project teams with a focus on skills for future of work related to leadership, team culture, task planning, communication, and time management (Galbraith & Webb, 2013; Presler-Marshall et al., 2022; Weeks & Kelsey, 2007). In response to the industry's requirement for teamwork skills in the graduates they hire, schools from various disciplines have responded to this need by increasing the use of team projects in their curriculum (Druskat & Kayes, 2000). Druskat & Kayes (2000) describe these teams as short-term project teams which comprise of students from diverse backgrounds and skill sets. These short-term project team settings are instrumental in preparing individuals for the workforce.

Virtual vs Co-located Teams: The research on co-located versus virtual project teams has been a topic of interest in recent years (Zhang et al., 2018). While co-located teams traditionally refer to teams working in common physical environments/location, virtual teams contain project members that work remotely and rely on communication technologies to collaborate and deliver projects. Ongoing research on virtual project teams has revealed multiple factors being under exploration. Some advantages of virtual teams are that organizations can hire project team members from a diverse pool of talent not limited by geographical constraints (Bell & Kozlowski, 2002). Research on virtual project teams has also led to advancements in collaboration technology. On the other hand, Garro-Abarca et al. (2021) have given useful insights on the ongoing challenges in virtual project teams related to communication, coordination and trust development primarily affected by the absence of face-to-face interactions.

In addition to virtual and traditional co-located teams, **hybrid communication project networks** combining elements of both co-located and virtual teams has been explored by project teams seeking to make the most of the benefits of both the approaches (Neumayr et al., 2022; Sithambaram et al., 2021). With the **post pandemic world** switching to hybrid and/or virtual teams (Kinnula et al., 2018; Willermark & Pareto, 2020), the field of scientific research on project teams is going to see an upward trend in more studies on virtual collaboration networks.

With the existing project teams literature's focus on organizational and/or disciplinary project teams within multiple sub-domains or variable related to project team success (Drouin & Sankaran,

2017), the literature review explores interorganizational and inter-disciplinary project teams in the AEC industry in the following section.

2.4 Interorganizational Project Teams in the AEC Industry

The Architectural, Engineering and Construction (AEC) industry represents a special case of project teams which are interorganizational and interdisciplinary in nature (Garcia et al., 2021; Korkmaz & Singh, 2012). Garcia et al. (2021) further elaborates that these project teams are formed amongst owner, designer, contractor, and various stakeholders that collaborate to deliver projects related to the built environment. What makes these project teams unique is their **temporary nature** where collaborators represent multiple organizations, disciplines, and backgrounds and in most cases, have no prior or future work relations with one another (Schexnayder & Fiori, 2021; Solis et al., 2013). In addition to this temporary nature of the inter-organizational and interdisciplinary AEC teams, with the constant increase in scale and complexity of AEC projects, these project teams struggle to achieve efficient and effective communication to drive project success (Cheung et al., 2013; Senescu et al., 2013; Solis et al., 2013).

With multiple factors affecting an AEC project team, **trust and motivation** play a crucial role in ensuring smooth working relationships, both at an organizational and individual level (Cheung et al., 2013; Rotimi et al., 2016). Marlow et al.(2018) argue that quality triumphs frequency when it comes to communication for project performance. **Timely communication** has a positive impact on project performance as numerous construction activities are inter-connected and overlap with each other. (Safapour et al., 2019). With several types of communication (e-mail exchange, in-person meetings, project management information systems, phone calls etc.) exhibiting a variety of challenges in the AEC industry, a key research area related to construction productivity has been found to be “improving communication and collaboration between stakeholders” (Q. Chen et al., 2018; Marlow et al., 2018, p. 27). What quality means here is beyond the content of the information or its method of exchange, but it is also about who it is with and how frequent that exchange is at the ongoing stage of a project in the AEC industry.

Zhou et al. (2017) identified project team types used in research related to construction, education and information technology industry based on a seven-dimensional scaling model which are as follows: construction project team, CM/GC project team, DB project team, Build Operate Transfer project team, infrastructure project team, megaproject team, construction management team, engineering project design team, on-site vs virtual design team, ancient construction project team,

multicultural construction project team, geographically dispersed construction project team, BIM-enabled construction team, BIM-enabled construction team, green project team, academic research project team, agile project team and virtual project team.

To increase productivity in such interorganizational collaborations, the AEC industry has investigated **high performance teams** that are driven on establishing trust within team members, shared values and goals and open communication lines (Jørgensen, 2018). Communication networks within an AEC project team dynamically evolve during the project with multiple short-term networks being formed for collaboration depending on the scale and the timeline of task at hand (Garcia et al., 2021). Zhao et al. (2021) further argue that there is an inconsistency between the organization framework and collaboration behavior that exists within AEC project team networks. Chinowsky et al. (2010) states that a team can deliver high performance by focusing on team success instead of individual goals. He further elaborates on the crucial and innovative role of **social network analysis (SNA) model for construction** in his research that links to enhancement of project team performance. Social network model has equipped project team research to dig deeper into interdependencies and the various team components (Carter et al., 2015; Kereri & Harper, 2019; Park et al., 2020).

Multiple reviews in the past 5 years have had gaps/potential for future research on project teams that involve studying the missing levels of analysis to test out the various mediating variables across project team constructs (Chan et al., 2021; Leiringer & Zhang, 2021). Chan et al. (2021) describes these levels of analysis as the following: individual, sub-team, project team and at the organization level. While these levels exist within a project team, multiple studies have looked at another crucial type that exists with project teams i.e., single team versus multiteam systems (MTSs) (Luciano, DeChurch, et al., 2018).

Single vs Multiteam Systems: Within an interorganizational setup, two types of teams can exist, single teams and multiteam systems (MTS) (Shuffler et al., 2015). Shuffler et al. (2015) points out that while both exist within interorganizational setups, the major difference between the two types of team systems is that single teams bring together individuals from different organizations to work on a specific project and multiteam systems involve multiple teams working together in coordination and collaboration with each other. In a multiteam system, there are multiple teams within a project team, each working on their own goals and responsibilities that have certain connections

and interdependencies (Asencio & DeChurch, 2017). These teams work together in order to achieve an overarching goal/objective.

The key differences between single versus multiteam systems within an interorganizational setup are as follows:

1. **Structure:** Single teams typically have a single team leader or project manager responsible for overseeing the team's activities. In contrast, multiteam systems often have more complex structures with multiple leaders or managers who coordinate and facilitate effective collaborations across teams (Asencio & DeChurch, 2017; Garcia et al., 2021).
2. **Interdependence and complexity:** Single teams might collaborate with other teams within a project team, but their primary focus is on their project or goal and is not dependent on the success of other teams. On the other hand, teams within multiteam systems are highly interdependent and depend on each other for project team success. Multiteam systems are more complex than single teams as managing and coordinating multiple teams with different goals, dynamics, and organizational cultures requires additional attention to communication, collaboration, and team alignment (Garcia et al., 2021).
3. **Duration:** Single teams within interorganizational setups are often formed for a specific project or a period of time. Once the project is completed, the team may dissolve or reconfigure for new projects. Multiteam systems, on the other hand, can be more long-term and persistent, as they involve ongoing collaboration and coordination between multiple teams (Shuffler et al., 2015).

Diving deep into the existence of the above-mentioned types of teams in the AEC industry, these types of teams are prevalent on different project depending on the stage of the project lifecycle, type of project delivery and scale and complexity of the construction project (Campbell et al., 2022). Single teams are often observed in Design-Bid-Build (DBB) and Design-Build (DB) projects in the AEC industry. Within DBB, single teams are more prevalent during the building phase when the construction firm typically assembles a project team composed of employees, subcontractors and potentially representatives from the owner or design firm. Within DB firms, the single team system is prevalent throughout the project lifecycle. The design-build firm forms a cohesive team comprising architects, engineers, construction professionals, and other necessary experts who collaborate throughout the course of the project to ensure construction process alignment with the design intent (Baiden et al., 2006).

Multiteam systems (MTS) are often observed in large and complex AEC projects that demand multiple teams to collaborate and coordinate in order to achieve the project's objectives. A few examples of such projects are: (a) Mega construction projects; (b) Public-private-partnerships; (c) complex renovation or retrofit project and (d) large-scale infrastructure project.

Level of Analysis: In the context of interorganizational AEC project teams, multiple studies have examined different levels of analysis to understand the dynamics and functioning of interorganizational setups (Ahola, 2018; Manata et al., 2018). Chan et al. (2021) describes these levels of analysis as the following: individual, sub-team, project team and at the organization level.

1. **Individual Level:** This level of analysis focuses on understanding the characteristics, behaviors, and attributes of individual team members within a project team. The individual level factors that have been explored in past research are individual skills, attitudes, motivation, and personality traits that have been found to have a direct impact on team performance and collaboration (Ahearne et al., 2015; Garcia & Mollaoglu, 2020).
2. **Sub-Team Level:** This level of analysis focuses on studying the dynamics and communication networks within smaller units or sub-teams that exist within the larger interorganizational project team. In AEC project, an example of a sub-team would be defined based on function or disciplines like architectural design, structural engineering, MEP etc., (Baiden et al., 2006).
3. **Project Team Level:** This level involves the overall functioning, performance, and project outcomes of the project teams. Past studies have studied multiple variables related to project team constructs that include team coordination, team decision making, conflict management, team communication, team effectiveness etc., (Buvik & Rolfsen, 2015; Jafari Navimipour & Charband, 2016).

While multiple researchers have looked at AEC interorganizational project teams, their place within the existing literature on project team settings is still limited and project teams literature focus has largely been on organizational teams and/or disciplinary teams. Hence, there exists an established **need to study the state of research of interorganizational and interdisciplinary project teams within the AEC industry** and find a **methodology to derive future research directions/propositions in this area**.

2.5 Literature Review Methodologies

Bibliometric Analysis and Scoping Review

Multiple methodologies exist out there that aim to study existing research in order to derive future research areas within a field of research (C. Chen & Song, 2019). A quantitative method used to examine patterns of publications and citations within a specific field or research area is called bibliometric analysis. Multiple review articles of the past have adopted this method of analysis (Cancino et al., 2017; Nobanee et al., 2021). It involves the collection and analysis of bibliographic data, such as the number of publications, authors, journals, and citations. Bibliometric analysis helps identify influential authors, journals, and research trends within a particular discipline. It often involves analyzing citation patterns, co-authorship networks, and keyword analysis to assess the visibility, influence, and collaboration within a specific field of research (Cancino et al., 2017; Nobanee et al., 2021).

Further exploration of teams and project teams literature indicates that scoping review as a research methodology has proved effective in the past two decades in determining future research directions for advancement of various aspects of research on project teams (Kereri & Harper, 2019; Mathieu et al., 2019; Park et al., 2020). A scoping review is a systematic and comprehensive method used to map and summarize research findings on a specific topic Pham et al. (2014). It involves identifying and screening a large number of studies to provide an overview of existing literature. C. Chen & Song (2019) mention that scoping reviews can be helpful in identifying gaps in knowledge, defining research questions, and informing the design of future studies. 2 types of literature reviews exist: traditional (non-systematic) and systematic (Ahola, 2018). Ahola (2018) elaborates that the scoping review process in systematic literature review is transparent by each step of the search process in detail which include the journal database, keywords searched for, reasoning for including or excluding publications and the methods used to analysis the final sample.

Scoping review as a research methodology in combination with bibliometrics analysis has become a noted approach for analyzing research areas and provides research evidence (C. Chen & Song, 2019; Engebø et al., 2020; Pham et al., 2014). These methodologies are broadly connected through citation network analysis driven by social network analysis (SNA) theory (Carter et al., 2015). Citation network analysis using SNA helps uncover connections, influences, and collaborations within the scientific community by analyzing citation or co-citation patterns and relationships between researchers and publications.

Analysis Methods used in Scoping Reviews and Bibliometric Analysis

The various methods of analysis identified in prior scoping reviews involving network analysis are as follows: *Evolution of publications over time; Co-citation Analysis of Journals; Cluster Analysis; Co-occurrence network of Author Keywords; Country Co-Authorship Network Analysis* and *Document Citation Network Analysis using SNA*.

A co-citation analysis of journals maps two documents from different journals that are cited from the same document in a third journal (Cancino et al., 2017). Major research interests in a scientific field can be found in keywords as they capture an incisive description of a research paper (Xu et al., 2022). Xu et al. (2022) mentions that visualizing the keywords in a keyword co-occurrence network (KCN) can offer a good picture of any research domain and helps in understanding the organization and connections between specific research interests over an identified timespan. Radhakrishnan et al. (2017) elaborate that in a KCN, each node represents a keyword, and the links represents the co-occurrence of a pair of keywords. A citation network analysis identifies groups of documents that are connected based on their citation relationships. Using SNA, they analyze the structure of the co-citation relationships to determine clusters of documents that tend to cite each other or are frequently cited together by other documents

Past Scoping Reviews within the Project Teams Literature

Many scoping reviews of teams literature have been carried out in the past two decades (Kereri & Harper, 2019; Mathieu et al., 2019; Park et al., 2020). Mathieu et al. (2019) in their review of team effectiveness in complex work teams concluded with the following:

“Team interventions have matured and demonstrated their efficacy when targeted at different leverage points in team lifecycles and episodic processing and proven valuable for enhancing team effectiveness and human welfare in many industries...Teams are increasingly being conceptualized as dynamic networks of activities that reside in a multilevel context and coevolving with environmental variables. Dynamic theories are being advanced, digital trace measurement protocols are being developed, and innovative research designs and analytic techniques are being implemented.”

Kereri & Harper (2019) in their literature review on social networks and construction teams emphasize on using SNA to identify the collaboration levels in construction project teams using social

factors based on real-time data. The social factors include shared goals, independence, open communication, trust, shared commitment to working together, shared accountability, shared values, and experience (Kereri & Harper, 2019). Zerjav et al. (2023) in their review of project management review articles encourage authors to take up literature review methodology with a focus on micro-level practices within projects, and their teams and leadership. A review of existing project management review articles based on their focus and contributions produced the hierarchy starting from perspectives on project management to project networks to organizations lastly ending at individuals and teams (Zerjav et al., 2023).

Scoping/literature reviews have also been performed within the teams' research from a network perspective. Park et al. (2020) in their review on work teams from a network perspective concluded with the following:

“...Overall, our review suggests that social networks have a significant impact on teams. We suggested that future scholars should better represent the coevolution of network relationships within and between teams, consider the fuzzy boundaries of teams, and model team phenomena in terms of multiplex or multidimensional networks... We believe that continued application of network thinking and methodology to the study teams holds great promise for advancing our understanding of organizational work team functioning and effectiveness.”

Limited scoping reviews exist with a focus on interorganizational project teams in the AEC industry. Ahola (2018) in their review describe three ideal network types in interorganizational projects: market-based network, dyad-driven network, and integrated core network. They propose a future research area towards exploring different approaches on how the organizational composition is linked to project goal based on both forecasts and actual results.

The valuable recommendations of the existing scoping reviews have been embraced by many scholars in assessing the dynamic nature of project teams and its effect on project team performance. However, **scoping review of project teams literature utilizing a citation network analysis (CNA) approach has not been used to find research directions specific to complex AEC interorganizational project teams while also evaluating their place in the larger spectrum of project teams research.** (Leppink & Pérez-Fuster, 2019; Mathieu et al., 2019; Park et al., 2020).

2.6 Summary

In response to the above-mentioned gap, this study aims to conduct a systematic scoping review combined with bibliometric analysis of project teams literature to investigate and advance inter-organizational collaborations within project teams. Such a review can reveal the relations and evolution of research on project teams considering key differentiating concepts such as type of industry, student versus authentic project teams, virtual versus co-located team settings etc. (Carter et al., 2015; Kereri & Harper, 2019).

Chapter 3 METHODOLOGY

3.1 Introduction

The main research question directing this study is as follows:

What is the state of practice for AEC project teams based on the literature and how has project teams research evolved and is connected across domains?

To achieve this goal, the study adopts a scoping review methodology combined with a citation network analysis using SNA of prior research on project team settings across multiple domains (McLaren & Bruner, 2022; Wen et al., 2021).

The first step of the systematic literature search was to conduct a preliminary literature search of the existing scoping review articles related to project teams to identify the relevant search strategy. The articles in the list below constitute the result of this search that guided this work's systematic literature review methodology process:

- Carter, Dorothy & Dechurch, Leslie & Braun, Michael & Contractor, Noshir. (2015). Social Network Approaches to Leadership: An Integrative Conceptual Review. *The Journal of applied psychology*. 100. 10.1037/a0038922.
- Jafari Navimipour, N., & Charband, Y. (2016). Knowledge sharing mechanisms and techniques in project teams: Literature review, classification, and current trends. *Computers in Human Behavior*, 62, 730–742.
- Leppink, J., & Pérez-Fuster, P. (2019). Social Networks as an Approach to Systematic review. *Health Professions Education*, 5(3), 218–224
- Mathieu, J. E., Gallagher, P. T., Domingo, M. A., & Klock, E. A. (2019). Embracing Complexity: Reviewing the Past Decade of Team Effectiveness Research. *Annual Review of Organizational Psychology and Organizational Behavior*, 6, 17–46.
- Park, S., Grosser, T. J., Roebuck, A. A., & Mathieu, J. E. (2020). Understanding Work Teams from a Network Perspective: A Review and Future Research Directions. *Journal of Management*, 46(6), 1002–1028.
- Pham MT, Rajić A, Greig JD, Sargeant JM, Papadopoulos A, McEwen SA. A scoping review of scoping reviews: advancing the approach and enhancing the consistency. *Res Synth Methods*. 2014 Dec;5(4):371-85

- Wen, Q.-J., Ren, Z.-J., Lu, H., & Wu, J.-F. (2021). The progress and trend of BIM research: A bibliometrics-based visualization analysis. *Automation in Construction*, 124, 103558. <https://doi.org/10.1016/j.autcon.2021.103558>

Following the lessons learned, this chapter is organized in the following subsections: Data Collection, Sample, Data Analysis, Methodology Process Map and Data Quality Measures. The current study's methods for data collection and analysis are discussed in the subsections hereafter.

3.2 Data Collection

The scoping review methodology was conducted using an online citation database called “SCOPUS” (Carter et al., 2015; Mathieu et al., 2019; Park et al., 2020). The list of references for this study were finalized by combining citation lists through multiple independent systematic search paths (Carter et al., 2015; Mathieu et al., 2019) which are captured in as follows:

Search Path 1: Author Search (Pham et al., 2014)

One of the starting points for the literature search was through an author search in SCOPUS. With the help of an expert team, the researcher identified key authors who have made contributions to teams and project teams literature. The list of key researchers along with their domain/most contributed topics is listed in Table 3.2-1.

Table 3.2-1 List of Key Researchers for Author Search

Author	Domain/Most Contributed Topics
Carter D.R.	Bibliometric Analysis, Communication
Chinowsky P.	Construction Industry, Project-based Organizations
Contractor N.	Communication, Crews, Space Flight
Franz T.M.	Clinical Teams, Communication
Hollenbeck J.R.	Leader-Member Exchange, Transformational Leadership
Kozlowski S.W.J.	Organizational Behavior, Scientific Societies
Leicht R.M.	Construction Industry, Project-based Organizations
Luciano M.M.	Delivery of Healthcare, Hospital Organization
Mathieu J.E.	High Performance Work Systems, Communication
Taylor J.E.	Construction Industry, Project Delivery
Zerjav V.	Construction Industry, Project Delivery

1. The researcher set the following filters in the SCOPUS database before exporting the citations list:
 - a. Document Type: Article, Review
 - b. Publication Stage: Final (i.e., in process publications were eliminated at this stage)
2. This step filtered the references down to 755 and the citations were exported in a CSV format.
3. The researcher, then, went through the title, keywords, abstracts, and discussions of each publication to filter the publications to those focusing on ‘project team settings.’ The final count after this step was 206. A few examples of publication titles that did not meet the criteria mentioned in this step are as follows:
 - “A call for technology developers to apply life cycle and market perspectives when assessing the potential environmental impacts of chemical technology projects.”
 - “A project sponsor's impact on practice-based learning within projects.”

Search Path 2: Article Title, Abstract, Keywords Search (Mathieu et al., 2019)

The second starting point for literature search was through “title, keyword, abstract” search in SCOPUS.

1. The researcher input “Project Teams” as the search word. Through this step, the count of references obtained was 87,603.
2. The researcher then limited the document type to either an article or a review which filtered the references down to 47,551.
3. The next step was to set the publication stage as final (i.e., in process publications were eliminated at this stage) which filtered the references to 46,965.
4. In the next step, the researcher did a keyword search of ‘project teams’ or ‘project team’ within the 46,965 references which brought down the references to 656 documents and the citations were exported in a CSV format.
5. The publications which have not been cited at all (i.e., Count under ‘Cited by’ = 0) were removed from the list and filtered the references down to 554.

Search Path 3: Article Title, Abstract, Keywords Search (Carter et al., 2015):

The third starting point for literature search was through “title, keyword, abstract” search in SCOPUS.

1. The researcher input “Teamwork” as the search word. Through this step, the count of references obtained was 46,273.

2. The researcher then limited the document type to either an article or a review which filtered the references down to 31,966.
3. The next step was to set the publication stage as final (i.e., in process publications were eliminated at this stage) which filtered the references to 31,531.
4. The researcher then did a ‘search within documents’ (i.e., searching for project teams within the references found in step 3 of Search Path 3. This step filtered the references to 6,064.
5. In the next step, the researcher did a keyword search of ‘project teams’ or ‘project team’ within the 6,064 references which brought down the references to 107 and the citations were exported in a CSV format.
6. The publications which have not been cited at all (i.e., Count under ‘Cited by’ = 0) were removed from the list and filtered the references down to 102.

Search Path 4: Article Title, Abstract, Keywords Search within the AEC Literature (Kereri & Harper, 2019)

The fourth starting point for literature search was through “title, keyword, abstract” search in SCOPUS.

1. The researcher input “Project Networks” as the search word. Through this step, the count of references obtained was 1,027.
2. The researcher then put the following filters in order to capture the references from AEC literature as a source:
 - a. Source Title Filter:
 - i. Journal of Construction Engineering and Management
 - ii. Automation in Construction
 - iii. International Journal of Project Management
 - iv. Construction Management and Economics
 - v. Journal of Management in Engineering
 - vi. Engineering Construction and Architectural Management
 - vii. Journal of Computing in Civil Engineering
 - viii. Social Science and Medicine
 - ix. Journal of Environmental Management
 - x. Journal of Civil Engineering and Management
 - xi. IEEE Transactions on Engineering Management

- xii. International Journal of Managing Projects in Business
- xiii. Engineering Project Organizations Journal/Conference
- b. Document Type: Article, Review
- c. Publication Stage: Final
- 3. Step 2 of Search Path 4 filtered the references to 154 and the citations were exported in a CSV format.
- 4. The publications which have not been cited at all (i.e., Count under 'Cited by' = 0) were removed from the list and filtered the references down to 114.

Combining Search Path 2, Search Path 3, and Search Path 4:

1. The list of publications from search path 2, search path 3 and search path 4 were then combined to get a total of 770 publications.
2. The researcher found multiple duplicates (i.e., publications that were found in multiple search paths), kept one of each and removed the duplicate publications. This step filtered the publications to 702.
3. The researcher, then, went through the abstracts and discussions of each publication to limit the search to those focusing on 'project teams.' The final count after this step was 586 publications.

Combining Search Path 1 (Author Search) with combination of Search Path 3 and Search Path 4:

1. The researcher then combined the final list of publications from Search Path 1 (206 publications) and the final list after combining search paths 2, 3 and 4 (586 publications) to get a total of 718 publications.
2. The researcher found multiple duplicates (i.e., publications that were found in multiple search paths), kept one of each and removed the duplicate publications. This step filtered the publications to 518.

To ensure internal validity, the final list of publications was validated by one additional researcher with experience in project teams research by going through all the articles (Kereri & Harper, 2019). At the end of this step, **512 articles remained** which became the final sample of this study. The above-mentioned systematic literature search process is depicted in Figure 3.2-1.

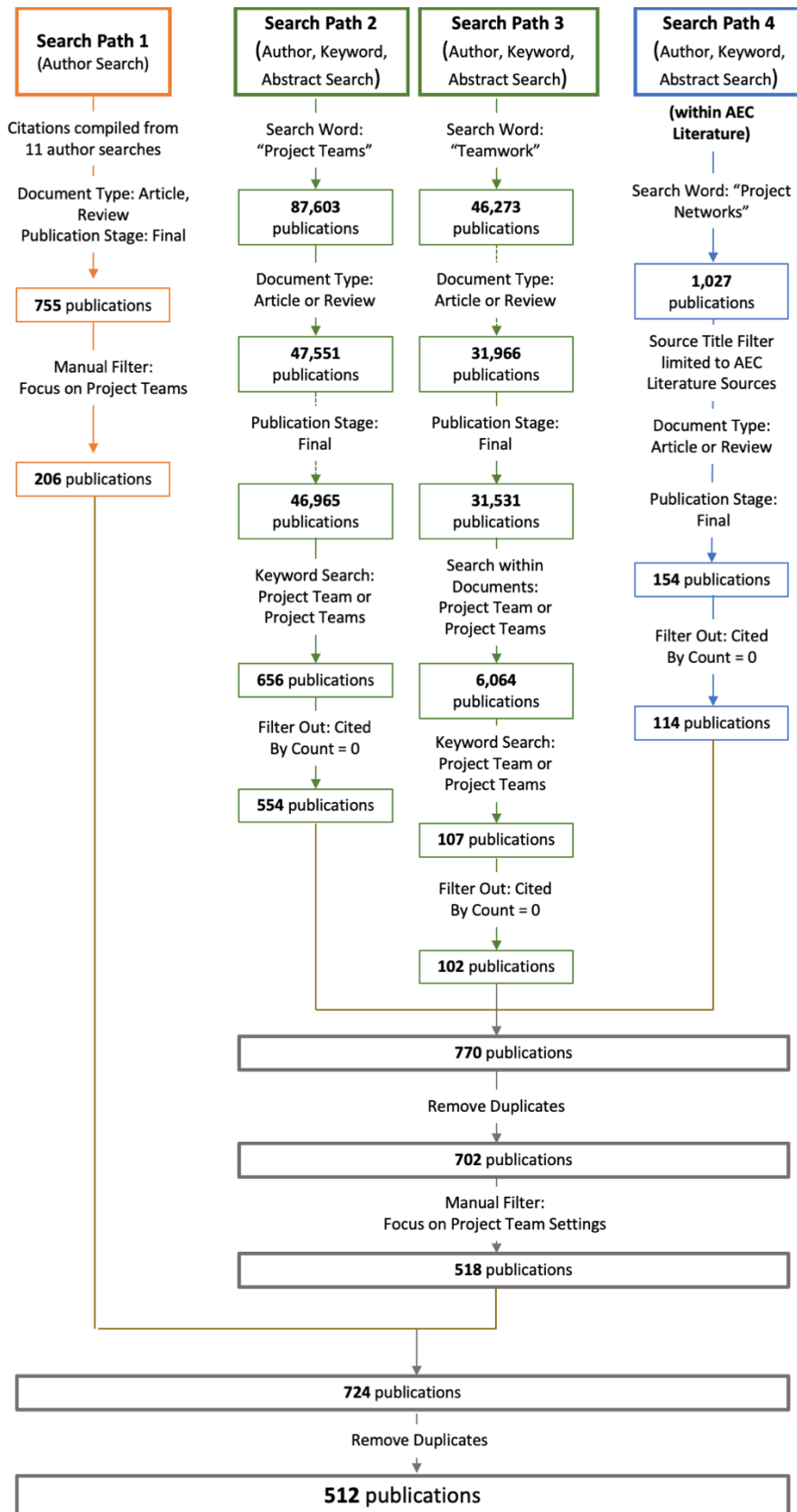


Figure 3.2-1 Scoping Review Literature Search Process Map

3.3 Sample

The **unit of analysis** driving this study are articles and reviews obtained via an open citation database called SCOPUS (Leppink & Pérez-Fuster, 2019) with the publications in their final stage. As discussed in the previous sub-section, **512 publications** were finalized as the **sample** for this study which are provided in detail in Appendix A. Appendix A covers the publication title, author, year of publication and cite score. The final list of publications covers all the articles and reviews studying project team settings across different domains. While exporting the citations lists from SCOPUS, the following information was exported for each publication: Author(s), Author(s) ID, Document Title, Year, Source Title, Volume, Citation Count, Source & Document Type, Publication Stage, Abstract & Keywords (Author Keywords, Index Keywords) and References.

3.4 Data Analysis

This study adopted mixed methods to analyze the sample of 512 publications. In order to explore the trends and evolution of research on project team settings across multiple domains and categories, additional information was extracted from the final list of 512 publications. The author went through the abstract, methods and results section of each of these publications to code for the following 4 categories:

- C1: Type of Industry
- C2: Virtual vs Co-located Teams
- C3: Authentic vs Student Teams
- C4: Organizational vs Interorganizational Teams

After coding for the above-mentioned categories, the sample was filtered to extract publications specific to the AEC industry and focusing on interorganizational project team setups. This set of publications was further coded by the author based on the following 2 categories:

- C5: Single vs Multiteam Systems
- C6: Level of Analysis (Individual, Sub-Team, or Project Team)

The above-mentioned categories were methodologically identified and refined while performing the literature review in this study. After the initial coding of the sample for all the categories (C1 to C6), data analysis was carried out at 2 levels, L1 and L2.

L1: The overall sample of 512 publications based on project team settings across multiple domains was analyzed. It aimed to provide insights into the state-of-practice of project teams connected

across multiple domains. It also aimed to derive useful results on the position of research specific to AEC project teams within the broader landscape of project teams.

The mixed methods used for this level of analysis are as follows:

1. **Evolution over Time Analysis:** This analysis involved mapping timeline visualizations of multiple categories on the same graph (for e.g., Type of industry plotted against authentic vs student teams). The timeline visualizations mapped each publication as a node along the timeline, where a second category was assigned as a color to the node and the node size was based on the number of cites received by the publication.
2. **Journal Co-citation Analysis:** A co-citation analysis of journals covering all the publications was performed. A co-citation analysis of journals maps two documents from different journals that are cited from the same document in a third journal.
3. **Country Co-authorship Network Analysis:** A co-authorship network of countries depicts collaborations between various researchers affiliated with institutions in different countries. The network represents collaborations between authors based on their joint publications.
4. **Keyword Co-occurrence Network (KCN) Analysis:** Major research interests in a scientific field can be found in keywords as they capture an incisive description of a research paper (Xu et al., 2022). To dive deeper into the study of project teams, a keyword co-occurrence network (KCN) was constructed using VOSviewer. Subsequently, the network underwent **cluster analysis** utilizing Citespace, allowing for the identification of research areas associated with the keyword clusters. The KCN gave insights on potential keyword hotspots for future research on project team settings.

L2: The sample specific to AEC project teams was analyzed which aimed to gather insights on the evolution and potential future research areas for AEC interorganizational project teams.

The mixed methods used for this level of analysis are as follows:

1. **Evolution over Time:** This analysis involved mapping timeline visualizations of categories C5 and C6 to study the evolution of AEC interorganizational project teams related to single versus multiteam systems and at what level of analysis have the project team settings been analyzed.
2. **Citation Network Analysis using SNA:** A citation network analysis using SNA (adjacency matrix) was performed to capture the connected papers within the sample of AEC

project teams. Subsequently, the network underwent cluster analysis utilizing Citespace, allowing for the identification of research areas associated with the publication clusters. The clusters were further analyzed in combination with keyword hotspots identified through KCN (in L1 analysis) by analyzing a comprehensive set of connected publications related to the identified research hotspots (Discussed in detail in Section 4.3.2).

Data Analysis Tools

All analyses were done using Excel, VOSviewer (Wen et al., 2021) and Citespace (C. Chen & Song, 2019) which are free downloadable open-source software.

- **VOSviewer** is a software to extract bibliometric maps from a database like Web of Science or SCOPUS. The graphical network visualizations created in VOSviewer are based on web links to scientific publications, journals, authors, countries, keywords, or terms based on co-authorship, co-occurrence, citation, bibliographic coupling, or co-citation (van Eck & Waltman, 2010). VOSviewer was used to perform journal co-citation analysis, country co-authorship analysis, KCN and citation network analysis.
- **Citespace** bases its results primarily on co-citation analysis theory and pathfinder algorithm. It is designed to identify the key intellectual and pivotal points in the research development of a domain (C. Chen & Song, 2019). Citespace was used in this study to conduct co-citation analysis of literature and perform cluster analysis within co-occurrence analysis of keywords and documents citation network analysis.

VOSviewer uses the smart local moving algorithm introduced by Waltman and Van Eck in their paper titled "A smart local moving algorithm for large-scale modularity-based community detection" published in 2013. The primary purpose of this algorithm is to detect communities or clusters in networks based on modularity optimization. Modularity is a measure that quantifies the strength of the division of a network into communities. Here's a brief overview of how the smart local moving algorithm works:

- **Modularity:** Modularity (Q) is a key concept in community detection algorithms. It measures the difference between the fraction of edges within communities and the expected fraction of edges that would exist in a random network with the same node degrees. Higher modularity value indicates better-defined communities.
- **Initialization:** The algorithm starts by assigning each node in the network to its own community, creating as many communities as there are nodes.

- **Local Moving:** The algorithm then proceeds through iterations of local moving steps. In each step, it considers moving a node from its current community to one of its neighboring communities. The algorithm evaluates the change in modularity that would result from such a move. If the move would increase modularity, the node is moved to the new community; otherwise, it remains in its current community.
- **Iterative Improvement:** The local moving steps are iterated multiple times, with nodes being considered for moving in a random order during each iteration. This randomness helps to avoid getting stuck in local optima and allows for the exploration of different solutions.
- **Termination:** The algorithm continues to perform local moving steps until no further improvement in modularity can be achieved, or until a predefined number of iterations is reached.
- **Community Detection:** After the algorithm has terminated, the final communities that have been identified are considered as the clusters or communities in the network.

The smart local moving algorithm is computationally efficient, making it suitable for large-scale networks that contain a large number of nodes and edges. It often produces meaningful community structures that can be effectively visualized using tools like VOSviewer. Figure 3.5-1 depicts the process map of the research methodology adopted in this study.

3.5 Methodology Process Map

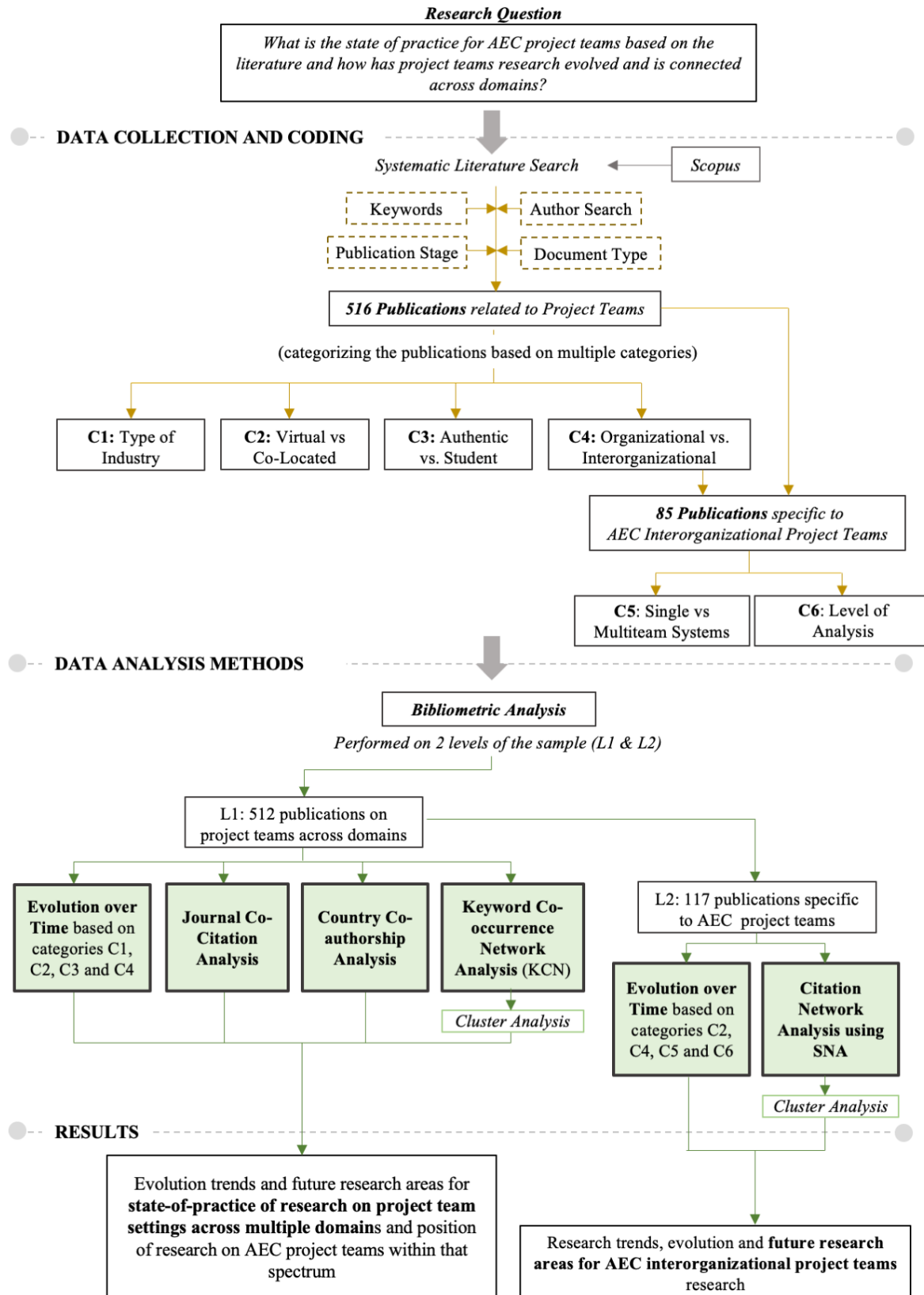


Figure 3.5-1 Methodology Process Map

*C1, C2, C3... represent the labels for multiple categorizations that were done for the publications in the sample

*L1 and L2 represent the labels for the two levels at which the analysis was performed

Detailed methodology maps for 2 levels of data analysis discussed above i.e., L1 (Figure 4.2-1) and L2 (Figure 4.3-1) are given in Chapter 4.

3.6 Data Quality Measures

In order to maintain research quality, several validity and reliability measures were adopted during the study which are as follows:

- An open-source database (SCOPUS) was used for the systematic search of references and the final list of publications (Carter et al., 2015; Mathieu et al., 2019);
- Thorough documentation of steps for every systematic literature search path to reach the final list of publications (Pham et al., 2014);
- Multiple search paths were adopted as a data quality measure to get a comprehensive and reliable list of final publications as the sample for this study (Mathieu et al., 2019);
- A specific search path with a focus on AEC journals (source of reference) was used in order to validate the higher-level keyword search paths using “project teams” as the keyword which did not have any filter on the source of reference;
- An Author Search was conducted as a search path using identified key authors who have made contributions to teams and project teams' literature to ensure reliability (Pham et al., 2014);
- To ensure internal validity, the final list of publications was validated by an additional researcher with experience in project teams research (Kereri & Harper, 2019).

Chapter 4 RESULTS

4.1 Introduction

The main research question directing this research study is as follows:

What is the state of practice for AEC project teams based on the literature and how has project teams research evolved and is connected across domains?

This chapter covers results from the two levels of analysis performed on the sample. First, the overall sample of 512 publications based on project team settings across multiple domains was studied. It provided insights into the state-of-practice of project teams connected across multiple domains. It also focused on the position of research specific to AEC project teams within the broader landscape of project teams. Second, the sample specific to AEC project teams was studied which gave results related to evolution and potential future research areas for AEC interorganizational project teams.

4.2 State-of-Practice: Project Teams

Section 4.2 focuses on the state-of-research on project teams across multiple industries. Figure 4.2-1 describes the methodology followed in this section:

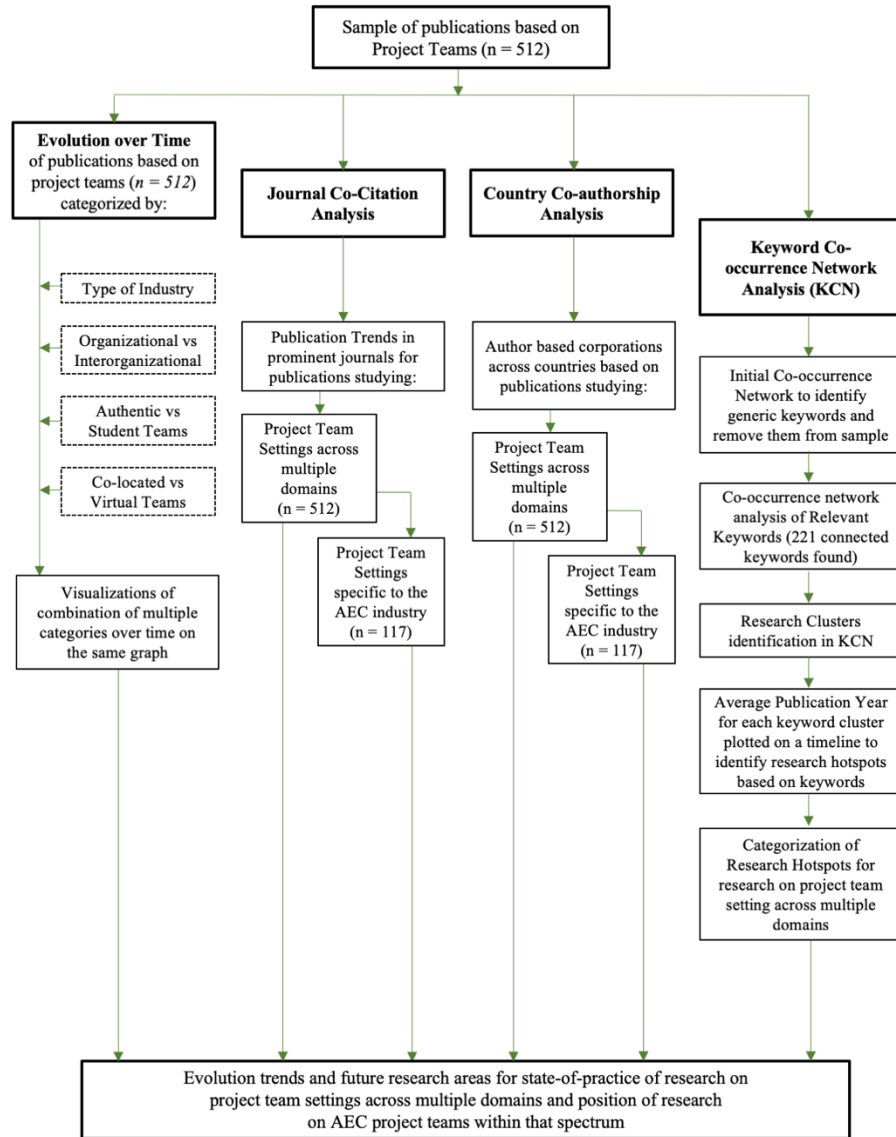


Figure 4.2-1 Methods to Results Process Map for Section 4.2

4.2.1 Evolution over Time

The unit of analysis driving this study are journal articles and reviews obtained via an open citation database called SCOPUS with the publications in their final stage. As discussed in the previous chapter, 512 publications were finalized as the sample for this study. APPENDIX lists those publications in detail including title and year of publication. The sample of 512 publications was coded based on the following categories: type of industry, virtual vs co-located teams, authentic vs student teams and organizational vs interorganizational.

Organizational versus Interorganizational Project Teams

Out of the 512 publications that serve as the sample for this study, 408 publications (79.6%) study organizational project teams, while 104 cover inter-organizational (20.4%) project teams. In Figure 4.2-2, the timeline distribution of publications is depicted with a separation between organizational and interorganizational categorization.

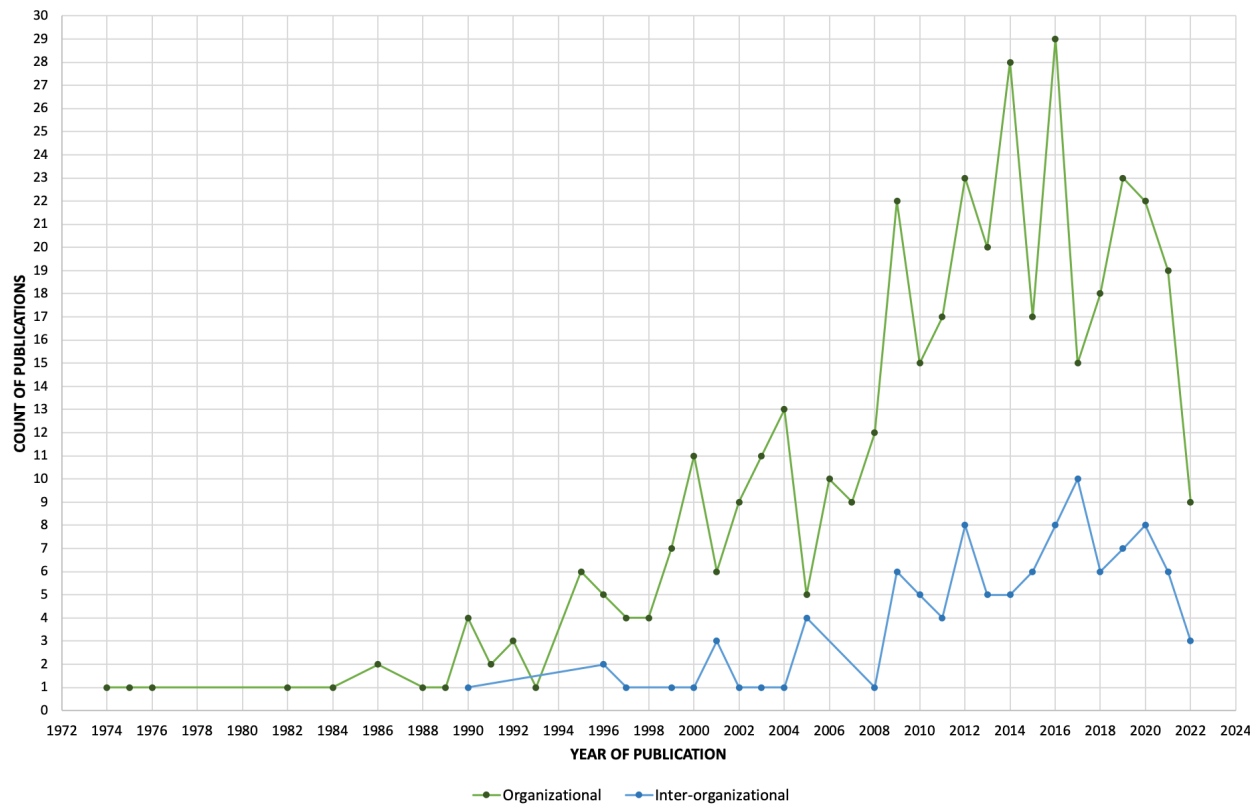


Figure 4.2-2 Evolution of Publications relating to Project Teams (Organizational vs Interorganizational)

Figure 4.2-2 above shows that the study on organizational project teams:

- dates back to the year 1974 (Dressler & Nash, 1974) performed for the first time in the healthcare industry; and
- has witnessed a steady upward trend since 1994, reaching its peak in 2016.

Figure 4.2-2 above also shows that the study on interorganizational project teams:

- surfaced for the first time in 1990 (Regensburg & Van Der Veen, 1990) which studied a project team working on a multidisciplinary design project; and
- has been relatively limited, yet they have exhibited a notable upward trend from 2009 to 2021.

Figure 4.2-3 captures the evolution of publications spread across several types of industries plotted on the y-axis. Each node in the graph represents a publication which is further layered by color (depicting whether the publication studied organizational or interorganizational teams). The node size is dependent on the number of cites received by the publication.



Figure 4.2-3 Evolution of Publications 1 (differentiated by multiple categories)

The majority of research on interorganizational project teams can be seen with the *AEC teams* and some in *R&D and science* and *Engineering* teams. The blue nodes in Figure 4.2-3 provide evidence that reinforces the underlying motivation driving this study. It becomes increasingly apparent that there is limited research focused on interorganizational project teams.

Authentic versus Student Project Teams

Figure 4.2-4 captures the evolution of publications spread across several types of industries plotted on the y-axis. Each node in the graph represents a publication which is further layered by color (depicting whether the publication was studied in authentic or student teams or both). The node size is dependent on the number of cites received by the publication.



Figure 4.2-4 Evolution of Publications 2 (differentiated by multiple categories)

Figure 4.2-4 above shows that the study on project teams:

- were initiated in the **healthcare industry** and in **R&D and science** teams;
- has been the most consistent in authentic **R&D and science** teams;

- has the most cited articles between the years, 2000 to 2007, most picked up by authentic teams in *R&D and science, psychology, information technology* and *healthcare*;
- have limited studies involving both authentic and student teams in *aerospace engineering, biotechnology, digital marketing, food & beverages, media, online gaming*, and *transportation*;
- have only been studied in both authentic and student teams in the same studies in *psychology*;
- have limited studies studying project teams from multiple industries;
- have limited studies involving student teams;
- related to student teams date back to 1996 (T. W. Porter & Lilly, 1996) where data was collected from 80 student teams working on a new product introduction project; and
- related to student teams have been mostly covered in courses related to *education sciences, engineering, business management* and AEC with the greatest number of citations in business management.

Virtual vs Co-located Project Teams

Figure 4.2-5 captures the evolution of publications spread across several types of industries plotted on the y-axis. Each node in the graph represents a publication which is further layered by color (depicting whether the studied project team was virtual, co-located or both). The node size is dependent on the number of cites received by the publication.



Figure 4.2-5 Evolution of Publications 3 (differentiated by multiple categories)

Figure 4.2-5 above shows that the study on project teams:

- related to a hybrid project team was studied for the first time in an *AEC* project team in 1996 (P. Chinowsky & Goodman, 1996);
- related to virtual project teams surfaced for the first time in an *AEC* project team (Anumba & Duke, 1997) which explores the effective utilization of Internet and intranet technologies within a collaborative communications infrastructure designed for construction project teams; and

- have no studies related to virtual project teams in the following industries: *Aerospace engineering, automotive engineering, environmental engineering, food and beverages, healthcare, manufacturing, non-profit, retail, supply chain management* and *transportation*.

Figure 4.2-7 and Figure 4.2-6 capture the trends in the evolution of study of co-located or virtual project teams. Figure 4.2-7 further distributes the sample based on authentic and student teams marked on the y-axis while Figure 4.2-6 does a similar distribution based on organizational and interorganizational teams. The node size is dependent on the number of cites received by the publication.

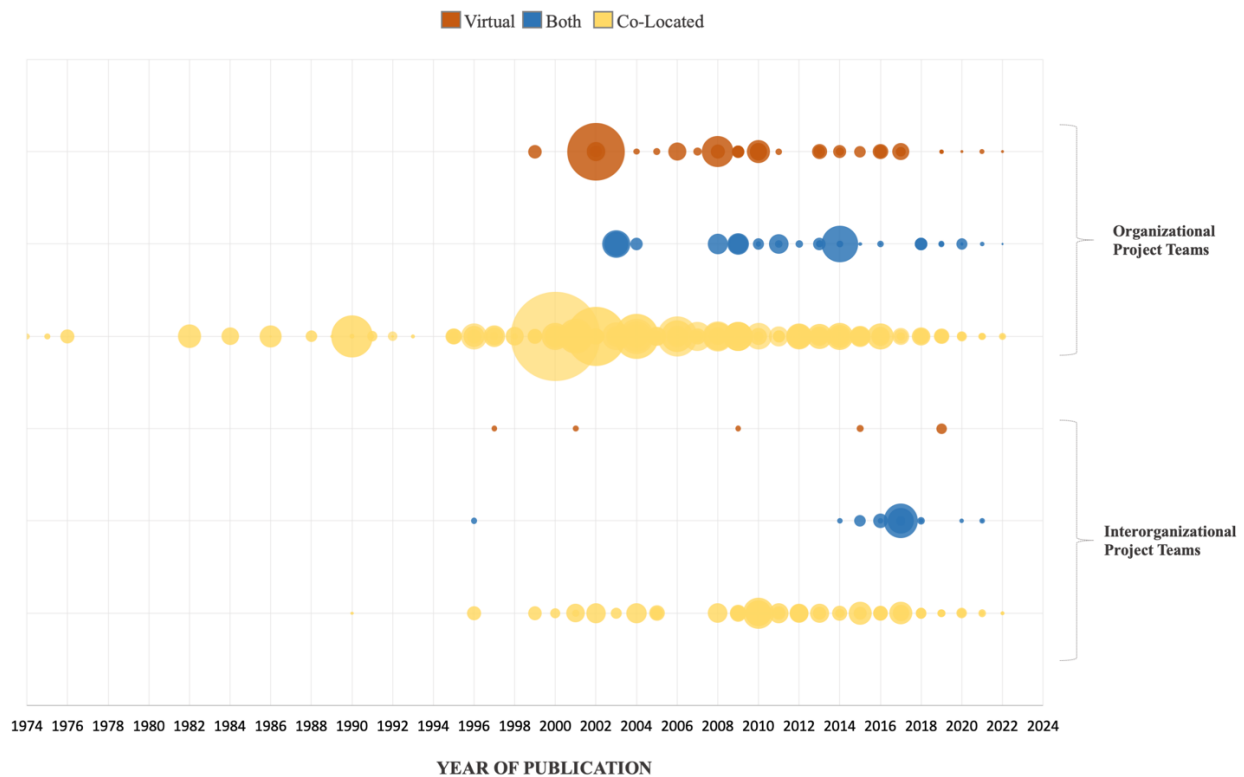


Figure 4.2-6 Evolution over Time (Co-located vs Virtual) based on Interorganizational versus Organizational

Figure 4.2-6 shows that research on project teams:

- under traditional co-located organizational project teams started back in the day in 1976 and the research peaked between 2008 to 2012;
- related to virtual project teams has been explored much more in organizational project teams as compared to interorganizational project teams; and

- related to virtual project teams surfaced for the first time in an interorganizational project team (Anumba & Duke, 1997) which explores the effective utilization of Internet and intranet technologies within a collaborative communications infrastructure designed for construction project teams.

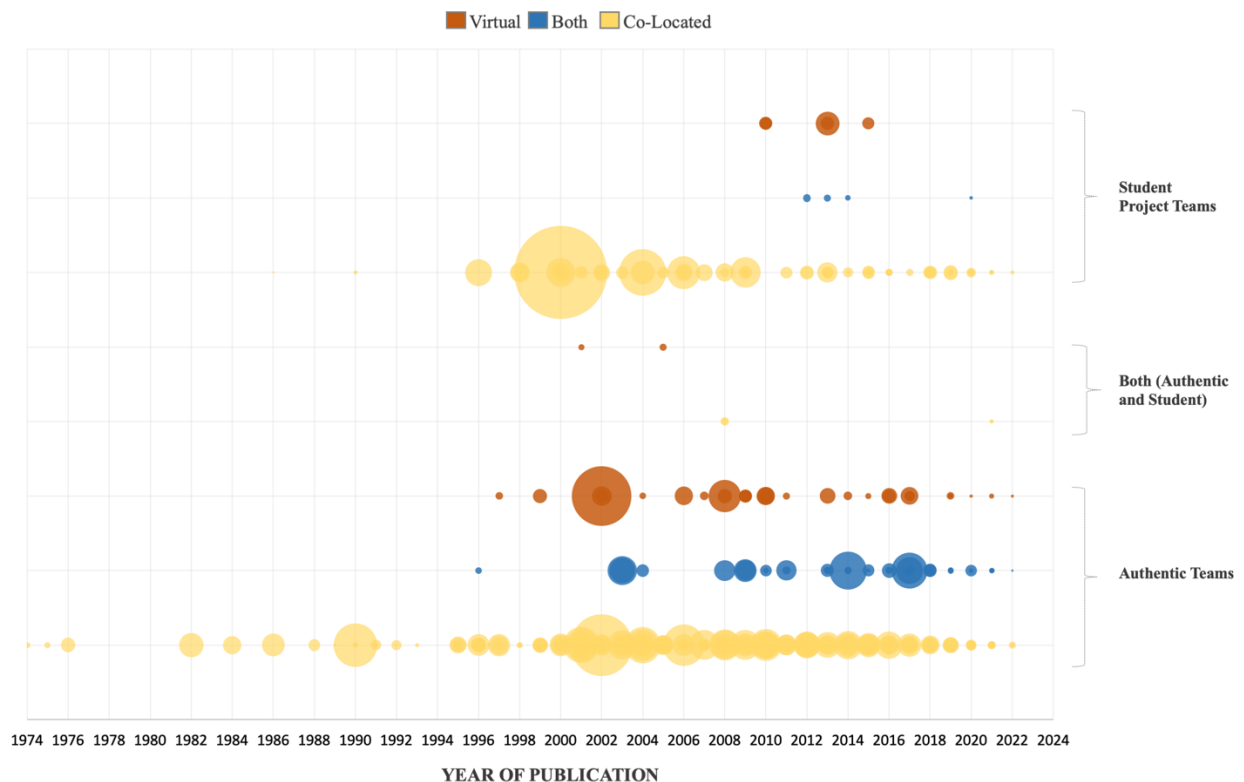


Figure 4.2-7 Evolution over Time (Co-located vs Virtual) based on Student versus Authentic Teams

Figure 4.2-7 shows that the study on project teams:

- related to co-located teams has existed both in authentic and student teams; and
- related to virtual project teams has existed mostly for authentic teams but has not been explored much in student project teams. With the post pandemic world switching to hybrid and/or virtual teams (Kinnula et al., 2018; Willermark & Pareto, 2020), we are going to see that changing a lot and hence, there is a need for research of project team settings for virtual student project teams.

4.2.2 Publication Trends in Prominent Journals

Using VOSviewer (Cancino et al., 2017), a co-citation analysis of journals covering all the publications in the study sample ($n = 512$) was performed. A co-citation analysis of journals maps two documents from different journals that are cited from the same document in a third journal

(Cancino et al., 2017). The result is shown in Figure 4.2-8. In Figure 4.2-8, node size indicates the importance/relevance of that journal within project teams' research, using number of citations; while the node color indicates connected clusters of authors in cited work (Van Eck & Waltman, 2010). The co-citation relationships are shown with the lines between the nodes and their thickness shows the total link strength. As seen in Figure 4.2-8, two clusters were found in our study sample. The most significant journals in terms of total link strength and citation frequency in cluster 1, pink color, are *International Journal of Project Management*, *Academy of Management Review* and *Administrative Science Quarterly*. On the other hand, the significant journals from cluster 2, yellow color, are *Journal of Applied Psychology* and *Academy of Management Journal*.

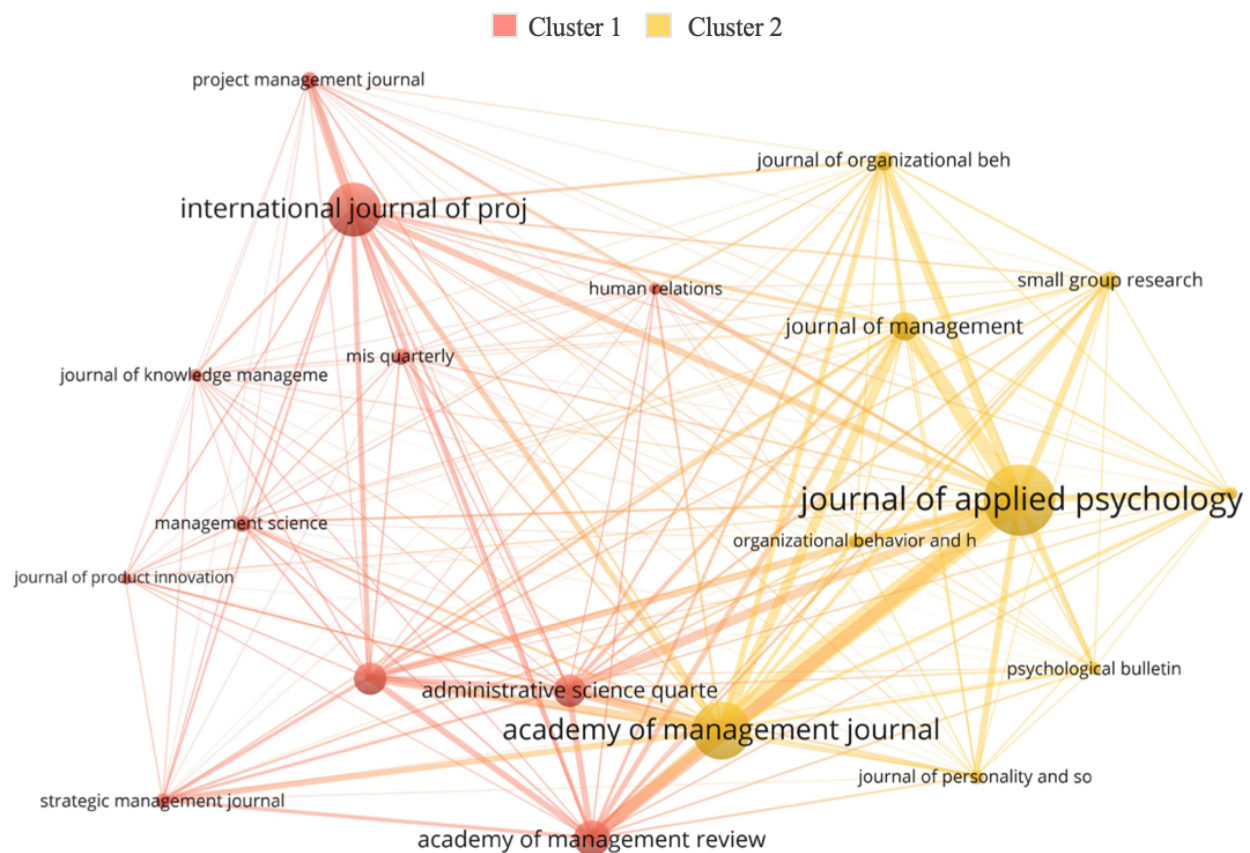


Figure 4.2-8 Mapping of Journals covering publications on Project Teams (journal co-citation analysis)

Table 4.2-1 Top 10 Highly cited journals in Project Teams Research

Journal	Host Country	Citations	Total Link Strength
Journal of Applied Psychology	USA	845	21588

Table 4.2-1 (cont'd)

Academy of Management Journal	USA	689	18515
Journal of Management	USA	348	10224
Organizational Science	USA	381	9592
Journal of Organizational Behavior	United Kingdom	232	7207
Small Group Research	USA	209	5657
Academy of Management Review	USA	443	12066
Administrative Science Quarterly	USA	395	10225
International Journal of Project Management	United Kingdom	648	10048
Strategic Management Journal	United Kingdom	175	5012

Table 4.2-1 shows that among the top ten cited journals seven are published in the USA and the remaining three are in the United Kingdom. This observation highlights the predominant development of project team research within these journal outlets. The data presented in *Table 4.2-1* and Figure 4.2-8 reveals that no single journal emerges as the central journal indicating that multiple journals have had an impact with their contributions to research on project team settings.

AEC Project Teams Research

A secondary journal co-citation network was extracted from the study sample by filtering for publications related to the AEC Industry which is shown in Figure 4.2-9.

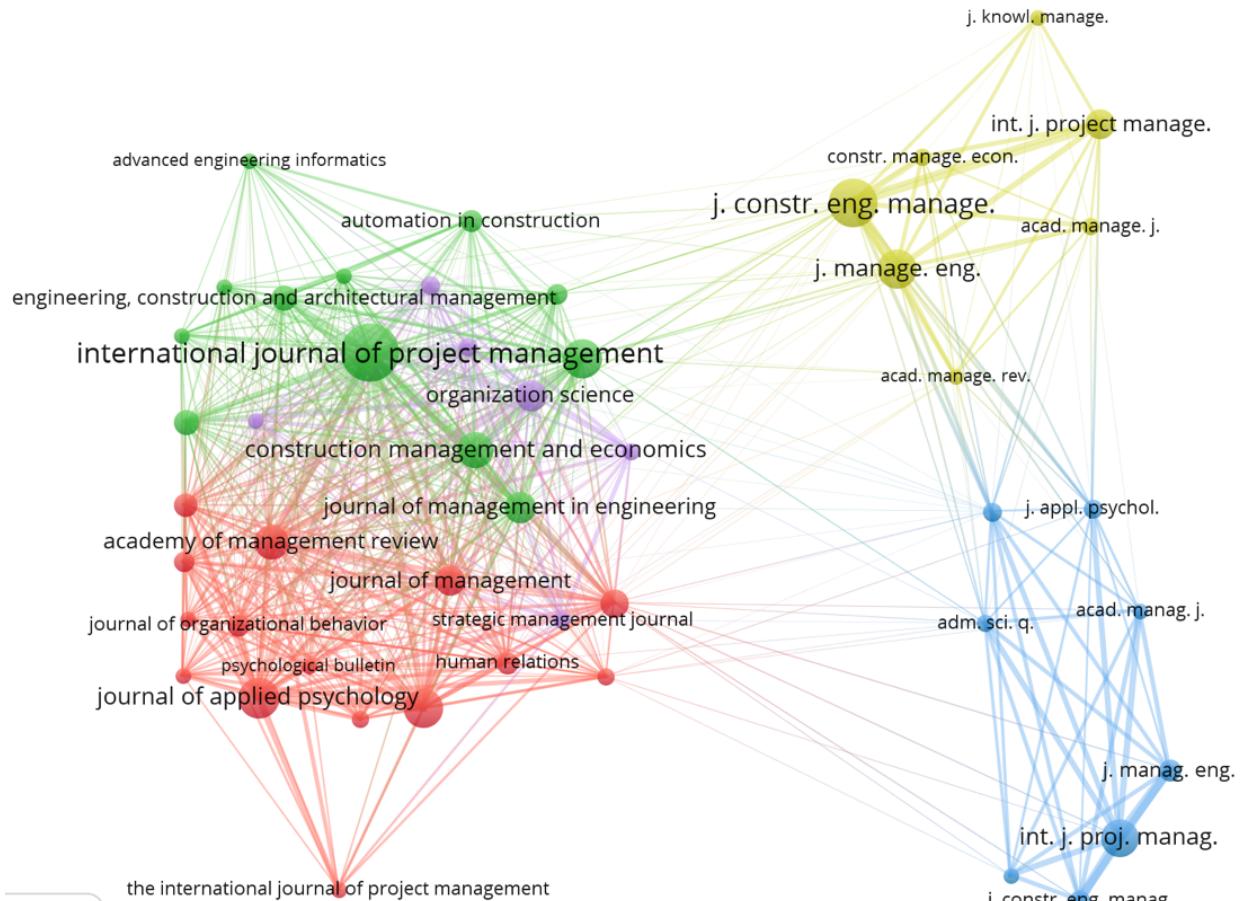


Figure 4.2-9 Mapping of Journals covering publications on AEC Project Teams (journal co-citation analysis)

Figure 4.2-9 shows that the co-citation analysis identified multiple overlapping clusters that exist within journals related to AEC project teams research. The most significant journals in terms of total link strength and citation frequency in each cluster are:

- **Red Cluster (*Academy of Management Review; Journal of Management; Journal of Applied Psychology*):** They all belong to the field of organizational behavior, management, and psychology. These journals primarily focus on research related to business and management, organizational theory and behavior, human resource management, project management, social and personality psychology, and related topics.
- **Blue Cluster (*International Journal of Project Management; Journal of Construction Engineering and Management*):** These journals primarily focus on research related to various aspects of management, organizational behavior, and project management.
- **Green Cluster (*International Journal of Project Management; Automation in Construction, Engineering; Construction and Architectural Management*):** These journals

primarily focus on research related to various aspects of construction and project management, as well as the use of information systems and technology in these domains.

- **Purple Cluster (*Organizational Science; Strategic Management Journal*):** These journals primarily focus on research related to various aspects of management, strategy, organization, and business policy.
- **Yellow Cluster (*Journal of Construction, Engineering and Management*):** They all belong to the field of management, with a specific focus on construction management and project management.

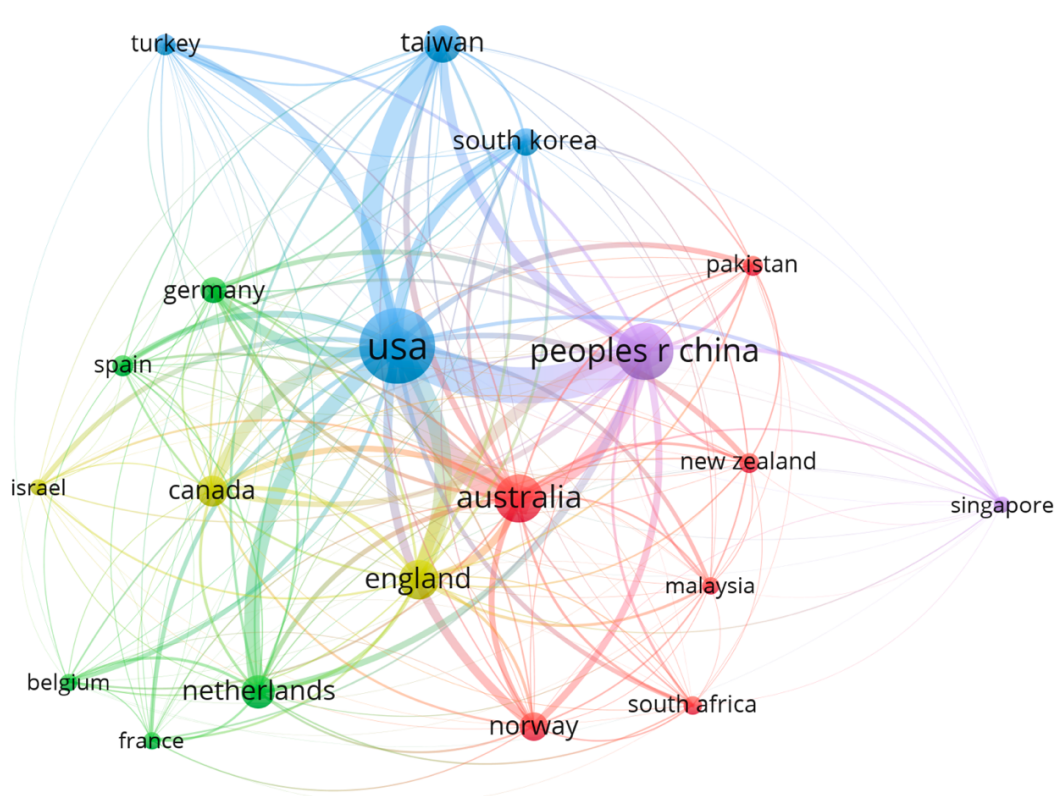
The data presented reveals that multiple journals have had an impact with their contributions to research on project team settings in the AEC industry.

4.2.3 Author-based Corporations across Countries

Xu et al. (2022) assert that network analysis is a useful tool to identify the countries at the forefront of any scientific research. Furthermore, they suggest that this approach can facilitate the identification of countries or regions that are likely to be strong partners for research collaborations (Xu et al., 2022). This sub-section looks at author-based country affiliations within research on project team settings based on the study sample of 512 publications.

A co-authorship network of countries depicts collaborations between various researchers affiliated with institutions in different countries. The network represents collaborations between authors based on their joint publications (Zyoud & Zyoud, 2021). After constructing the co-authorship network, VOSviewer aggregates the author nodes based on their country affiliations. This step involves grouping authors from the same country into single nodes representing their respective countries. VOSviewer calculates the similarity between each pair of nodes (authors or countries) in the network (Romero & Portillo-Salido, 2019). VOSviewer applies a clustering algorithm to group similar nodes together.

Figure 4.2-10 displays a co-authorship network of citing countries where thickness of the link between two countries represents the collaboration strength between them. The node size corresponds to the contribution of each node (i.e., bigger the node, bigger the country's contribution based on co-authorship) (Zyoud & Zyoud, 2021). The node color indicates that the nodes are related to each other within the same cluster (van Eck & Waltman, 2010; Zyoud & Zyoud, 2021).



*Figure 4.2-10 Collaboration Networks of Countries in Project Teams Research
(Based on co-authorship network of countries)*

Figure 4.2-10 shows that research on project teams:

- has the most significant contribution from **United States** with strong collaboration strengths with **People's Republic of China, Australia, England, and Taiwan**;
- has **People's Republic of China** and **Australia** in the next top ranks with noteworthy contributions to the field of project teams research;
- based on co-authorship network of countries has frequent author-based cooperation seen in the following country pairs: *USA & People's Republic of China, USA & Australia, USA & Netherlands, USA & Taiwan, People's Republic of China & Australia, and People's Republic of China & England*; and
- has academic exchanges and collaborations from a wide spectrum of countries.

AEC Project Teams Research

A secondary co-authorship network was extracted from the study sample by filtering for publications related to the AEC Industry which is shown in Figure 4.2-11.

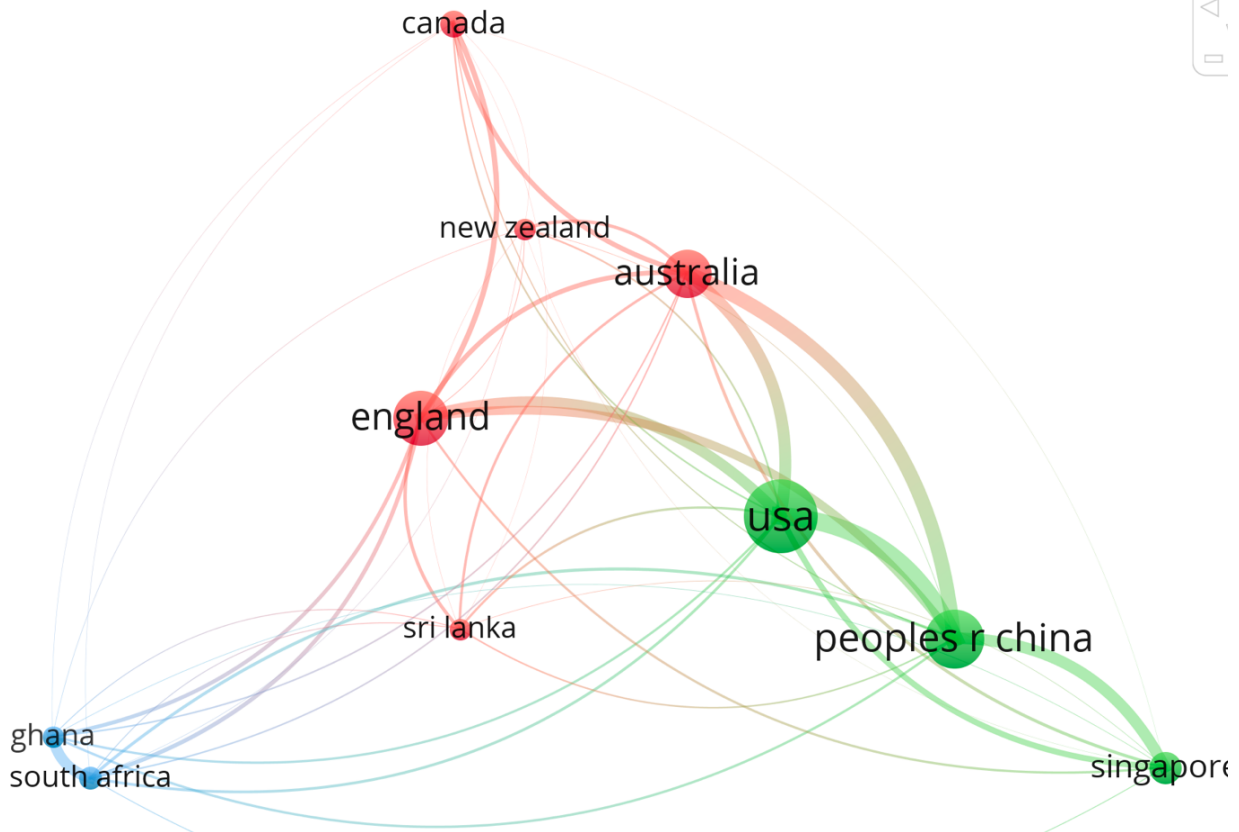


Figure 4.2-11 Collaboration Networks of Countries in Project Teams Research within the AEC Industry (Based on Co-authorship network of Countries)

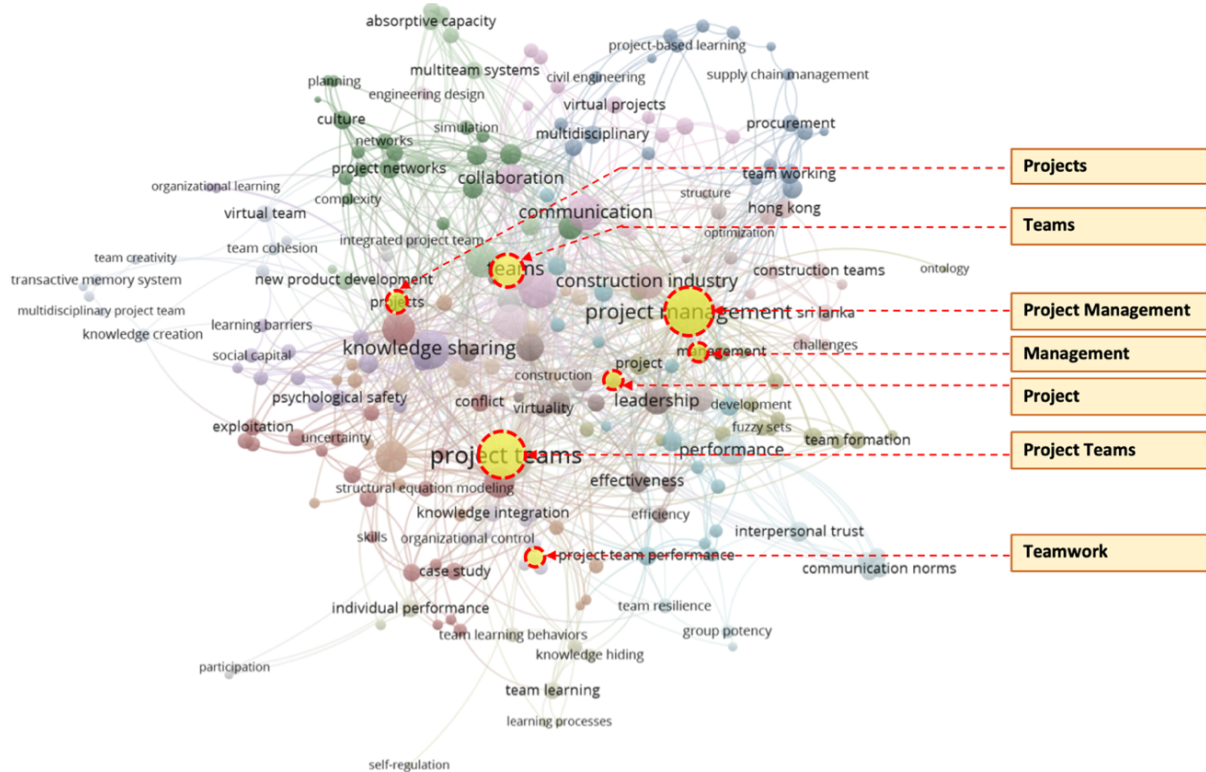
As depicted in Figure 4.2-11, the United States, People's Republic of China, England, and Australia occupy the top ranks, indicating a considerable number of co-cited research articles in the AEC industry from these collaborations. However, compared to Figure 4.2-10, the visualization network shows limited involvement of other countries. This suggests that there is a need to focus more on expanding author collaborations within current research on project team settings in the AEC industry.

4.2.4 Research Trends based on Author Keywords

Major research interests in a scientific field can be found in keywords as they capture an incisive description of a research paper (Xu et al., 2022). Using VOSviewer, a keyword co-occurrence network (KCN) based on the publications studying project teams was constructed as shown in Figure 4.2-12 and Figure 4.2-13 (Radhakrishnan et al., 2017).

Radhakrishnan et al. (2017) elaborate that in a KCN, each node represents a keyword, and the links represents the co-occurrence of a pair of keywords. The weight of the link is determined by the

frequency of a pair of words co-occurring in multiple articles. Xu et al. (2022) mentions that visualizing the keywords in a network can offer a good picture of any research domain and helps in understanding the connections between specific research interests over an identified timespan. Hence, a KCN gives insights into the cumulative knowledge of a domain of research and can be used to explore existing and upcoming knowledge hotspots based on clustering patterns, link strengths and the spread of the keywords across a given timeline.



*Figure 4.2-12 Initial Co-occurrence Network of Keywords
(Before removing generic keywords such as management, project, project teams)*

Before the initial KCN was created, identical terms (e.g., project team, project teams, virtual teams, virtual team) were merged (as project teams, virtual teams respectively). The initial co-occurrence network analysis (Figure 4.2-12) of all the author keywords captures generic central keywords like project teams, project management, teams, management, and teamwork validating the primary sample targeting all the publications related to the study of various aspects of project teams. For more accurate clustering of analysis results, the generic keywords were omitted as they do not link to any research trends this study aims to explore (Pham et al., 2014). Figure 4.2-13 demonstrates the updated co-occurrence network of keywords after removing the generic keywords. To ensure a comprehensive coverage of both low and high frequency keywords, a minimum occurrence

threshold of 2 was established (Pham et al., 2014). Applying this filter identified a total of 228 keywords, out of which 221 were found to be connected.

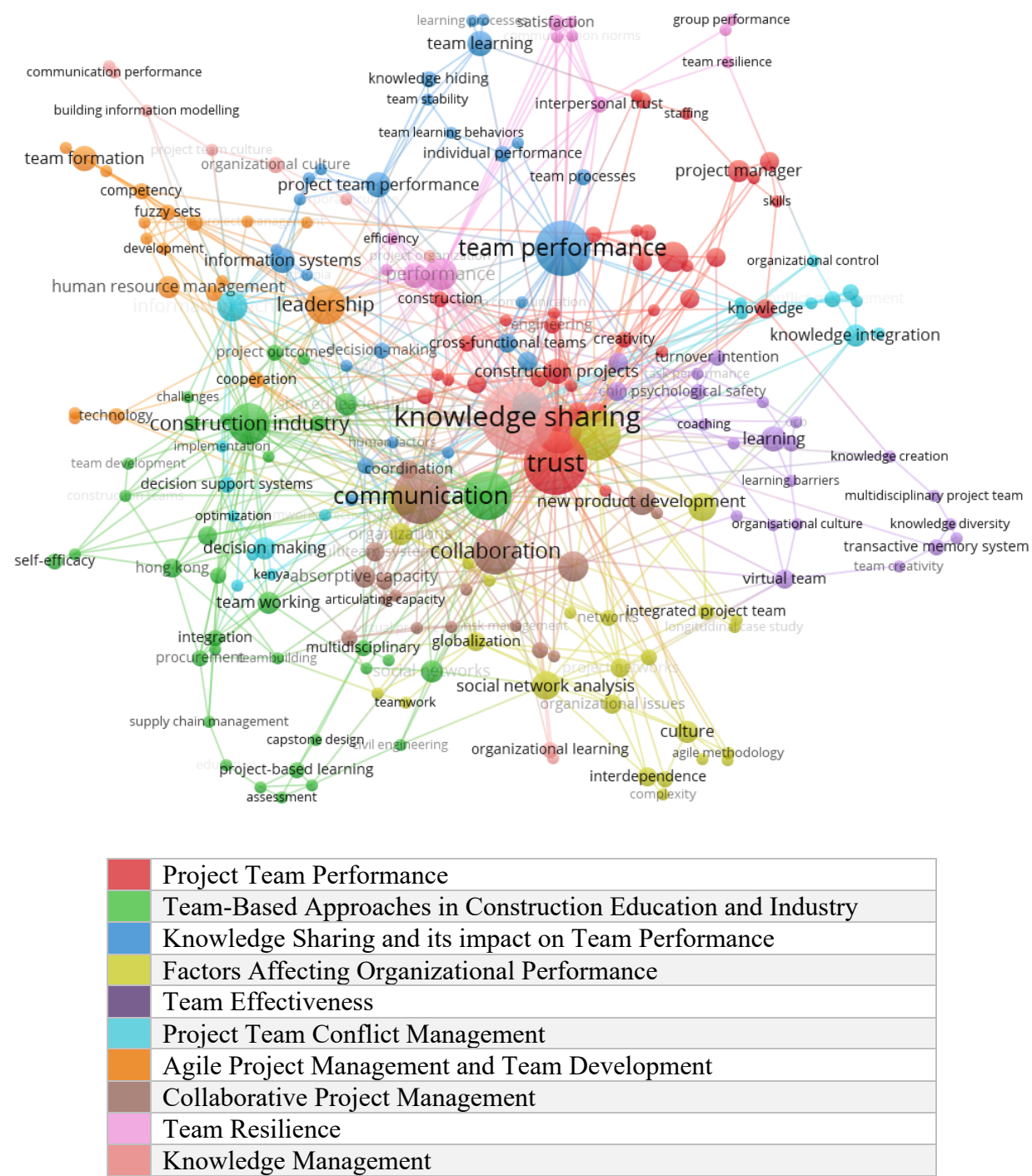


Figure 4.2-13 Keyword Hotspots in Project Teams Research
(co-occurrence network of Author Keywords)

Based on the data from the KCN in Figure 4.2-13, the top five author keywords explored the most within research on project teams in the order of their total link strength are *knowledge sharing*, *trust*, *knowledge management*, *innovation*, and *communication*. All the five keywords have their average publication years between 2012 and 2015 (Refer to the layered average publication year KCN in APPENDIX B).

Using Cite space (C. Chen & Song, 2019), the connected co-occurring keywords depicted in Figure 4.2-13 can be organized into the following 10 clusters:

Table 4.2-2 Identified Keyword Cluster based on Keyword Co-occurrence Network

Keyword Cluster	Focus Area	Keywords
Project Team Performance	The cluster captures the factors that contribute to the success of project teams and the challenges that they face in achieving their goals.	creative problem solving, project performance, work engagement, creativity, construction project team, transformational leadership, project delivery, structural equation modeling, case study, project manager, hybrid teams, exploration, exploitation, construction projects, engineering, interaction, team effectiveness, virtuality, virtual teams, task interdependence, design, organization, conflict, trust, construction, knowledge, ambidexterity, skills, internet, project leadership, uncertainty, staffing, it, action research, information management, communications
Team-Based Approaches in Construction Education and Industry	The keywords linked in this cluster are related to various team-based approaches that are used in the construction industry and education, as well as the challenges and outcomes associated with these approaches.	systematic literature review, team-based learning, project-based learning, shared leadership, inter-professional, self-efficacy, assessment, civil engineering, consultants, project teams, software engineering, quality, challenges, industrialized building system (ibs), social networks, multidisciplinary, knowledge management, capstone design, team development, project outcomes, relational contracting, social exchange theory, team working, construction teams, virtual work, integration, team, building, construction industry, procurement, education, empowerment, supply chain management

Table 4.2-2 (cont'd)

Knowledge Sharing and its Impact on Team Performance	The cluster captures the factors that contribute to or hinder the effective sharing of knowledge within teams and the impact of knowledge sharing on team performance.	knowledge hiding, qualitative research, social network, team stability, professional development, team performance, cross-functional teams, decision-making, team learning, team learning behaviors, multiple team membership, individual performance, project team performance, human factors, knowledge-based systems, learning processes, team processes, team communication, social factors, knowledge acquisition, information systems, developing countries, cohesion, is project teams, user involvement
Factors Affecting Organizational Performance	Some of the keywords in this group are related to the structural and cultural characteristics of organizations and the processes and practices that facilitate or hinder organizational performance in project-based contexts.	organizational structure, complexity, diversity, contractors, integrated project team, longitudinal case study, culture, networks, productivity, social network analysis, innovation, boundary spanning, interdependence, tacit knowledge, data mining, organizational issues, project networks, agile methodology, planning, simulation, globalization, virtual organization, teamwork
Team Effectiveness	The cluster captures the factors that contribute to or hinder the effective functioning of teams.	team cohesion, psychological safety, turnover intention, team coordination, knowledge leadership, organizational culture, team creativity, ocb, organizational citizenship behavior, transactive memory system, virtual team, coaching, learning barriers, emotional intelligence, knowledge diversity, social capital, knowledge creation, learning, multi-disciplinary project teams
Project Team Conflict Management	The cluster captures the factors related to conflict management	process conflict, task conflict, conflict management, cross-functional project teams, decision support systems, project success, structure, relationship conflict, teamwork effectiveness, knowledge integration, organizational control, information technology, optimization, multicultural management, decision making, team building, implementation, systems development
Agile Project Management and Team Development	This group encompasses keywords related to project management methodologies as well as team-related concepts	development, multi-objective optimization, scrum, team creation, competency, fuzzy sets, agile, team leadership, virtual enterprise, agile project management, cooperation, team formation, leadership, management, fuzzy log, ict, technology, motivation, human resource management, virtual reality

Table 4.2-2 (cont'd)

Collaborative Project Management	This cluster captures the process of teams working together towards a common goal and the process of information and expertise exchange within a team.	articulating capacity, common knowledge, virtual project teams, absorptive capacity, integrated project delivery, integrated project delivery (ipd), coordination, knowledge transfer, multiteam systems, communication, virtual projects, collaboration, new product development, risk management, team size, virtual project team, team management, resource sharing
Team Resilience	This group encompasses keywords related to team-related concepts which are essential for building effective and resilient teams.	team resilience, communication norms, global project teams, interpersonal trust, role clarity, group potency, efficiency, effectiveness, performance, group performance, satisfaction feedback
Knowledge Management	The cluster captures factors that lead to creating an environment that encourages creating. Sharing and applications of knowledge within an organization.	communication performances, project team culture, building information modelling, knowledge sharing, project-based organization, organizational culture, project organization, corporate culture, organizational learning

After identifying the clusters formed by the 221 connected keywords, the differentiated keywords were plotted on a timeline as shown in Figure 4.2-14 (based on the data from the layered average publication year KCN in APPENDIX B).

The x-axis represents the average publication year of each keyword. Each node represents a keyword, and the color of the node is the keyword cluster (from Figure 4.2-13) it belongs to. The size of each node represents the number of occurrences of each keyword within the sample of 512 publications.

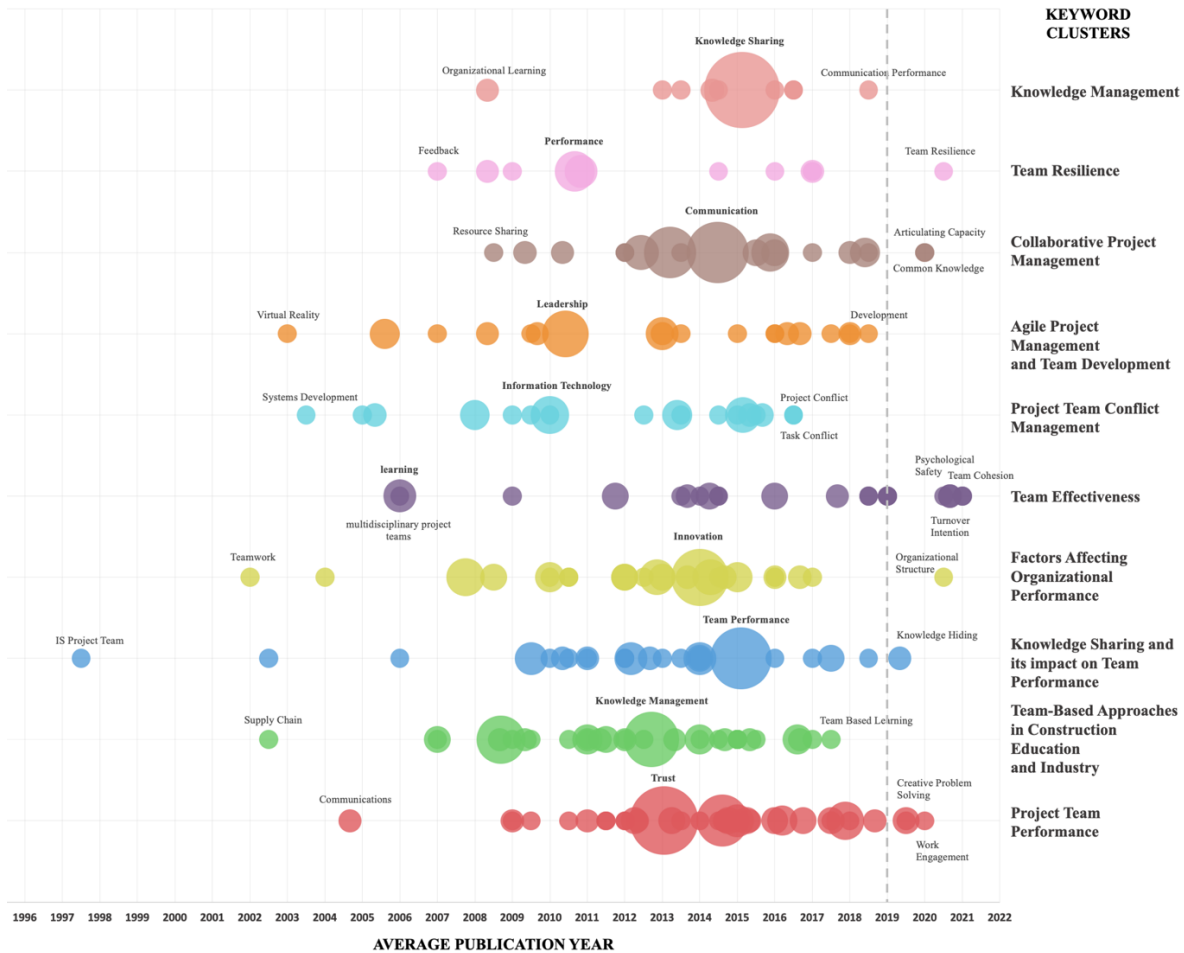


Figure 4.2-14 Evolution of Keywords (co-occurrence network of Author Keywords)

*Each row depicts the first keyword, the keyword with most occurrences and all the keywords occurring after 2019 in their respective keyword cluster

*The dotted line marks the year 2019 highlighting the keywords occurring in the past 4 years

Figure 4.2-14 provides insight into the temporal relevance of the identified keywords in the past 25 years of scientific research of project team settings. Within each cluster row in Figure 4.2-14, the first keyword, their last keyword and/or the keywords with their average publication year after 2019 have been labelled next to the node. The keywords with their average publication year after 2019 (as shown in Figure 4.2-14) are low frequency connected keywords that are presently under exploration in the context of project team settings (C. Chen & Song, 2019; Pham et al., 2014).

Figure 4.2-15 lists the low frequency keywords, the clusters they belong to and determines the nature of these keyword occurrences based on the following categories: Organizational vs Interorganizational Teams, Authentic vs Student Teams, Co-located vs Virtual Teams, AEC vs Non-AEC and Type of Industry.

		CLUSTER	KEYWORDS	Authentic vs Student	Co-Located vs. Virtual	Org. vs Inter-Org	Non-AEC vs. AEC	Type of Industry
KEYWORD HOTSPOTS	Project Team Performance		creative problem solving	■ ■	■ ■	■ ■	■ ■	AEC, R&D and Science
			project performance	■ ■	■ ■	■ ■	■ ■	Information Technology, R&D and Science
			work engagement	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	AEC, Business Management, Engineering
	Knowledge Sharing and its impact on Team Performance		knowledge hiding	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	Oil and Gas, R&D and Science, Information Technology, Aerospace
			psychological safety	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	AEC, R&D and Science
			turnover intention	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	AEC, R&D and Science, Engineering
	Team Effectiveness		task performance	■ ■	■ ■	■ ■	■ ■	R&D and Science, Engineering
			team cohesion	■ ■	■ ■	■ ■	■ ■	AEC, Education Sciences
			organizational culture	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	■ ■ ■ ■ ■	* AEC, Business Management, Engineering
			knowledge leadership	■ ■	■ ■	■ ■	■ ■	R&D and Science, Information Technology
			team creativity	■ ■	■ ■	■ ■	■ ■	Business Management, Education Sciences
	Collaborative Project Management		articulating capacity	■ ■	■ ■	■ ■	■ ■	AEC
			common knowledge	■ ■	■ ■	■ ■	■ ■	AEC
	Team Resilience		team resilience	■ ■	■ ■	■ ■	■ ■	AEC, Information Technology

* Belongs to AEC but study was on an organizational project team

Figure 4.2-15 Keyword Hotspots in Project Team Settings (2019 to 2022 Sample $n = 34$)

The categorization of the keyword hotspots in Figure 4.2-15 highlights several important concepts related to the recent research trends in the studies on project teams. It shows that base on the keyword co-occurrence network, the study on project teams related to:

- Virtual authentic teams have a scope to explore keyword hotspots like **work engagement**, **knowledge hiding**, **psychological safety**, **task performance**, **knowledge leadership**, **articulating capacity**, **common knowledge**, and **team resilience** which are currently otherwise under exploration in co-located project team settings;

- Authentic interorganizational project teams can explore keyword hotspots like *creative problem solving, work engagement, psychological safety, turnover intention, team cohesion, organizational structure, articulating capacity, common knowledge, and team resilience*;
- Student teams has their research hotspots based on the keywords *work engagement, turnover intention, task performance, team cohesion* and *team creativity*. These keywords come under two clusters: *Project Team Performance* and *Team Effectiveness*;
- Student teams have surfaced mostly in courses related to *business management* and *engineering* in the last 4 years; and
- Virtual student teams have an emerging need for research exploring *work engagement* and *task performance*.

AEC Interorganizational Project Teams

Within the spread of these keywords across multiple industries, keyword hotspots and their research clusters can be identified specific to AEC interorganizational project teams. Based on the keyword co-occurrence network in Figure 4.2-15, study on AEC interorganizational project teams can potentially have their research focus around following keyword hotspots:

Table 4.2-3 Keyword Hotpot Areas for AEC Interorg. Project Teams (based on KCN)

Research Cluster	Keyword Hotspots
Project Team Performance	<i>Creative Problem Solving, Work Engagement</i>
Project Team Effectiveness	<i>Psychological Safety, Turnover Intention</i>
Collaborative Project Management	<i>Articulating Capacity, Common Knowledge</i>
Team Resilience	<i>Team Resilience</i>

Section 4.3.2 further explores these keyword hotspots for AEC interorganizational project teams by studying them in relation to identified clusters within the connected publications on AEC project teams through a citation network analysis.

4.2.5 Summary

To capture the evolution of research on project teams and how it is connected across domains, this section covered multiple types of analysis done on the sample. The main findings and research trends/propositions can be summarized as follows:

1. The most cited publications doing research on **project team** settings lie between the years, 2000 and 2007, and are primarily studying authentic project teams in the fields of R&D

and science, psychology, information technology, business management and the AEC industry.

2. Top five author keywords explored the most within **project teams** research are knowledge sharing, trust, knowledge management, innovation, and communication with all of them having their average publication year between 2012 and 2015.
3. Research on **interorganizational project team** settings has received limited attention but show an upward trend in the past decade. It has been explored the most in the AEC industry followed by its limited presence in R&D and Science and Engineering teams.
4. Research on **student teams** has been limited with notable exceptions in courses related to business management and engineering. Therefore, future research should aim to broaden their scope to academic fields related to other industries.
5. Research on **virtual project teams** has limited studies within interorganizational setups and within the spectrum of student teams. Future research should prioritize exploring these settings further.
6. The research gap regarding **virtual project teams** is particularly evident in industries like automotive engineering, non-profits, and environmental engineering.
7. Future investigations on **virtual project teams** can focus on variables related to work engagement, knowledge hiding, psychological safety, task performance, knowledge leadership and team resilience.
8. Analysis of author-based country co-authorship networks highlights the need to enhance global collaborations among researchers studying project team settings in the **AEC industry**.
9. Recent research trends, based on keyword analysis over the past four years, have primarily focused on AEC industry, Business Management, and Information Technology.
10. There is potential for investigating specific research keyword hotspots related to **AEC interorganizational project teams**. Research areas such as collaborative project management and team resilience offer avenues for exploration. Relevant keywords include Team Resilience, Articulating Capacity, Common Knowledge, Psychological Safety, Turnover Intention, Creative Problem Solving, and Work Engagement.

The key findings and their applications are further discussed in Chapter 5.

4.3 State-of-Practice and Future Research Areas: AEC Project Teams

Section 4.2 focused on the state-of-research on project teams across multiple industries and also looked at the position of research specific to the AEC industry within the broader landscape of project teams. This section looks at the sample specific to AEC project teams. Figure 4.3-1 describes the methodology followed in this section:

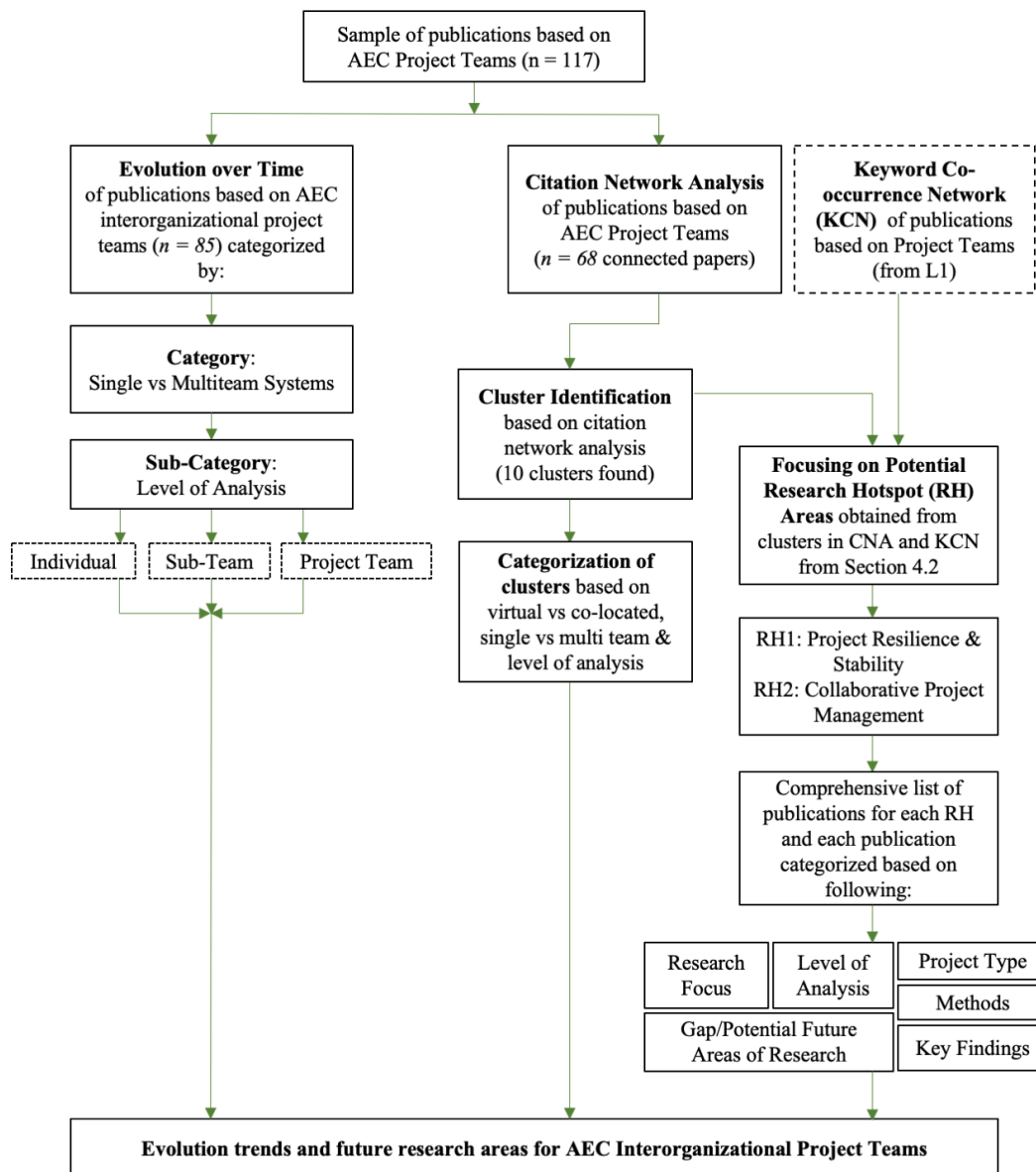


Figure 4.3-1 Methods to Results Process Map for Section 4.3

4.3.1 Evolution over Time

Single vs Multiteam Systems and Level of Analysis

Multiple reviews in the past 5 years have had gaps/potential for future research on project teams that involve studying the missing levels of analysis to test out the various mediating variables across project team constructs (Chan et al., 2021; Leiringer & Zhang, 2021). Chan et al. (2021) describes these levels of analysis as the following: individual, sub-team, project team and at the organization level. While these levels exist within a project team, multiple studies have looked at another crucial type that exists with project teams i.e., single team versus multiteam systems (MTSs) (Luciano, DeChurch, et al., 2018). Hence, 85 publications on interorganizational project teams in the AEC industry were coded based on the categorization of single versus multiteam systems and further coded based on the level of analysis conducted in each study.

Within the publications studying AEC project teams, 85 publications look at interorganizational project team settings. Figure 4.3-2 captures the evolution of the 85 publications spread across the publications years plotted on the x-axis. Each node in the graph represents a publication which is further layered by color depicting whether the publication studied the project team settings at an individual level, sub-team level, project team level or a combination of the three. The node size is dependent on the number of cites received by the publication.

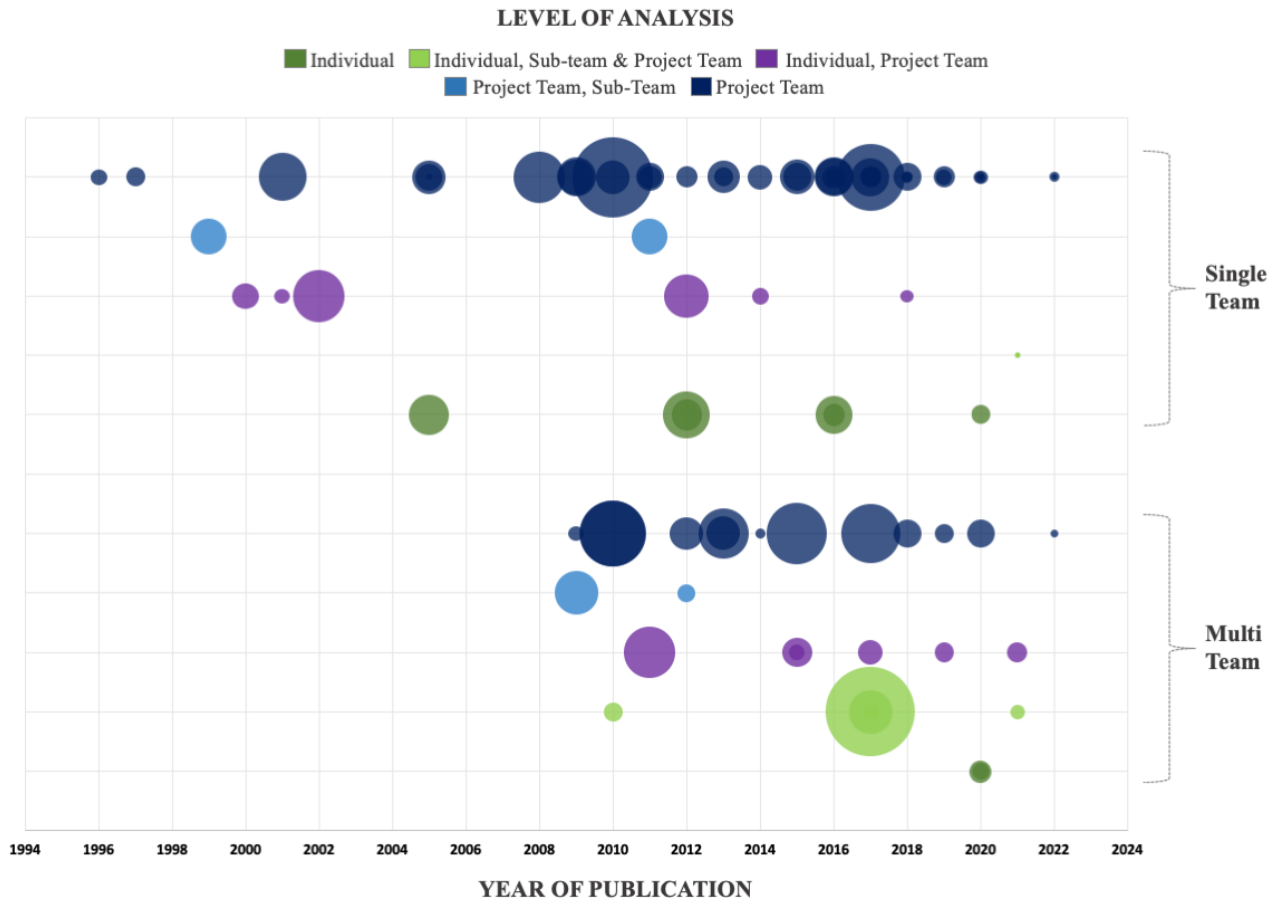


Figure 4.3-2 Evolution of Publications related to AEC Interorganizational Project Teams (categorized by Single vs Multiteam Systems and Level of Analysis)

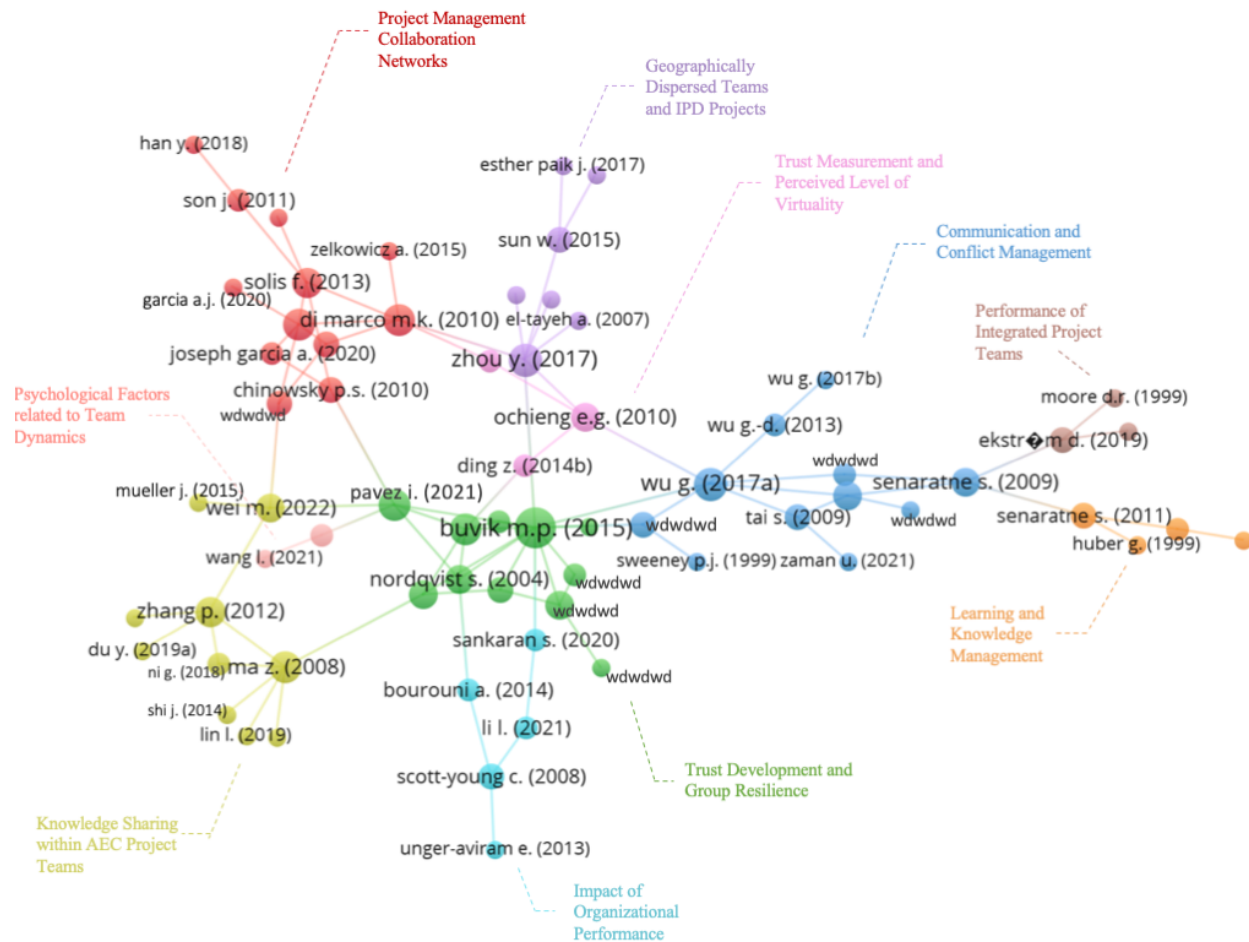
Figure 4.3-2 depicts the study on AEC interorganizational project teams, highlighting noteworthy observations:

- The majority of research on interorganizational AEC project teams has been explored in single team systems at the ***project team level***;
- The exploration on multiteam systems within AEC interorganizational project team settings emerged in the last fifteen years;
- Within the study on multiteam systems, significant emphasis has been given to project team constructs at the project team level, as well as a combination of individual and project team levels;
- The exploration of studies in interorganizational setups analyzing project teams at all the three level of analysis i.e., individual, sub-team and project team level is limited; and

- Limited attention has been given to studying interrelated project networks at *the sub-team level*. Hence, future research holds immense potential in focusing on sub-teams as a valuable level of analysis.

4.3.2 Future Research Areas based on Citation Network Analysis

Using VOSviewer, a citation network analysis was performed on the publications related to the AEC industry (n=117) as shown in Figure 4.3-3. A citation network analysis in VOSviewer identifies groups of documents that are connected based on their citation relationships. The algorithms in VOSviewer analyze the structure of the co-citation network to determine clusters of documents that tend to cite each other or are frequently cited together by other documents (Radhakrishnan et al., 2017). The node color indicates connected clusters of publications in cited work (Van Eck & Waltman, 2010) and the thickness of the links shows the total link strength. 68 connected publications were found, and 10 clusters were identified.



Cluster	Color	N	Cluster	Color	N
Cluster 1	Red	12	Cluster 6	Cyan	5
Cluster 2	Green	12	Cluster 7	Orange	4
Cluster 3	Blue	11	Cluster 8	Brown	3
Cluster 4	Yellow	9	Cluster 9	Pink	3
Cluster 5	Purple	7	Cluster 10	Light Blue	2

Figure 4.3-3 Citation Network Analysis of Publications on AEC Project Teams

Table 4.3-1 covers the various clusters identified in the citation network (Figure 4.3-3) of connected publications ($n = 68$) and identifies the common research focus for each cluster. It can be noted that due to the interconnectedness of the clusters, there are certain overlaps in the research focus.

Table 4.3-1 Clusters of publications on AEC Project Teams (based on CNA)

Cluster	Research Focus
Cluster 1	The common theme of the publications is project management and collaboration networks within project teams. These publications explore various aspects of project networks, interdependencies, effectiveness, organizational structures, knowledge transfer, collaboration, and project team dynamics.
Cluster 2	The common theme of the publications is trust development and group resilience within project team settings. The publications explore topics such as team performance, trust development, knowledge sharing, team member selection, innovation, group resilience, leadership, team learning, coordination, and knowledge sharing within project-based organizations.
Cluster 3	The common theme of the cluster is the study of communication and conflict management within AEC project teams. These publications mostly adopt case studies as their research method particularly in the context Sri Lanka, Australia, and China. The various research focus includes the role of communication in hybrid arrangements, emotional intelligence and performance, intragroup conflicts, support and commitment factors and communication management. The publications aim to provide insights and strategies for improving communication effectiveness, teamwork, conflict resolution, and overall project success within the construction industry.
Cluster 4	The common theme of the publications is knowledge sharing within AEC project teams . These publications focus on understanding and exploring various aspects of knowledge sharing, including the modes of interaction (technology-based vs. face-to-face), knowledge-sharing strategies, and behavior related to knowledge sharing within project teams. The publications aim to shed light on the dynamics, challenges, and factors influencing knowledge sharing among team members in project-based settings, with a focus on improving knowledge management and collaboration for better project outcomes.
Cluster 5	The common theme of the publications is how project teams can effectively collaborate, communicate, and implement innovation in complex engineering projects, with a particular emphasis on virtual teams, geographically dispersed teams, and IPD projects in the AEC industry.
Cluster 6	The common theme of the publications is the impact of organizational performance on the success of AEC project teams. These publications explore various aspects of project team management, including organizational groupings, horizontal leader identification, project member assignment strategies, and the influence of project managers. The focus is on understanding the relationship between project team dynamics, perceived justice, turnover intentions, goal feedback, recognition, and performance success within project-based organizations.

Table 4.3-1 (cont'd)

Cluster 7	The common theme of the publications is learning and knowledge management within AEC project teams. These publications focus on various aspects of fostering learning, improving relationships, assembling integrated project teams, and linking individual, team, and organizational learning. The publications aim to provide insights and strategies for improving learning processes, collaboration, and overall project performance within AEC project team settings.
Cluster 8	The common theme of the publications is the performance of integrated project teams in the AEC industry. These publications explore various aspects related to the effectiveness and performance of integrated project teams in various stages of the project lifecycle. The focus is on understanding the factors that influence the performance of integrated project teams, including the early design stages, collaborative procurement approaches, and the management of unexpected change events.
Cluster 9	The common theme of the publications is trust measurement and perceived level of virtuality in hybrid construction project teams . The common theme explored is the analysis and investigation of factors, dynamics, and challenges that impact communication and virtuality in diverse settings.
Cluster 10	The common theme of the publications is the examination of the relationship between psychological factors related to team dynamics within project teams. The publications explore the influence of individual-level psychological factors, such as stress and anxiety, on team processes and outcomes within AEC project teams.

The clusters identified in Table 4.3-1 were further plotted on a graph to see the distribution of the connected publications within each cluster based on the following categories:

- Single vs Multiteam Systems;
- Level of Analysis (Individual, Sub-Team, or Project Level); and
- Virtual vs Co-located Teams.

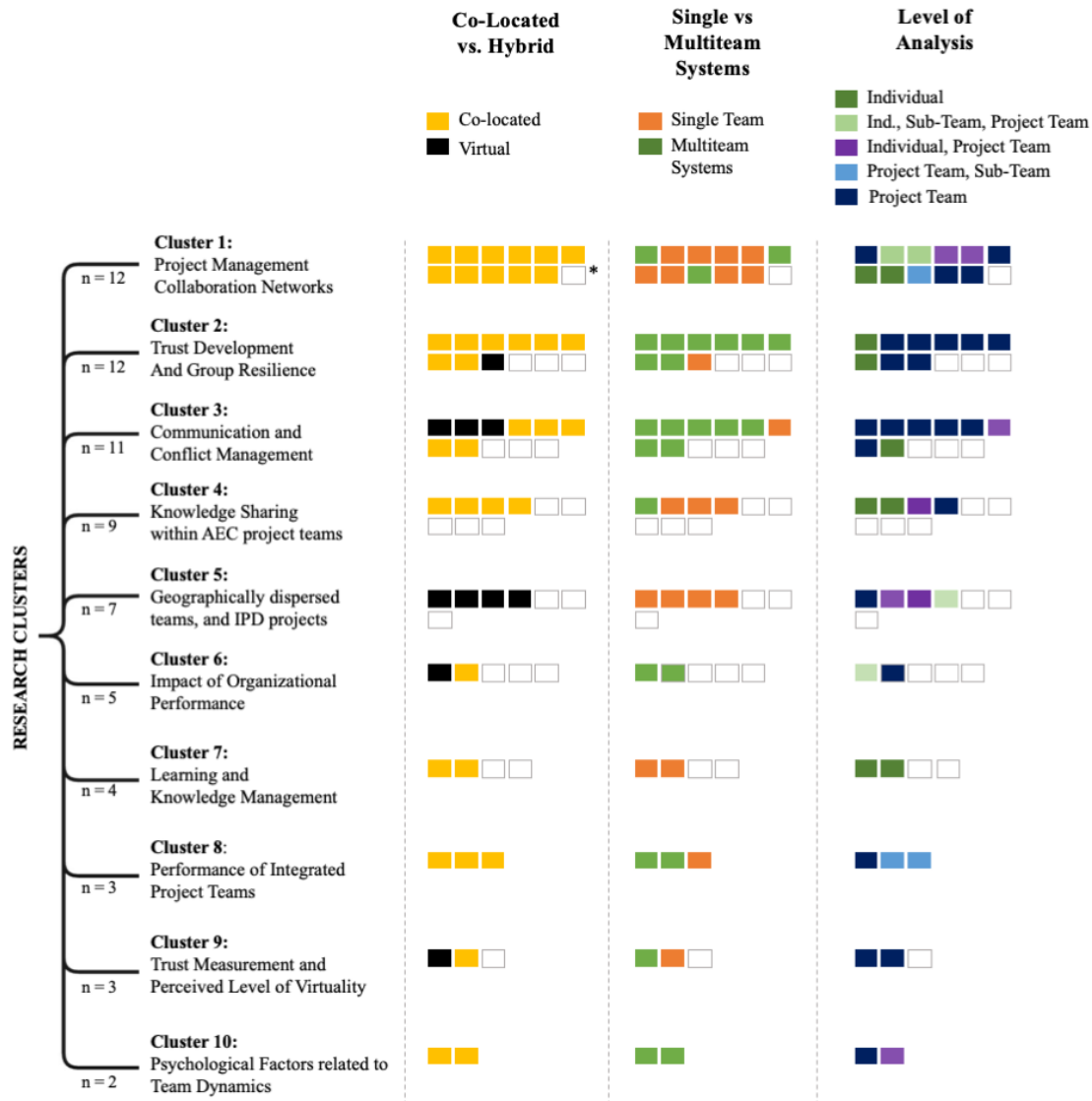


Figure 4.3-4 Categorization of clusters identified within connected publications on AEC project teams based on citation network analysis)

*The empty boxes indicate that these publications are limited to organizational aspects within AEC project teams

The categorization of the clusters identified within connected publications on AEC project teams in Figure 4.3-4 highlights several important trends related to interorganizational project team settings in the AEC industry. It shows that the study on AEC interorganizational project teams:

- has potential for future research to focus on *learning and knowledge management, performance of integrated project teams, trust measurement and perceived level of virtuality and psychological factors related to team dynamics*;

- related to multiteam systems has been explored the most in research areas like *IPD Projects* and *Project Management and Collaboration Networks*;
- related to sub-team level of analysis has been explored the most in research related to the *performance of integrated project teams* and *project management collaboration networks*; and
- related to virtual project networks has potential in the research areas: *knowledge sharing within project teams* and *trust development and group resilience*.

Within the clusters of connected publications studying AEC project team settings, it is evident that multiple publications within each cluster primarily focus on team dynamics within organizational boundaries. Hence, there rises a clear need for future expansion of research related to interorganizational setups and multiteam systems in the AEC industry.

Potential Research Hotspots

Each identified cluster specified crucial connected papers in related literature (Nobanee et al., 2021). Utilizing these clusters, the study examined the intersection of research areas alongside our findings in keyword research hotspots, primarily focusing on two key areas: *Team Resilience & Stability* and *Collaborative Project Management Networks*. Next 2 sub-sections look at the relevant publications related to each of the above-mentioned research hotspots. The list of the relevant samples was collected through a combination of publications list obtained from Keyword Co-occurrence Network in Section 4.2.4 and the clusters identified in Figure 4.3-3 which are closely related to the research hotspot.

For each research hotspot, the relevant publications were explored in detail based on the following: Author, Publication Title, Research Focus, Level of Analysis, Project Type, Methods, Key Findings and Gap/Potential for Future Research (Chan et al., 2021; Leiringer & Zhang, 2021). The gaps/potential for future research identified for each research hotspots were then combined and converted into agendas for future research recommendations/propositions.

Team Resilience and Stability

A comprehensive list of publications centered around keyword hotspots related to team resilience was created (Table 4.3-2) using a combination of two primary clusters identified through citation network analysis: cluster 2 and cluster 10 from Table 4.3-1. Cluster 2 focuses on trust development and group resilience, examining the dynamics and factors that contribute to the resilience of teams. Cluster 10 studies the relationship between psychological factors and team dynamics, giving insights on how various psychological elements influence the overall performance and resilience of

teams. Hence, this sub-section aims to offer agendas for future research related to team resilience and its implications in AEC interorganizational project teams.

Table 4.3-2 Sample Publications - Team Resilience and Stability

Author	Publication (cite score)	Focus	Level of Analysis; Project Type; Methods	Key Findings	Gap/Potential for Future Research
Wei M., Hao S., Ren X. (2022)	Non-spatial proximity and project team resilience: the role of knowledge sharing and team cohesion (3)	Influence of team composition on project team resilience based on proximity and explores the role of knowledge sharing and team cohesion in their relationship.	Project Team; Construction Projects in China; Cross-sectional Survey	Value proximity, social proximity, knowledge sharing, and team cohesion have a positive influence on project team resilience.	Carry out a longitudinal survey to measure project team resilience; explore more mediating variables like collective potency and team psychological safety.
Pavez I., Gómez H., Laulié L., González V.A. (2021)	Project team resilience: The effect of group potency and interpersonal trust (10)	Testing a model in which interpersonal trust group potency drive the perception of team resilience in project team members.	Individual; Construction Projects in Chile; Cross-sectional Survey	Affect-based trust and group potency mediate the relationship between cognition-based trust and project team resilience.	Carry out a longitudinal survey to measure project team resilience; test project team resilience for team-level outcomes.

Table 4.3-2 (cont'd)

Ahiaga-Dagbui D.D., Tokede O., Morrison J., Chirnside A. (2020)	Building high-performing and integrated project teams (9)	Studies the effectiveness and limitations of a project facilitation model as a tool for developing successful inter-organizational relationships	Individual and Project Team; Water Supply Upgrade Project in Australia; Case study (triangulated data sources)	Results indicate that facilitated workshops positively affect team performance by sustaining best for practice principles and psychological safety	Further studies need to explore characteristics, experience, and profile for project facilitator to ensure maximum success; empirical studies need to be done to define the types of projects that would benefit from a facilitation model
Buvik M.P., Tvedt S.D. (2017)	The influence of project commitment and team commitment on the relationship between trust and knowledge sharing in project teams (43)	To test how trust directly and indirectly affects knowledge sharing in AEC project teams	Individual and Project Team; Construction Projects in Norway; Medication Analysis	In the context of project teams, project commitment is more important for knowledge sharing than team commitment.	Consider multilevel nature of project teams for future analysis; Carry out a longitudinal survey to capture the dynamic nature of trust, commitment, and knowledge sharing
Savelsbergh C.M.J.H., Poell R.F., van der Heijden B.I.J.M. (2015)	Does team stability mediate the relationship between leadership and team learning? an empirical study among dutch project teams (36)	Influence of leadership on team learning behaviors with team stability as a potential mediator	Project Team; Building and utilities, Infrastructure, Area Decontamination, and development; Cross-sectional Survey	Both person-oriented and task-oriented leadership were found to be positively related to team learning behaviors in project teams	Examine whether the leadership behaviors that promote team learning vary over time depending on the project phase

Table 4.3-2 (cont'd)

Buvik M.P., Rolfsen M. (2015)	Prior ties and trust development in project teams - a case study from the construction industry (111)	Influence of prior ties between team members influence trust development with a project team	Individual and Project Team; School Construction Project in Norway; Single case study	Positive prior ties enhance a higher level of trust and create good conditions for the initial phase of a construction project	Future research should explore negative prior experiences' effect on the project; Also include expectations of team members related to future interactions when studying trust development
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The analysis done in Table 4.3-2 allows for a number of observations:

- The majority of the research on aspects of team resilience and stability is based on cross-sectional surveys or qualitative case studies conducted on single projects;
- There are relatively limited studies that measure team resilience through a facilitation model for building psychological safety in inter-organizational setups;
- Recognizing the multilevel nature of project teams, future research can investigate the dynamics of trust, commitment, and team stability across different level within the project team structure and capture this analysis over a longitudinal study which can provide insights on how these factors evolve over time;
- Multiple publications suggest conducting further studies through longitudinal studies to capture factors like future team member expectations (Buvik & Rolfsen, 2015), the dynamic nature of trust and commitment (Buvik & Tvedt, 2017) and effect of variables like psychological safety on team resilience (Wei et al., 2022); and
- While recommendations to conduct further studies through longitudinal studies are common, such recommendations are still majorly unaddressed.

Project Management Collaboration Networks

A comprehensive list of publications centered around keyword hotspots related to collaborative project management networks was created (Table 4.3-2) using a combination of three primary clusters identified through citation network analysis: cluster 1 (Project Management Collaboration Networks), cluster 4 (Knowledge Sharing within AEC project teams) and cluster 8 (Performance

of Integrated Project Teams) given in Table 4.3-1. Cluster 1 focuses on project management and collaboration networks within project teams. These publications explore different aspects of project networks, interdependencies, knowledge transfer, collaboration, and project team dynamics. The publications in cluster 4 explore various aspects of knowledge sharing, including the modes of interaction (technology-based vs. face-to-face), knowledge-sharing strategies, and behavior related to knowledge sharing within project teams. Cluster 8 covers publications related to the effectiveness and performance of integrated project teams in various stages of the project lifecycle.

Table 4.3-3 Sample Publications - Project Management Collaboration Networks

Author	Publication	Focus	Level of Analysis, Project Type, Methods	Key Findings	Gap/Potential for Future Research
Chan, Kai-Ying & Oerlemans, Leon & Meslec, Nicoleta. (2021)	The impact of multiple project team membership on individual and team learning: A micro-meso multi-level empirical study	Research aims to study the effect of multiple project team membership on individual and team learning.	Individual, Project Team; Multiple construction and infrastructure projects; Cross-sectional Survey	Individual learning has a positive impact on both internal and external team learning.	Future studies can look at the missing variables like leadership and task/project complexity linked to multiple project team membership
Garcia A.J., Mollaoglu S., Frank K.A., Duva M., Zhao D. (2021)	Emergence and evolution of network structures in complex interorganizational project teams	To study how temporary knowledge transfer networks within AEC project teams evolve during the project delivery stage and adopt structure different and independent from each other	Individual, Sub-Team, Project Team; An AEC project team working on an institutional project; Mixed methods	Project managers can promote core-periphery structures to help in project team coordination at the earliest stages of design	Explore the network dynamics in complex interorganizational AEC teams considering different modalities, interaction quality, project delivery method and phases of construction

Table 4.3-3 (cont'd)

Joseph Garcia A., Mollaoglu S. (2020)	Individuals' Capacities to Apply Transferred Knowledge in AEC Project Teams	This study focuses on the key knowledge-related factors that affect the individuals to apply that knowledge transferred to them in project teams in the AEC industry.	Individual level; An IPD large scale construction project; Multiple regression model on a longitudinal project	The way individuals in a project team absorb the knowledge transferred to them is directly related to the articulating capacity of the knowledge sender	Explore where to put individuals with high absorptive and articulating capacity a project team structure; Utilize the findings in inter-organizational project teams in other industries
Garcia A.J., Mollaoglu S. (2020)	Measuring Key Knowledge-Related Factors for Individuals in AEC Project Teams	This study aims to identify essential individual-level knowledge-related factors and develop indicators to measure them.	Individual level; An IPD construction project; Survey collection	The study confirmed the validity and reliability of the indicators to measure individual-level knowledge-related factors which are knowledge application, absorptive capacity, common knowledge, and articulating capacity	Future research to perform structural equation modeling or multilinear regression with the measurement model and use knowledge application as a dependent variable; the measurement model to be tested in projects of different sizes and other delivery methods

Table 4.3-3 (cont'd)

Ni Guodong, Cui Qingbin, Sang Linhua, Wang Wenshun, Xia Dongchun (2017)	Knowledge-sharing, culture, project-team interaction, and knowledge-sharing performance among project members	To explore a mechanism to improve knowledge-sharing performance with a focus on knowledge sharing culture (KSCu) and project-team interaction (PTI)	Project Team Level; 78 Chinese AEC Engineering Management organizations; Cross-sectional survey and structural equation modelling	There exists a positive relationship between KSCu and knowledge-sharing performance; PTI plays a factor in the effect of KSCu on knowledge-sharing performance	Future research needs to focus on individual behavioural factors such as knowledge-sharing attitude, willingness, and motivation
Zelkowitz A., Iorio J., Taylor J.E., Via C.E. (2015)	Exploring the role of cultural boundary spanners at complex boundaries in global virtual AEC networks	To test the efficacy of cultural boundary spanners placed at a knowledge and technical boundary domain for improving network performance	Individual and Project Team level; Global Virtual Project Networks among graduate across the globe; longitudinal study using SNA and Team Recordings	Interactions in a network based on cultural spanners have a negative impact the efficiency of knowledge transfer in virtual project networks	The model of testing cultural boundary spanners needs to be tested on authentic project teams on complex virtual interorganizational projects
Solis F., Sinfield J.V., Abraham D.M. (2013)	Hybrid approach to the study of inter-organization high performance teams	Study of hybrid methodology using network theory and jobs-to-be-done framework for high performance teams.	Individual and Project Team level; healthcare construction project; Single case study (SNA Metrics)	SNA metrics with problem solving frameworks can generate comprehensive insights for composition and team performance of HPTs	Lack of application of structured interviews, surveys, and longitudinal surveys to judge the effectiveness of the SNA metrics

The analysis done in Table 4.3-3 allows for a number of observations:

- Additional studies need to be conducted in multicultural contexts to better understand the impact of cultural diversity within interorganizational collaboration networks;
- Further exploration is needed to study collaboration networks in the context of multiple project team memberships and consider variables like project/task complexity along with possible associations with knowledge-related factors;
- Studies on integrated project teams and multiteam systems can be seen in the context of IPD (Integrated Project Delivery). Multiple studies (Engebø et al., 2020; Garcia & Mollaoglu, 2020) suggest testing the various models related to knowledge sharing and collaboration networks within different project delivery methods (for e.g., Design-Bid-Build, Design-Build);
- Emphasis needs to be placed on investigating collaboration networks through longitudinal case studies of inter-organizational project teams on complex projects;
- Future research can consider exploring project team network dynamics considering factors like communication modalities, interaction quality, and phase of the project; and
- In order to ensure generalizability of the ever-evolving findings on collaborations networks in AEC project teams, it is essential to test the various project team network models on inter-organizational teams in industries beyond the AEC industry.

4.3.3 Summary

To capture the evolution of research and future research areas for AEC interorganizational project teams, this section covered multiple types of analysis done on the sample of 117 publications based on AEC project teams. The main findings and research trends/propositions can be summarized as follows:

1. The majority of research on AEC interorganizational project teams focuses on single team systems with findings at the project team level.
2. Research on AEC interorganizational project team setups has been limited in examining all three levels of analysis: individual, sub-team and project team levels.
3. Future research should address the exploration of interrelated project networks within AEC interorganizational project teams, particularly at the sub-team level.
4. The majority of the research focused on multiteam systems within AEC interorganizational teams are found in the research domains of IPD Projects and integrated project team collaboration networks.

5. Through citation network analysis of interconnected papers, several potential research areas for AEC interorganizational project teams have emerged. These include learning and knowledge management, integrated project team performance, measurement of trust, perception of virtuality, and psychological factors influencing team dynamics.
6. Within AEC interorganizational project teams, research on virtual project collaboration networks presents future research opportunities for investigating knowledge sharing among project teams, as well as the development of trust and group resilience.
7. Limited studies have examined the measure of team resilience through a facilitation model for building psychological safety in interorganizational setups.
8. Acknowledging the multilevel nature of project teams, future research should explore the dynamics of trust, commitment, and team stability across different levels within the project team structure. Longitudinal studies can provide valuable insights into how these factors evolve over time.
9. To gain a better understanding of the impact of cultural diversity within interorganizational collaboration networks, additional studies need to be conducted in multicultural contexts.
10. Additional research is needed to examine collaboration networks within the context of multiple project team memberships. This investigation should consider variables like project/task complexity and explore potential associations with knowledge-related factors.
11. In order to ensure the generalizability of findings on collaboration networks in AEC project teams, which are continually evolving, it is crucial to test the various project team network models on interorganizational teams in industries beyond the AEC industry.

The key findings and their applications are further discussed in Chapter 5.

Chapter 5 DISCUSSION AND CONCLUSION

5.1 Introduction

In this chapter, the author presents the summary of findings and then discusses their implications and applications in the domain of research on project teams. The author also highlights the research deliverables accomplished in this study. The chapter is concluded by presenting limitations to this study and a recommendation for future studies of a similar nature.

5.2 Summary of Findings

This section talks about the key findings found at two levels of results in the study: (a) state-of-practice for project teams and (b) state-of-practice and future research areas for AEC interorganizational project teams.

State-of-Practice: Project Teams

The main findings and research trends/propositions can be summarized as follows:

1. The most cited publications doing research on **project team** settings lie between the years, 2000 and 2007, and are primarily studying authentic project teams in the fields of R&D and science, psychology, information technology, business management and the AEC industry.
2. Top five author keywords explored the most within **project teams** research are knowledge sharing, trust, knowledge management, innovation, and communication with all of them having their average publication year between 2012 and 2015.
3. Research on **interorganizational project team** settings has received limited attention but show an upward trend in the past decade. It has been explored the most in the AEC industry followed by its limited presence in R&D and Science and Engineering teams.
4. Research on **student teams** has been limited with notable exceptions in courses related to business management and engineering. Therefore, future research should aim to broaden their scope to academic fields related to other industries.
5. Research on **virtual project teams** has limited studies within interorganizational setups and within the spectrum of student teams. Future research should prioritize exploring these settings further.
6. The research gap regarding **virtual project teams** is particularly evident in industries like automotive engineering, non-profits, and environmental engineering.

7. Future investigations on **virtual project teams** can focus on variables related to work engagement, knowledge hiding, psychological safety, task performance, knowledge leadership and team resilience.
8. Analysis of author-based country co-authorship networks highlights the need to enhance global collaborations among researchers studying project team settings in the **AEC industry**.
9. Recent research trends, based on keyword analysis over the past four years, have primarily focused on AEC industry, Business Management, and Information Technology.
10. There is potential for investigating specific research keyword hotspots related to **AEC interorganizational project teams**. Research areas such as collaborative project management and team resilience offer avenues for exploration. Relevant keywords include Team Resilience, Articulating Capacity, Common Knowledge, Psychological Safety, Turnover Intention, Creative Problem Solving, and Work Engagement.

State-of-Practice and Future Research Areas: AEC Interorganizational Project Teams

The main findings and research trends/propositions can be summarized as follows:

1. The majority of research on AEC interorganizational project teams focuses on single team systems with findings at the project team level.
2. Research on AEC interorganizational project team setups has been limited in examining all three levels of analysis: individual, sub-team and project team levels.
3. Future research should address the exploration of interrelated project networks within AEC interorganizational project teams, particularly at the sub-team level.
4. Majority of the research focused on multiteam systems within AEC interorganizational teams are found in the research domains of IPD Projects and integrated project team collaboration networks.
5. Through citation network analysis of interconnected papers, several potential research areas for AEC interorganizational project teams have emerged. These include learning and knowledge management, integrated project team performance, measurement of trust, perception of virtuality, and psychological factors influencing team dynamics.
6. Within AEC interorganizational project teams, research on virtual project collaboration networks presents future research opportunities for investigating knowledge sharing among project teams, as well as the development of trust and group resilience.

7. Limited studies have examined the measure of team resilience through a facilitation model for building psychological safety in interorganizational setups.
8. Acknowledging the multilevel nature of project teams, future research should explore the dynamics of trust, commitment, and team stability across different levels within the project team structure. Longitudinal studies can provide valuable insights into how these factors evolve over time.
9. To gain a better understanding of the impact of cultural diversity within interorganizational collaboration networks, additional studies need to be conducted in multicultural contexts.
10. Additional research is needed to examine collaboration networks within the context of multiple project team memberships. This investigation should consider variables like project/task complexity and explore potential associations with knowledge-related factors.
11. In order to ensure the generalizability of findings on collaboration networks in AEC project teams, which are continually evolving, it is crucial to test the various project team network models on interorganizational teams in industries beyond the AEC industry.

5.3 Discussions

Based on the various findings on research trends and future research areas that emerge through a scoping review performed in this study, this section provides the implications and applications of those findings in the domain of project teams research.

Research on project teams across multiple industries: The literature on project teams has extensively discussed different factors and variables (Caniëls et al., 2019; Kleinsmann & Valkenburg, 2005) that influence project team functioning and success. However, it is important to recognize that these variables can differ across industries due to the unique characteristics of project teams, scale of the project and research focus specific to each industry (Zhou et al., 2017). This study examined a diverse range of industries, including healthcare, information technology, AEC, human resource development etc. as identified in the literature (Carlson et al., 2018; Greetham & Ippolito, 2018; Hansen, 2006; Iorio & Taylor, 2014). The findings emphasize the significant contributions of fields such as *R&D and Science*, *Psychology*, *Information Technology*, *Business Management*, and *AEC* to the understanding of project team settings. However, it is worth noting that multiple industries are underrepresented in the study such as aerospace engineering, biotechnology, digital marketing, food & beverages, media, online gaming, and transportation, highlighting the need for future research expansion in these areas.

Authentic versus Student Project Teams (Future of Workforce Development): Publications studying project teams exhibit a significant variation when considering the nature of the teams involved: authentic teams in the real world or student teams that is the future of workforce (Presler-Marshall et al., 2022; Weeks & Kelsey, 2007). Project team settings in student teams are designed to develop the necessary skills for future professionals and eventually transition into authentic teams. In response to the industry's demand for graduates with strong teamwork skills, educational institutions across disciplines have increasingly incorporated team projects into their curricula (Druskat & Kayes, 2000). The results indicate that the research on these student teams has primarily been explored in courses related to business management and engineering with limited exploration in other areas. Therefore, future research should aim to broaden their scope to academic fields related to other industries. This study also highlights the potential future research areas which can be explored within student team settings which are: *work engagement, turnover intention, task performance, team cohesion* and *team creativity*. The study also found a lack of research in student teams related to virtual team collaborations.

Virtual vs Co-located Project Teams (Advancing virtual collaboration networks): The post-pandemic era has emphasized the importance and continued necessity of virtual team collaborations (Kinnula et al., 2018; Willermark & Pareto, 2020). This study indicates that majority of research on virtual team networks has been prevalent in industries such as AEC, R&D and Science, and Information Technology. This study identified several potential future research areas for virtual team collaborations, which include *work engagement, knowledge hiding, psychological safety, task performance, knowledge leadership*, and *team resilience*. These keywords primarily emerged from research conducted during and after the pandemic, demonstrating the growing challenges faced by virtual teams.

The cut-off date for data collection in this study dates to end of November 2022. The study reveals several noteworthy trends and identifies potential areas for future research. Utilizing evolution of time graphs, the evolution in various categorizations is evident but not all categories exhibit significant trends. However, one category stands out as promising, particularly in light of the growing interest in hybrid project setups: co-located (in person) versus virtual/hybrid project teams.

However, the study points towards a lack of a lot of publications in the final stages related to virtual teams in the dataset from the past year, suggesting that similar studies in the future could shed light on more significant changes in research trends concerning virtual teams in the post-pandemic

world (Willermark & Pareto, 2020). Additionally, the study revealed a lack of research on virtual or hybrid team networks in industries such as automotive engineering, non-profits, and environmental engineering. This insight highlights the reliance of certain industries on face-to-face interactions for project success and could be considered as a key category in similar scoping reviews in the future. To gain deeper insights into this category, future studies can further explore this aspect by incorporating studies published up to 2023. By doing so, researchers can better address the dynamics of in person vs hybrid project teams and add more valuable findings for the evolving field of project teams research.

Future of research on Interorganizational Collaborations and the AEC Industry: As backed by the literature (Caniëls et al., 2019; Jørgensen, 2018), the studies on interorganizational project teams have received limited attention but show an upward trend in the past decade. While several studies have examined interorganizational collaboration networks in the AEC industry, this study indicates that they still remain limited in the broader context of project teams.

The AEC industry comprises intricate interorganizational and interdisciplinary project teams (Korkmaz & Singh, 2012) involving numerous dynamic factors related to project team success. As collaboration networks within these teams exist at different levels within the composition of a single or a multiteam system (Shuffler et al., 2015), this study investigated the levels of analysis covered in research on AEC interorganizational project team settings.

The existing research on AEC interorganizational project teams primarily focuses on single team systems at the project team level, indicating a scarcity of studies on large-scale and complex projects which mostly have multiteam systems in place. Hence, selecting appropriate projects (scale, complexity, and project delivery method) for study on interorganizational project teams becomes crucial to advancing the understanding of project team performance in more complex settings (Campbell et al., 2022). The study notes that while multiteam systems are prevalent in integrated project delivery (IPD) cases, the number of IPD case studies remains limited. This prompts the exploration of whether constructs tested in IPD projects can be applied to design-build (DB) or design-bid-build (DBB) firms handling large-scale projects. The study also reveals that the stage of the construction project can play a crucial factor in determining the research outcomes and hence, stage of project needs to be explored in similar scoping reviews in the future.

As research on interorganizational project teams has revealed the complex nature of the dynamic project networks involved (Engebø et al., 2020; Garcia & Mollaoglu, 2020), this study identified

two potential future research hotspots for AEC interorganizational project teams: *team resilience and stability*, and *project management collaboration networks*. Moreover, with a focus on virtual collaborations within these teams, the study suggests investigating *knowledge sharing among virtual project teams* and studying the *development of trust and group resilience within virtual collaboration networks*. The study also highlights that in order to ensure the generalizability of findings on collaboration networks in AEC project teams, it is crucial to test the various project team network models longitudinally on interorganizational teams in industries beyond the AEC industry. By addressing these research gaps, a deeper understanding of collaboration dynamics in the AEC industry can be achieved, contributing to improved project outcomes and overall success.

5.4 Conclusions

Working towards the main goal of this research, “What is the state of practice for AEC project teams based on the literature and how has project teams research evolved and is connected across domains?” the study achieved its deliverables through a scoping review and multiple citation network analysis methods: The study established and accomplished the following objectives:

1. Explore the trends and evolution of project teams literature differentiated by characteristics such as type of industry, authentic versus student teams, virtual vs co-located teams and organizational vs interorganizational teams.
2. Explore the evolution of prior works within project teams research with a focus to study the state-of-research and future research directions of AEC interorganizational project teams

The sample of 512 publications included in this study covered various industries and a wide range of categories regarding the types of project teams studied in research. In Chapter 4, the study identified several avenues for future research in the field of project teams. The findings were presented through tables and figures, which included figures related to evolution over timelines and citation network analysis. Each network consisted of nodes representing journals, publications, countries, and keywords while the links between them highlighted the collaboration relations.

The proposed future research areas covered specific research propositions for virtual project teams, interorganizational collaborations within virtual project teams, student teams (the future of workforce development), interorganizational collaborations within AEC project teams, and recommendations for industries that promise exploration in future research but are currently underrepresented in the project team literature. Additionally, the study identified potential keywords and specific

research hotspots for future studies focusing on AEC interorganizational project teams. The insights from this study provide guidance for researchers interested in exploring key areas within the field of AEC project teams and offers opportunities to dive deeper into specific research directions. Ultimately, this study aims to serve as a foundation for future investigations into project teams. By summarizing the current state-of-practice of project teams research and providing insights for further development, it is hoped that this research will contribute to the advancement and growth of future studies on project team settings.

5.5 Limitations/ Gaps for Future Research

Although the study has made some interesting inferences, some shortcomings still exist in this study.

1. Since the results and discussions are based on previous research studies, the conclusions should be tested for and validated through empirical studies in the future.
2. Although the comprehensiveness of the selected database has been ensured in this study, additional searches for other databases and additional keyword searches can be added in future studies.
3. While this study looked at multiple categories to explore the evolution of project teams across multiple industries, some categories the future reviews can explore are as follows: geographical location of the projects, project scale, stage of the project (specific to the AEC industry).
4. It should be noted that the analysis of the state of research in this study relied on available visualization tools. While these tools provided valuable insights, there may be other visualization techniques or approaches that could have provided additional perspectives.
5. Furthermore, a potential improvement for future studies would be to advocate for the inclusion of coding for team-related categories as a requirement in major journal sources. This enhancement would facilitate a more comprehensive and standardized approach to conducting scoping reviews, enabling researchers to gain a more holistic understanding of the field.
6. Diving deeper into research related to bibliometric analysis for future areas of study, a meta-analysis can be conducted to gain valuable statistical insights into the impact of treating multiple variables within a research field. While project team research has a long history, it remains a complex and multifaceted subject. By delving deeper into relevant studies

and performing a meta-analysis, we can uncover essential statistical insights regarding the effects of treating multiple variables. Unfortunately, multi-level studies in interorganizational setups are currently scarce. Consequently, the current lack of a specific sample size required for such meta-analysis indicates that the field is not yet fully matured. This, in turn, highlights the need for more comprehensive work in interorganizational studies across various domains, paving the way for metanalytic studies for future advancements.

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APPENDIX A: LIST OF PUBLICATIONS (SAMPLE FOR STUDY)

Table 5.5-1 List of Publications (Sample for Study)

Authors	Title	Year	Cited by
Mathieu J.E., Hollenbeck J.R., Knippenberg D.V., Ilgen D.R.	A century of work teams in the journal of applied psychology	2017	243
Edson M.C.	A Complex Adaptive Systems View of Resilience in a Project Team	2012	36
Liu W.-H., Cross J.A.	A comprehensive model of project team technical performance	2016	36
Badir Y.F., Büchel B., Tucci C.L.	A conceptual framework of the impact of NPD project team and leader empowerment on communication and performance: An alliance case context	2012	36
Kukenberger M.R., Mathieu J.E., Ruddy T.	A Cross-Level Test of Empowerment and Process Influences on Members' Informal Learning and Team Commitment	2015	57
Zhou Y., Cheung C.M., Hsu S.-C.	A dimensional model for describing and differentiating project teams	2017	6
Lumseyfai J.	A Four-Pillared Holistic Model for Improving Performance in Engineering Virtual Project Teams	2020	2
Pirró G., Mastroianni C., Talia D.	A framework for distributed knowledge management: Design and implementation	2010	27
Hans R.T., Mnkanla E.	A framework for improving the recognition of project teams as key stakeholders in information and communication technology projects	2019	4
Chang Y.F., Watada J., Ishii H.	A fuzzy MCDM approach to building a model of high-performance project team - a case study	2012	9
Strnad D., Guid N.	A fuzzy-genetic decision support system for project team formation	2010	59
Hosseini S.M., Akhavan P., Abbasi M.	A knowledge sharing approach for R&D project team formation	2017	3
Haselberger D.	A literature-based framework of performance-related leadership interactions in ICT project teams	2016	4
Keller R.T.	A longitudinal study of the individual characteristics of effective R&D project team leaders	2017	11
Hosseini S.M., Akhavan P.	A model for project team formation in complex engineering projects under uncertainty: A knowledge-sharing approach	2017	12
Alencar L.H., de Almeida A.T.	A model for selecting project team members using multicriteria group decision making	2010	34
Rahmanniyay F., Yu A.J., Seif J.	A multi-objective multi-stage stochastic model for project team formation under uncertainty in time requirements	2019	6

Table 5.5-1 (cont'd)

Rahmanniyay F., Yu A.J.	A multi-objective stochastic programming model for project-oriented human-resource management optimization	2019	11
Killumets E., D'Innocenzo L., Maynard M.T., Mathieu J.E.	A Multilevel Examination of the Impact of Team Interpersonal Processes	2015	8
DeShon R.P., Kozlowski S.W.J., Schmidt A.M., Milner K.R., Wiechmann D.	A multiple-goal, multilevel model of feedback effects on the regulation of individual and team performance	2004	413
Ding Z., Ng F., Li J.	A parallel multiple mediator model of knowledge sharing in architectural design project teams	2014	35
White M.J., Gutierrez A., McLaughlin C., Eziakonwa C., Newman L.S., White M., Thayer B., Davis K., Williams M., Asselin G.	A pilot for understanding interdisciplinary teams in rehabilitation practice	2013	22
Coates G., Duffy A.H.B., Hills W., Whitfield R.I.	A preliminary approach for modelling and planning the composition of engineering project teams	2007	5
Natvig D., Stark N.L.	A project team analysis using Tuckman's model of small-group development	2016	5
Hosseini M.R., Bosch-Sijtsema P., Arashpour M., Chileshe N., Merschbrock C.	A qualitative investigation of perceived impacts of virtuality on effectiveness of hybrid construction project teams	2018	4
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Hewitt B., Walz D.B., McLeod A.	The effect of conflict and knowledge sharing on the information technology project team performance	2020	5
May G.L., Gueldenzoph L.E.	The effect of social style on peer evaluation ratings in project teams	2006	33
Román-Calderón J.P., Aguilar-Barrientos S., Escalante J.E., Barbosa J., Arias Salazar A.	The Effect of Student Work Group Emotional Intelligence on Individual Task Performance in Teams	2021	3
Chiocchio F., Grenier S., O'Neill T.A., Savaria K., Willms J.D.	The effects of collaboration on performance: a multilevel validation in project teams	2012	47
Porter T.W., Lilly B.S.	The effects of conflict, trust, and task commitment on project team performance	1996	136
Contractor N.	The emergence of multidimensional networks	2009	29
Gent L., Parry A.E., Parry M.E.	The high-cooperation hospital project team	1998	7
Collier D.	The human factors of project team decision-making for radioactive waste management	2013	2
Jiang J.J., Klein G., Pick R.A.	The impact of IS department organizational environments upon project team performances	2003	29
Radhakrishnan A., Zaveri J., David D., Davis J.S.	The impact of project team characteristics and client collaboration on project agility and project success: An empirical study	2022	1
Tsai W.-L.	The Impact of Project Teams on CMMI Implementations: a Case Study from an Organizational Culture Perspective	2021	2
Hacker M.	The impact of top performers on project teams	2000	17
Forgues D., Koskela L.	The influence of a collaborative procurement approach using integrated design in construction on project team performance	2009	58

Table 5.5-1 (cont'd)

Zhang L., Cheng J., Wang D.	The influence of informal governance mechanisms on knowledge integration within cross-functional project teams: A social capital perspective	2015	17
Buvik M.P., Tvedt S.D.	The Influence of Project Commitment and Team Commitment on the Relationship between Trust and Knowledge Sharing in Project Teams	2017	43
Mathieu J.E., Goodwin G.F., Heffner T.S., Salas E., Cannon-Bowers J.A.	The influence of shared mental models on team process and performance	2000	1636
Wu Z., Yin B., Ning P.	The Influence of Team Human Capital on Safety Performance of Engineering Project Team: The Mediating Role of Safety Citizenship Behavior	2021	1
Rico R., Alcover C.-M., Sánchez-Manzanares M., Gil F.	The joint relationships of communication behaviors and task interdependence on trust building and change in virtual project teams	2009	32
Rusman E., Van Bruggen J., Sloep P., Valcke M., Koper R.	The mind's eye on personal profiles: A cognitive perspective on profile elements that inform initial trustworthiness assessments and social awareness in virtual project teams	2013	5
Zhang Z., Min M.	The negative consequences of knowledge hiding in NPD project teams: The roles of project work attributes	2019	49
Stephens J.P., Carmeli A.	The positive effect of expressing negative emotions on knowledge creation capability and performance of project teams	2016	56
Wu G.-D.	The relationship between project team dynamic feature, conflict dimension and project success - An empirical research from Shanghai, China	2013	11
Chen J.V., Widjaja A.E., Chen B.	The relationships among environmental turbulence and socio-technical risk factors affecting project risks and performance in NPD project teams	2017	3
Sherstyuk O., Olekh T., Kolesnikova K.	The research on role differentiation as a method of forming the project team	2016	16
Schofield J., Wilson D.C.	The role of capital investment project teams in organisational learning	1995	7
Purvanova R.K.	The Role of Feeling Known for Team Member Outcomes in Project Teams	2013	10
Kwofie T.E., Adinyira E., Fugar F.	Theoretical and practical implications for engendering project team communication effectiveness in mass housing project delivery in Ghana	2017	9
Witte E.H.	Toward a group facilitation technique for project teams	2007	20
Batistič S., Kenda R.	Toward a model of socializing project team members: An integrative approach	2018	16

Table 5.5-1 (cont'd)

Shokory S.M., Suradi N.R.M.	Transformational leadership and its impact on extra-role performance of project team members: The mediating role of work engagement	2018	5
Zhu F., Wang L., Yu M., Müller R., Sun X.	Transformational leadership and project team members' silence: the mediating role of feeling trusted	2019	12
Kabore S.E., Sane S., Abo P.	Transformational leadership and success of international development projects (ID projects): moderating role of the project team size	2021	2
Keller R.T.	Transformational leadership, initiating structure, and substitutes for leadership: A longitudinal study of research and development project team performance	2006	325
Schweiger D.M., Atamer T., Calori R.	Transnational project teams and networks: Making the multinational organization more effective	2003	55
Hankel A.	Transport optimization project team uses DMAIC to improve efficiency, customer satisfaction	2012	2
Olomolaiye A., Egbu C.	Trust and Knowledge Management in the Construction Industry	2005	1
Shazi R., Gillespie N., Steen J.	Trust as a predictor of innovation network ties in project teams	2015	68
Raes E., Kyndt E., Dochy F.	Turning points during the life of student project teams: A qualitative study	2015	2
Stork D., Sapienza A.M.	Uncertainty and equivocality in projects: Managing their implications for the project team	1995	10
Herrera R.F., Mourgues C., Alarcón L.F., Pellicer E.	Understanding Interactions between Design Team Members of Construction Projects Using Social Network Analysis	2020	23
Korzaan M., Harris A.	Understanding Predictors of Over-Optimism in IS Project Teams	2020	2
Culp G., Smith A.	Understanding psychological type to improve project team performance	2001	39
Lungeanu A., Huang Y., Contractor N.S.	Understanding the assembly of interdisciplinary teams and its impact on performance	2014	46
Briner W., Geddes M.	Understanding the big picture: Positioning the project team	1989	2
Hsu S.-C., Weng K.-W., Cui Q., Rand W.	Understanding the complexity of project team member selection through agent-based modeling	2016	42
Weaver S.J., Che X.X., Petersen L.A., Hysong S.J.	Unpacking Care Coordination Through a Multiteam System Lens	2018	27
Lee S., Sawang S.	Unpacking the impact of attachment to project teams on boundary-spanning behaviors	2016	14
McHugh O., Conboy K., Lang M.	Using agile practices to influence motivation within IT project teams	2011	30

Table 5.5-1 (cont'd)

El-Tayeh A., Gil N.	Using digital socialization to support geographically dispersed AEC project teams	2007	17
Petkovic D.	Using Learning Analytics to Assess Capstone Project Teams	2016	9
Kögl S., Silviu G.	Using patterns to capture and transfer tacit knowledge in virtual project teams	2019	3
Stouffs R.	Visualizing information structures and its impact on project teams: An information architecture for the virtual AEC company	2001	7
Morgan Tuuli M., Rowlinson S.	What empowers individuals and teams in project settings? A critical incident analysis	2010	21
Adikaram A.S., Wijayawardena K.	What happens to female employees in skewed IT project teams in Sri Lanka? Revisiting kanter	2015	4
Kamareiy M., Hassanzadeh A., Elahi S.	What Kind of knowledge is concealed by project team members? (case study: Oil industries' commissioning and operation company (OICO))	2018	3
Guo H., Zhang L., Huo X., Xi G.	When and how cognitive conflict benefits cross-functional project team innovation: The importance of knowledge leadership	2019	8
Gorla N., Lam Y.W.	Who should work with whom? Building effective software project teams	2004	185
Henderson L.S., Stackman R.W., Lindekilde R.	Why cultural intelligence matters on global project teams	2018	32
Cummings J., Pletcher C.	Why project networks beat project teams	2011	17
Holmer L.L.	Will we teach leadership or skilled incompetence? The challenge of student project teams	2001	29
Lin T.-C., Huang C.-C.	Withholding effort in knowledge contribution: The role of social exchange and social cognitive on project teams	2010	144
Haffer R., Haffer J., Morrow D.L.	Work Outcomes of Job Crafting Among the Different Ranks of Project Teams	2021	3
Gällstedt M.	Working conditions in projects: Perceptions of stress and motivation among project team members and project managers	2003	82
Zuofa T., Ochieng E.G.	Working separately but together: appraising virtual project team challenges	2017	17
Olaisen J., Revang O.	Working smarter and greener: Collaborative knowledge sharing in virtual global project teams	2017	61
Hansen C.J.	Writing the Project Team: Authority and Intertextuality in a Corporate Setting	1995	16

APPENDIX B: CO-OCCURRENCE TIMELINE NETWORK

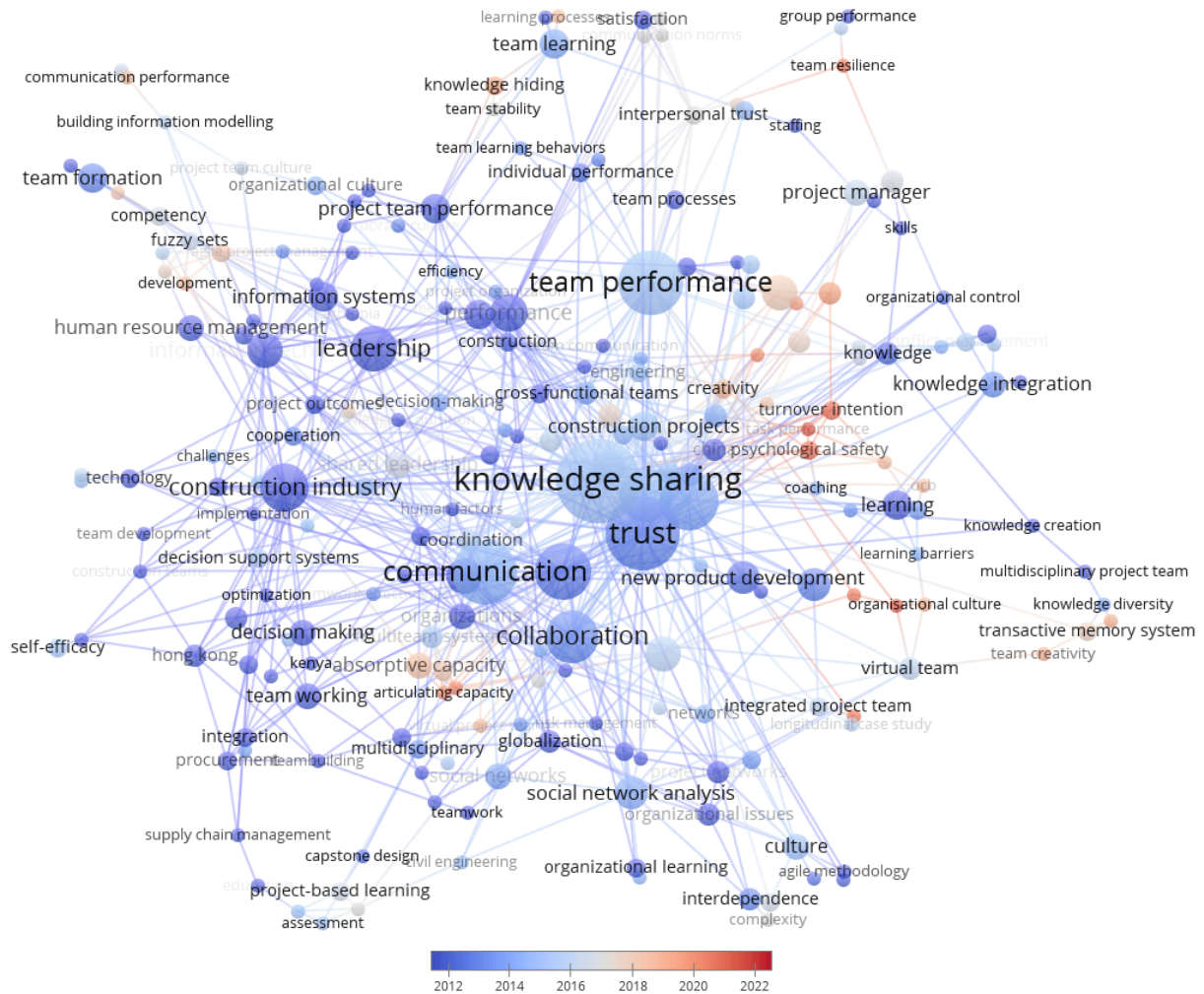


Figure 5.5-1 Co-occurrence Timeline Network

APPENDIX C: LIST OF PUBLICATIONS IN KEYWORD CLUSTERS

Table 5.5-2 List of Publications in Keyword Clusters

Research Cluster	Author	Title	Year
Project Team Performance	Reiter-Palmon R., Leone S.	Facilitating creativity in interdisciplinary design teams using cognitive processes: A review	2019
	Carmeli A., Levi A., Peccei R.	Resilience and creative problem-solving capacities in project teams: A relational view	2021
Knowledge Sharing and its impact on Team Performance	Kamareiy M., Hassanzadeh A., Elahi S.	What Kind of knowledge is concealed by project team members? (case study: Oil industries' commissioning and operation company (OICO))	2018
	Zhang Z., Min M.	The negative consequences of knowledge hiding in NPD project teams: The roles of project work attributes	2019
	Moh'd S.S., Černe M., Zhang P.	An Exploratory Configurational Analysis of Knowledge Hiding Antecedents in Project Teams	2021
Team Effectiveness	Zhang L., Guo H.	Enabling knowledge diversity to benefit cross-functional project teams: Joint roles of knowledge leadership and transactive memory system	2019
	Guo H., Zhang L., Huo X., Xi G.	When and how cognitive conflict benefits cross-functional project team innovation: The importance of knowledge leadership	2019
	Ahiaga-Dagbui D.D., Tokede O., Morrison J., Chirnside A.	Building high-performing and integrated project teams	2020
	Braun M.T., Kozlowski S.W.J., Brown T.A., DeShon R.P.	Exploring the Dynamic Team Cohesion–Performance and Coordination–Performance Relationships of Newly Formed Teams	2020
	Yang Y., Kuria G.N., Gu D.-X.	Mediating Role of Trust Between Leader Communication Style and Subordinate's Work Outcomes in Project Teams	2020

Table 5.5-2 (cont'd)

Team Effectiveness	Liu Y., Keller R.T.	How Psychological Safety Impacts R&D Project Teams' Performance: In a psychologically safe workplace, R&D project teams perform better, more readily share knowledge and engage in organizational citizenship behavior, and are less likely to leave.	2021
	Liu Y., Keller R.T., Bartlett K.R.	Initiative climate, psychological safety and knowledge sharing as predictors of team creativity: A multilevel study of research and development project teams	2021
	Li L., Müller R., Liu B., Wang Q., Wu G., Zhou S.	Horizontal-Leader Identification in Construction Project Teams in China: How Guanxi Impacts Coworkers' Perceived Justice and Turnover Intentions	2021
	Román-Calderón J.P., Aguilar-Barrientos S., Escalante J.E., Barbosa J., Arias Salazar A.	The Effect of Student Work Group Emotional Intelligence on Individual Task Performance in Teams	2021
	Sagar S.K., Arif M., Oladinrin O.T., Rana M.Q.	Challenges negating virtual construction project team performance in the Middle East	2022
Collaborative Project Management	Joseph Garcia A., Mollaoglu S.	Individuals' Capacities to Apply Transferred Knowledge in AEC Project Teams	2020
	Joseph Garcia A., Mollaoglu S.	Measuring Key Knowledge-Related Factors for Individuals in AEC Project Teams	2020
Team Resilience	Karlsen J.T., Berg M.E.	A study of the influence of project managers' signature strengths on project team resilience	2020
	Pavez I., Gómez H., Laulié L., González V.A.	Project team resilience: The effect of group potency and interpersonal trust	2021

APPENDIX D: CITATIONS CLUSTER IDENTIFICATION

Table 5.5-3 List of Publications in Keyword Clusters

Cluster	Authors	Title	Year
1	Di Marco M.K.; Taylor J.E.; Alin P	Emergence and role of cultural boundary spanners in global engineering project networks	2010
1	Chinowsky P.S.; Diekmann J.; O'brien J.	Project organizations as social networks	2010
1	Son J.; Rojas E.M.	Evolution of collaboration in temporary project teams: an agent-based modeling and simulation approach	2011
1	Unsal H.I.; Taylor J.E.	Modeling interfirm dependency: game theoretic simulation to examine the holdup problem in project networks	2011
1	Chinowsky P.; Taylor J.E.; Di Marco M.	Project network interdependency alignment: new approach to assessing project effectiveness	2011
1	Solis F.; Sinfield J.V.; Abraham D.M.	Hybrid approach to the study of inter-organization high performance teams	2013
1	Zhang L.; He J.; Zhou S.	Sharing tacit knowledge for integrated project team flexibility: case study of integrated project delivery	2013
1	Zelkowicz A.; Iorio J.; Taylor J.E.; Via C.E.	Exploring the role of cultural boundary spanners at complex boundaries in global virtual aec networks	2015
1	Han Y.; Li Y.; Taylor J.E.; Zhong J.	Characteristics and evolution of innovative collaboration networks in architecture engineering and construction: study of national prize-winning projects in china	2018
1	Joseph Garcia A.; Mollaoglu S.	Individuals' capacities to apply transferred knowledge in aec project teams	2020
1	Garcia A.J.; Mollaoglu S.	Measuring key knowledge-related factors for individuals in aec project teams	2020
1	Garcia A.J.; Mollaoglu S.; Frank K.A.; Duva M.; Zhao D.	Emergence and evolution of network structures in complex interorganizational project teams	2021
2	Nordqvist S.; Hovmark S.; Zika-Viktorsson A.	Perceived time pressure and social processes in project teams	2004
2	Maurer I.	How to build trust in inter-organizational projects: the impact of project staffing and project rewards on the formation of trust knowledge acquisition and product innovation	2010
2	Ding Z.; Ng F.; Li J.	A parallel multiple mediator model of knowledge sharing in architectural design project teams	2014

Table 5.5-3 (cont'd)

2	Savelsbergh C.M.J.H.; Poell R.F.; Van Der Heijden B.I.J.M.	Does team stability mediate the relationship between leadership and team learning? An empirical study among dutch project teams	2015
2	Buvik M.P.; Rolfsen M.	Prior ties and trust development in project teams - a case study from the construction industry	2015
2	Wen Q.; Qiang M.	Coordination and knowledge sharing in construction project-based organization: a longitudinal structural equation model analysis	2016
2	Hsu S.-C.; Weng K.-W.; Cui Q.; Rand W.	Understanding the complexity of project team member selection through agent-based modeling	2016
2	Buvik M.P.; Tvedt S.D.	The influence of project commitment and team commitment on the relationship between trust and knowledge sharing in project teams	2017
2	Oyedele A.; Owolabi H.A.; Oyedele L.O.; Olawale O.A.	Big data innovation and diffusion in projects teams: towards a conflict prevention culture	2020
2	Ahiaga-Dagbui D.D.; Tokede O.; Morrison J.; Chirnside A.	Building high-performing and integrated project teams	2020
2	Pavez I.; Gómez H.; Lauli L.; González V.A.	Project team resilience: the effect of group potency and interpersonal trust	2021
2	Wei M.; Hao S.; Ren X.	Nonspatial proximity and project team resilience: the role of knowledge sharing and team cohesion	2022
3	Sweeney P.J.; Lee D.R.	Support and commitment factors of project teams	1999
3	Tai S.; Wang Y.; Anumba C.J.	A survey on communications in large-scale construction projects in china	2009
3	Senaratne S.; Hapuarachchi A.	Construction project teams and their development: case studies in sri lanka	2009
3	Senaratne S.; Udawatta N.	Managing intragroup conflicts in construction project teams: case studies in sri lanka	2013
3	Wu G.-D.	The relationship between project team dynamic feature conflict dimension and project success - an empirical research from shanghai china	2013
3	Senaratne S.; Ruwanpura M.	Communication in construction: a management perspective through case studies in sri lanka	2016
3	Reza Hosseini M.; Zavadskas E.K.; Xia B.; Chileshe N.; Mills A.	Communications in hybrid arrangements: case of australian construction project teams	2017
3	Wu G.; Liu C.; Zhao X.; Zuo J.	Investigating the relationship between communication-conflict interaction and project success among construction project teams	2017
3	Wu G.; Zhao X.; Zuo J.	Relationship between project's added value and the trust-conflict interaction among project teams	2017

Table 5.5-3 (cont'd)

3	Rezvani A.; Ashkanasy N.; Khosravi P.	Key attitudes: unlocking the relationships between emotional intelligence and performance in construction projects	2020
3	Zaman U.; Florez-Perez L.; Khwaja M.G.; Abbasi S.; Qureshi M.G.	Exploring the critical nexus between authoritarian leadership project team member's silence and multi-dimensional success in a state-owned mega construction project	2021
4	Ma Z.; Qi L.; Wang K.	Knowledge sharing in chinese construction project teams and its affecting factors: an empirical study	2008
4	Zhikun D.; Fungfai N.	Knowledge sharing among architects in a project design team: an empirical test of theory of reasoned action in china	2009
4	Zhang P.; Ng F.F.	Attitude toward knowledge sharing in construction teams	2012
4	Shi J.; Lin L.; Tang D.	Reciprocal preference-based knowledge sharing incentive of project team	2014
4	Mueller J.	Formal and informal practices of knowledge sharing between project teams and enacted cultural characteristics	2015
4	Ni G.; Cui Q.; Sang L.; Wang W.; Xia D.	Knowledge-sharing culture project-team interaction and knowledge-sharing performance among project members	2018
4	Lin L.; Wang H.	Dynamic incentive model of knowledge sharing in construction project team based on differential game	2019
4	Du Y.; Zhou H.; Yuan Y.; Liu X.	Explore knowledge-sharing strategy and evolutionary mechanism for integrated project team based on evolutionary game model	2019
4	Aljuwaiber A.	Technology-based vs. Face-to-face interaction for knowledge sharing in the project teams	2019
5	Bell B.S.; Kozlowski S.W.J.	A typology of virtual teams: implications for effective leadership	2002
5	El-Tayeh A.; Gil N.	Using digital socialization to support geographically dispersed aec project teams	2007
5	Liu L.; Leitner D.	Simultaneous pursuit of innovation and efficiency in complex engineering projects-a study of the antecedents and impacts of ambidexterity in project teams	2012
5	Sun W.; Mollaoglu S.; Miller V.; Manata B.	Communication behaviors to implement innovations: how do aec teams communicate in ipd projects?	2015
5	Zhou Y.; Cheung C.M.; Hsu S.-C.	A dimensional model for describing and differentiating project teams	2017

Table 5.5-3 (cont'd)

5	Esther Paik J.; Miller V.; Mollaoglu S.; Aaron Sun W.	Interorganizational projects: reexamining innovation implementation via ipd cases	2017
5	Manata B.; Miller V.; Mollaoglu S.; Garcia A.J.	Measuring key communication behaviors in integrated project delivery teams	2018
6	Scott-Young C.; Samson D.	Project success and project team management: evidence from capital projects in the process industries	2008
6	Unger-Aviram E.; Zwikael O.; Restubog S.L.D.	Revisiting goals feedback recognition and performance success: the case of project teams	2013
6	Bourouni A.; Noori S.; Jafari M.	Organizational groupings and performance in project-based organizations: an empirical investigation	2014
6	Sankaran S.; Vaagaasar A.L.; Bekker M.C.	Assignment of project team members to projects: project managers' influence strategies in practice	2020
6	Li L.; Møller R.; Liu B.; Wang Q.; Wu G.; Zhou S.	Horizontal-leader identification in construction project teams in china: how guanxi impacts coworkers' perceived justice and turnover intentions	2021
7	Huber G.	Facilitating project team learning and contributions to organizational knowledge	1999
7	Rahman M.M.; Kumaraswamy M.M.	Assembling integrated project teams for joint risk management	2005
7	Senaratne S.; Malewana C.	Linking individual team and organizational learning in construction project team settings	2011
7	Ling F.Y.Y.; Khoo W.W.	Improving relationships in project teams in malaysia	2016
8	moore d.r.; dainty a.r.j.	Integrated project teams' performance in managing unexpected change events	1999
8	forgues d.; koskela l.	The influence of a collaborative procurement approach using integrated design in construction on project team performance	2009
8	ekström d.; rempling r.; plos m.	Integrated project team performance in early design stages' performance indicators influencing effectiveness in bridge design	2019
9	ochieng e.g.; price a.d.f.	Managing cross-cultural communication in multicultural construction project teams: the case of kenya and uk	2010
9	ding z.; ng f.; wang j.	Testing trust scale measurement invariance in project teams	2014
9	reza hosseini m.; chileshe n.; baroudi b.; zuo j.; mills a.	Factors affecting perceived level of virtuality in hybrid construction project teams (hcpts) a qualitative study	2016

Table 5.5-3 (cont'd)

10	savelsbergh c.; gevers j.m.p.; van der heijden b.i.j.m.; poell r.f.	Team role stress: relationships with team learning and performance in project teams	2012
10	wang l.; lin h.; jiang w.	Effects of project leader workplace anxiety on project team member organizational citizenship behavior: a moderated mediation model	2021