


Task Interdependence in Software Teams: A Systematic Review Anchored in Kiggundu's Theory

Mayara Benício de Barros Souza  [Federal University of Pernambuco, Federal University of Vale do São Francisco | mbbs@cin.ufpe.br]

Fabio Q. B. da Silva  [Federal University of Pernambuco | fabio@cin.ufpe.br]

Abstract

Background: Task interdependence is a core mechanism underlying coordination, performance, and collaboration in team-based work. Kiggundu's task design theory has shaped how interdependence is conceptualized across knowledge-work settings, including Software Engineering (SE). However, there has been no consolidated synthesis of how Kiggundu's theory has been empirically applied, operationalized, and adapted in SE and related domains. **Objectives:** This review aims to (1) systematically synthesize empirical studies that explicitly cite or build on Kiggundu's task interdependence theory; (2) examine how task interdependence is conceptualized and measured in software development contexts; and (3) compare findings across other knowledge-work domains to identify convergent patterns, boundary conditions, and implications for SE research and practice. **Method:** We conducted a systematic literature review using forward snowballing from Kiggundu's foundational publications, identifying 23 eligible empirical studies published between 2013 and 2024. A structured extraction protocol was used to code studies for theoretical framing, conceptualization and measurement of interdependence, analytical role, outcomes, domain, unit of analysis, and methodological characteristics. Open and axial coding supported thematic development, complemented by cross-tabulations and visual mappings to support integrative synthesis. **Results:** Most studies model task interdependence as a predictor or moderator of outcomes such as team performance, learning, coordination, and relational or affective states. In software development, interdependence is frequently conceptualized as a structural and directional feature of work design, often examined in relation to autonomy, coordination mechanisms, and distributed collaboration. Cross-domain evidence reveals both convergent patterns, such as positive associations with effectiveness under supportive conditions, and important boundary conditions shaped by factors including autonomy, social support, task complexity, and role clarity. A smaller but growing set of studies emphasizes perceived (psychological) interdependence and socio-cognitive or affective pathways, particularly in agile and distributed teams. **Conclusions:** The findings indicate that Kiggundu's theory remains a relevant and adaptable framework for analyzing task interdependence in contemporary knowledge work, including software development. The synthesis highlights increasing attention to directionality, perceived interdependence, and emotional-cognitive dimensions, alongside persistent reliance on structural measures. By integrating evidence across domains, this review clarifies how structural task features interact with contextual and psychological factors, and outlines implications for software development practice as well as directions for future empirical research on software teams.

Keywords: Task Interdependence, Software Development, Team Effectiveness, Teamwork, Work Design, Systematic Literature Review, Cross-Domain Synthesis.

1 Introduction

Task interdependence is a foundational construct for understanding how teams coordinate, perform, and collaborate. It captures the degree to which work elements depend on one another across a process, shaping who must interact with whom, when, and how. Classic perspectives frame interdependence both as a work design property, determined by job structure, sequencing, and coordination mechanisms (Thompson, 1967; Hackman & Oldham, 1976), and as an emergent team state that arises through social and cognitive processes (Wageman, 1995; van der Vegt, 1999; Kuthyola *et al.*, 2017).

Kiggundu's (1981, 1983) task interdependence theory positions interdependence squarely within task design by emphasizing that work is organized through activity flows: the completion of one task depends on the timely and appropriate inputs of others. In doing so, the theory addresses a limitation of classical work-design approaches, which tend to

privilege individual job attributes, such as autonomy, while underrepresenting how task relationships generate coordination demands and distinct forms of perceived responsibility. Contemporary research further distinguishes structural interdependence (embedded in workflow and architecture) from perceived interdependence (how tightly individuals experience their reliance on others) (Chin, 2018; Berntzen & Wong, 2019; Yu, Zhao & Zhang, 2023) and highlights directionality (e.g., initiated vs. received dependence) as a theoretically meaningful attribute (Berntzen & Wong, 2021; Wong & van Gils, 2022). These distinctions are central to Kiggundu's framework.

In Software Engineering (SE), interdependence is especially salient. Software development is collaborative, iterative, and cognitively intensive; team effectiveness hinges on developers' ability to coordinate and share knowledge efficiently (Marsicano *et al.*, 2018). Beyond organizational task structures, software projects are saturated with technical interdependencies, among source code modules, architectural

layers, build and deployment tools, and distributed systems (Conway, 1968; Cataldo *et al.*, 2006; Niepce & Molleman, 1998). These dependencies amplify coordination demands and cross-role awareness, making success contingent not only on formal mechanisms but also on how interdependence is perceived and managed in practice (Silva *et al.*, 2016).

Empirical studies document benefits and costs associated with task interdependence, particularly in terms of cooperation, learning, and coordination, but also in terms of increased synchronization demands, coordination effort, and potential tensions in teamwork. On the positive side, higher interdependence can foster cooperation, open communication, cohesion, shared understanding, goal alignment, and commitment (Slocum & Sims, 1980; D'Oliveira & Persico, 2023). Perceived interdependence often stimulates proactive behaviors, such as initiative-taking and knowledge sharing, and supports interdisciplinary collaboration critical to agile and innovative settings (Aubé & Rousseau, 2005). On the challenging side, interdependence increases needs for synchronization, joint decision-making, and coordination overhead, which can introduce role ambiguity, overload, and conflict (Silva *et al.*, 2016; Marsicano *et al.*, 2018). This creates a familiar tension with autonomy: interdependence can enhance collaboration while simultaneously constraining discretion and self-management, with implications for motivation and satisfaction (Janz *et al.*, 1997; Kakar, 2018). In agile teams, the trade-off is pronounced, coordination must scale with dependence while autonomy enables responsiveness and innovation (Hoda *et al.*, 2013).

Interdependence in SE also varies by level and locus. Dependencies span activities in the process, artifacts across the lifecycle, and even sub-components within a single artifact. For example, requirement changes cascade into design modifications (Souza *et al.*, 2003); source-code dependencies follow control and data-flow relations (Podgurski & Clarke, 1989); and the density of dependencies in complex systems raises communication volume and collective decision-making needs (Yuan *et al.*, 2009). Conversely, architectural principles such as loose coupling can mitigate these effects, enabling greater team autonomy and reducing continuous coordination (Andres *et al.*, 2002). Understanding where interdependence originates (workflow vs. architecture vs. perception), how it is directed (initiated/received), and how it is experienced by team members is therefore central to managing SE work effectively.

Although Kiggundu's task interdependence theory offers a theoretically rich and direction-sensitive account of these dynamics, Software Engineering lacks a systematic synthesis of how this framework has been used to theorize, operationalize, and test task interdependence. Prior reviews (Courtright *et al.*, 2015; Liao, 2017; Griffin *et al.*, 2022) survey teamwork constructs at a high level or focus on specific industries, but do not examine how Kiggundu's conceptualization, especially issues of directionality (initiated/received), level of analysis, and measurement choices, has been applied, interpreted, or extended in SE and comparable knowledge-work settings.

This study addresses that gap by systematically reviewing empirical work that cites or builds on Kiggundu's theory of task interdependence. Our goal is to (i) clarify how interdependence is conceptualized and measured; (ii) synthesize its roles and mechanisms in shaping outcomes; and (iii) contrast SE with other knowledge-work domains to extract transferable insights and theoretical refinements with practical implications for software teams. To guide this review, and to keep the synthesis reproducible, theory-driven, and decision-relevant for software engineering, we organize our search, coding, and analysis around three questions:

RQ1: What is the empirical landscape of studies on task interdependence in software development and other knowledge-work domains, covering venue, context/domain, level of analysis, research design/methods, measures, and outcome focus?

Justification. RQ1 establishes the empirical and methodological context in which Kiggundu's theory has been applied. Because the theory originated in job design and organizational psychology but has since traveled across domains, understanding where, how, and at what level it has been empirically studied is necessary to interpret subsequent findings. Rather than serving as a purely descriptive exercise, this mapping provides the foundation for assessing whether observed conceptualizations, measures, and outcomes reflect domain-specific constraints, methodological choices, or theoretical adaptation, particularly in Software Engineering.

RQ2: How is task interdependence conceptualized, operationalized, and measured in empirical studies that cite Kiggundu, considering types (e.g., task, outcome, goal), directionality (initiated/received), structural vs. perceived interdependence, level of analysis, and instrument choices/adaptations?

Justification. RQ2 directly addresses the core theoretical contribution of Kiggundu's framework: the treatment of interdependence as a directional and multidimensional construct embedded in task design and motivational processes. By examining how empirical studies define and measure interdependence, this question assesses the degree to which the original theory is preserved, selectively adapted, or transformed in practice. This analysis responds to concerns about theoretical fidelity and is essential for evaluating whether Software Engineering research leverages the distinctive explanatory power of Kiggundu's theory or collapses it into more generic coordination constructs.

RQ3: What roles does task interdependence play in shaping work outcome and how do these patterns converge or diverge between software development and other knowledge-work contexts?

Justification. RQ3 focuses on the mechanisms and outcomes associated with task interdependence, building on Kiggundu's motivational logic and its predicted asymmetry between initiated and received interdependence. By comparing patterns across Software Engineering and other knowledge-work domains, this question allows us to examine whether the theory's original propositions hold in

sociotechnical contexts characterized by dense technical dependencies, or whether new boundary conditions and adaptations emerge. This comparative perspective directly supports theory refinement and grounds interpretations of observed outcomes in the original theoretical framework.

Together, these questions enable us to (i) map the state of empirical evidence, (ii) clarify constructs and measures, especially directionality and perceived vs. structural interdependence, and (iii) surface mechanisms and boundary conditions that matter for modern software teams. The remainder of the paper details our review protocol (search, screening, extraction, and coding), presents results (descriptive landscape; conceptualization/measurement map; roles and mechanisms), and discusses implications for SE practice and research, limitations, and priorities for future research.

2 Background: Task Interdependence and Kiggundu's Theory

Our investigation builds on a work-design tradition in which task interdependence is treated as a central property of how work is structured and experienced, rather than as a secondary coordination issue. This perspective emerged progressively across the empirical stages of our broader research program, beginning with an exploratory case study that revealed recurring tensions between autonomy, coordination, and responsibility in software teams (Souza, da Silva & Seaman, 2023). These findings motivated a systematic review and the adoption of a theoretical lens capable of explaining not only that interdependence exists, but how different forms of interdependence shape individual experience, coordination demands, and outcomes.

2.1 Work Design and the Place of Interdependence

In the Job Characteristics Model (JCM), Hackman and Oldham (1976) conceptualize work design through core task attributes, skill variety, task identity, task significance, autonomy, and feedback, that influence motivation and performance via three psychological states: experienced meaningfulness, responsibility, and knowledge of results. Within this framework, autonomy is the primary driver of responsibility, while interdependence is largely treated implicitly, as a contextual constraint on individual job design.

Subsequent research in organizational and management studies recognized task interdependence as a key social characteristic of work (Grant & Parker, 2009), emphasizing collaboration requirements, coupling of outcomes, and mutual dependence beyond simple task sequencing (Van der Vegt & Janssen, 2003; De Jong & Bal, 2014). However, many of these approaches conceptualize interdependence either as a structural property of workflows (e.g., pooled, sequential, reciprocal characterized by Thompson (1967) or as a generic coordination requirement, without fully theorizing how directionality, intensity, and functional importance

of dependencies shape individual experience and motivation (Wageman, 1995).

2.2 Kiggundu's Contribution: Directionality and Subdimensions

Kiggundu's Task Interdependence Theory directly addresses these limitations by integrating interdependence into work-design theory as a directional and multidimensional construct. Developed as an extension of the JCM, Kiggundu's theory starts from the premise that classical work-design approaches tend to privilege individual job attributes, such as autonomy, while underrepresenting a structural aspect of work: the way tasks connect individuals through activity flows and generate distinct coordination demands and forms of perceived responsibility.

A central contribution of the theory is the distinction between:

- Initiated task interdependence, when an individual's work affects the work of others; and
- Received task interdependence, when an individual depends on others' work to perform their own tasks.

To characterize these relationships, Kiggundu proposes three subdimensions:

- Scope, capturing the breadth and number of task relationships;
- Resources, referring to the exchange of essential inputs such as information, tools, or instructions; and
- Criticality, indicating how essential the dependency is for task completion and performance.

These dimensions allow task interdependence to be analyzed not merely as "high" or "low," but in terms of both intensity and functional relevance, capturing meaningful variation in how dependencies are experienced in practice.

Empirical tests of the theory showed a systematic asymmetry: initiated task interdependence exhibits motivational potential, being positively associated with responsibility and involvement, whereas received task interdependence tends to have antagonistic effects, correlating negatively with autonomy, involvement, and satisfaction. This asymmetry has been reinforced by later empirical studies, which show that initiated interdependence can heighten responsibility and motivation, while received interdependence often increases coordination effort, role conflict, and perceived constraints (Silva *et al.*, 2016; Marsicano *et al.*, 2018; Yu; Zhao; Zhang, 2023; Wong & Van Gils, 2022).

2.3 Why Kiggundu's Theory?

Several alternative theories (e.g., Grant & Parker, 2009; Courtright *et al.*, 2015) address interdependence at work, including Thompson's classic task interdependence typology, extensions of the JCM, and more recent work-design frameworks. However, these perspectives differ in both level of analysis and explanatory focus. Most treat interdependence as a structural attribute of tasks or teams, or as a background condition influencing coordination, rather than as a

directional construct grounded in activity flows and linked to distinct psychological and motivational mechanisms.

Kiggundu's theory is distinctive in three respects that motivated its adoption in this study. First, it explicitly theorizes directionality, allowing initiated and received interdependence to be examined separately rather than collapsed into a single construct. Second, it embeds interdependence within a motivational logic of work design, connecting task structure to responsibility for one's own outcomes and for the outcomes of others. Third, it offers a conceptual apparatus that is sufficiently abstract to travel across domains, yet concrete enough to be operationalized empirically.

These features make the theory particularly suitable for sociotechnical contexts, such as software development, where technical dependencies, coordination mechanisms, and interpersonal relationships are tightly intertwined.

2.4 Software Teams as a Stress Test for Interdependence Theory

Software engineering represents an especially demanding context for theories of task interdependence. Technical dependencies across code modules, architectural layers, build pipelines, and deployment environments amplify interdependence even when teams deliberately pursue modularity and low coupling (Conway, 1968; Parnas, 1972; Sosa *et al.*, 2002; Cataldo *et al.*, 2006). Organizational structure further imprints on technical architecture, reinforcing the need for alignment between social and technical systems (Conway, 1968; Thompson, 1967).

Empirical research in Software Engineering shows that interdependence interacts with autonomy, shaping satisfaction, role conflict, collaboration, and knowledge sharing (Kakar, 2016, 2018; Barbosa *et al.*, 2017; Marsicano *et al.*, 2018; Lee; Park; Lee, 2020). In distributed and remote work settings, interdependence often intensifies coordination demands, while also catalyzing communication practices that mitigate distance (Herbsleb & Mockus, 2003; Golden & Gajendran, 2018). These dynamics mirror, and in many cases magnify, the mechanisms articulated in Kiggundu's theory, making software teams a stress test for its explanatory power.

2.5 Positioning of the Present Study

Despite its conceptual relevance, Kiggundu's theory has not been examined systematically within the Software Engineering literature. Existing studies adopt its concepts selectively, operationalize interdependence in heterogeneous ways, or combine it with other theoretical perspectives without explicit reflection on their compatibility.

In this context, the present study adopts Kiggundu's theory as its central theoretical reference and contributes by mapping and synthesizing how the theory has been used in empirical research on software development teams and related knowledge-work domains. By examining patterns of conceptualization, measurement, outcomes, and methodological choices, the study seeks not only to consolidate the existing state of the art, but also to clarify gaps,

inconsistencies, and promising directions for future theoretical and empirical advancement in Software Engineering.

3 Review Method

We conducted a Systematic Literature Review (SLR) to identify, analyze, and synthesize empirical studies on task interdependence that explicitly engage with Kiggundu's theory. Rather than relying on traditional keyword-based database queries, we used forward snowballing (Wohlin, 2014) in order to trace how Kiggundu's theoretical framework has been taken up, operationalized, and extended across Software Engineering and other team-based knowledge-work domains.

3.1 Search Strategy and Rationale

Forward snowballing was selected because it enables us to:

- Trace theoretical development that may be missed by keyword searches.
- Capture influential and cross-disciplinary studies that build on Kiggundu's task design theory.
- Increase completeness by following citation chains from a conceptually rich starting point.
- Align the search strategy with our theory-anchored aims, keeping the review focused on studies that explicitly position interdependence in the Kiggundu tradition.

Following Wohlin (2014), we performed forward citation searches starting from two seed papers, defined as the theoretical foundation of task interdependence within the work-design tradition:

- Kiggundu, M. N. (1981). Task interdependence and the theory of job design. *The Academy of Management Review*, 6:499–508.
- Kiggundu, M. N. (1983). Task interdependence and job design: Test of a theory. *Organizational Behavior and Human Performance*, 31:145–172.

Citation searches based on these seed papers were conducted in four academic databases: Google Scholar, Scopus, Web of Science, and Emerald Publishing. These databases were selected due to their interdisciplinary coverage and their support for citation-based search mechanisms capable of retrieving studies that explicitly reference Kiggundu's work. This strategy ensured that the search captured empirical studies that engage directly with the theory, including work published outside traditional Software Engineering venues.

To ensure the timeliness and relevance of the synthesis, only studies published between 2013 and 2024 were considered.

3.2 Inclusion and Exclusion Criteria

Studies were included if they:

1. Explicitly addressed task interdependence in the context of work design, software engineering, or other team-based knowledge-work domains.

2. Presented empirical data (quantitative, qualitative, or mixed methods) or offered substantial theoretical contributions.
3. Provided insights into the conceptualization, measurement, or role of task interdependence.
4. Explicitly cited at least one of Kiggundu's seminal works.

Studies were excluded if they:

1. Were duplicated across databases.
2. Did not align with the objectives of the review.
3. Mentioned interdependence only superficially or in a manner disconnected from Kiggundu's theoretical framework.
4. Reported incomplete or insufficient empirical results.

3.2.1 Quality Assessment Strategy

This review adopts a theory-oriented and configurative synthesis approach, rather than an aggregative or effectiveness-focused one. Accordingly, we did not apply a formal quality scoring or numerical exclusion scheme. Formal quality appraisal is essential in effectiveness reviews that aggregate effect sizes or compare intervention outcomes, as methodological weaknesses may bias pooled results. In contrast, theory-building and interpretive reviews aim to synthesize how concepts are conceptualized, operationalized, and used across empirical studies, prioritizing conceptual contribution, analytical transparency, and theoretical diversity over statistical aggregation (Dixon-Woods *et al.*, 2005; Grant & Booth, 2009; Booth, Sutton, Papaioannou, 2016). Consistent with recommended practice for interpretive and thematic synthesis in Software Engineering and related fields (Kitchenham *et al.*, 2009; Cruzes & Dybå, 2011), rigor in this review is ensured through explicit inclusion criteria, transparent reporting of study characteristics and methods, and systematic coding and analysis procedures.

3.3 Study Selection Procedure and Flow

The selection of primary studies followed a structured five-stage process, adapted from Kitchenham and Charters (2007):

1. Identification (forward snowballing): Compile citing records from the four sources and deduplicate.
2. Title/Keyword screening: Remove clearly irrelevant items using the inclusion criteria.
3. Abstract review: Assess conceptual relevance and the presence of interdependence tied to Kiggundu's framing.
4. Introduction/Conclusion scan: Verify theoretical anchoring and relevance to team-based interdependence.
5. Full-text review: Confirm eligibility and classify Primary Studies (PS).

Citation searches yielded 652 records across the four databases (538 from Google Scholar, 50 from Web of Science, 32 from Emerald Publishing, and 32 from Scopus). After deduplication and title/keyword screening, 124 studies were

retained for abstract review. Abstract screening resulted in 96 studies, of which 38 advanced to the analysis of introductions and conclusions. Following full-text reading and final eligibility assessment, 23 studies met the inclusion criteria and were retained as primary studies for synthesis.

Of these 23 studies, 16 (69.6%) were identified through Google Scholar, 4 (17.4%) through Scopus, 2 (8.7%) through Emerald Publishing, and 1 (4.3%) through Web of Science. The lower representation of some databases in the final set is primarily attributable to duplicate removal and the application of conceptual relevance criteria. The selection of primary studies is summarized in Table 1.

The review process was conducted primarily by the first author, who carried out the search, screening, selection, and data extraction procedures. The second author independently reviewed the entire process, checking for consistency, completeness, and adherence to the protocol. Any ambiguities or discrepancies were discussed and resolved jointly. In particular, abstract and full-text screening were conducted by the first author and subsequently reviewed by the second author to check for consistency and completeness.

3.4 Data Extraction and Synthesis

For each primary study, we applied a structured extraction protocol to collect information on:

- Study objectives and hypotheses;
- Theoretical frameworks;
- Definitions and conceptualization of interdependence;
- Application domain and level of analysis;
- Study design, methods, and instruments;
- Outcome variables and the reported role of interdependence; and
- Contribution type (theoretical, methodological, empirical).

Table 2 illustrates the application of the data extraction protocol using an example of a data extraction form based on the primary study PS1.

Data extraction and coding were supported using structured spreadsheets in Google Sheets to record extracted variables and coding decisions across studies. Qualitative coding and cross-tabulation were performed using MaxQDA Version Pro 12, allowing close engagement with the primary studies and iterative refinement of categories.

Data synthesis was conducted using qualitative thematic analysis, combining open and axial coding (Strauss & Corbin, 1998). Coding was performed iteratively by the first author, with categories refined through cross-study comparison. The emerging thematic structure, category definitions, and interpretations were discussed with the second author, contributing to interpretive validation of the results. Coding proceeded iteratively until no new categories emerged from cross-study comparison, indicating thematic saturation. Any ambiguities or disagreements in coding or category definitions were resolved through discussion between the authors.

The thematic categorization was guided by conceptual criteria derived from the literature on work design and task interdependence, particularly Kiggundu (1981, 1983), Hackman and Oldham (1976), and Morgeson and Humphrey (2006). A categorization matrix and multiple cross-tabulations were used to structure the synthesis, and visualizations supported cross-domain comparisons, with particular attention to contrasts between Software Engineering and other knowledge-work domains.

Overall, this review method ensures that the synthesis is theory-driven, transparent, and analytically comparable across domains, providing a systematic map of how task interdependence has been conceptualized, measured, and related to outcomes in research relevant to Software Engineering practice and theory.

Table 1. Selection of primary studies using forward snowballing

Databases	Identification	Title/ Keyword	Abstract	Introduction/Conclusion			Full-text	
				Not relevant	Repeated/ duplicated	Included	Not relevant	PS
Google Scholar	538	77	59	18	12	29	13	16
Emerald	32	11	8	-	5	3	1	2
Scopus	32	20	16	4	7	5	1	4
Web of Science	50	16	13	1	11	1	-	1
Total	652	124	96	23	35	38	15	23

Table 2. Example of the Application of the Data Extraction Protocol

Dimension	Description
Study ID	PS1
Study objectives	To investigate how task interdependence, outcome interdependence, and autonomy affect team reflexivity in software development teams.
Study hypotheses	H1: Autonomy increases team reflexivity; H2: Task interdependence increases team reflexivity; H3: Outcome interdependence increases team reflexivity; H4: Outcome interdependence moderates the combined impacts of task interdependence and autonomy on reflexivity such that, when the outcome interdependence is high, the effects will be synergistic and, when the outcome interdependence is low, the effects will be antagonistic; H5: Plan-driven methods are lower in autonomy, task interdependence, and outcome interdependence than agile methods, and its team members, therefore, demonstrate lower reflexivity.
Theoretical frameworks	Work design theory (Hackman & Oldham, 1976), Task interdependence theory (Kiggundu, 1981, 1983), Organizational behavior literature on reflexivity and interdependence (West, 1996, 2000).
Definitions and conceptualizations of task interdependence	The degree to which team members depend on one another to perform their own tasks, reflecting a structural characteristic of work design. Interdependence is described as the operational dependence between activities, in which effective task execution requires inputs, information, or actions from other members, thereby generating demands for coordination and alignment.
Application domain and level of analysis	Software development (academic-industry collaborative projects); Team Level.
Study design, methods, and instruments	Pen-and-paper survey administered post-project; independent and dependent variables measured in two rounds; Quantitative, empirical survey study; Scales adapted from Kiggundu (1983), Pearce & Gregersen (1991), van der Vegt, Emans & van de Vliert (1998), Hackman & Oldham (1974), Hoegl & Parbooteah (2006).
Outcome variables and the reported role of interdependence	Autonomy, Task Interdependence (Initiated), Outcome Interdependence, Team Reflexivity. Task interdependence is reported as an antecedent of team reflexive processes, increasing demands for coordination and information exchange and, on its own, exerting a direct positive effect on reflexivity. However, its role is not limited to this direct effect: interdependence also plays a moderating role by interacting with autonomy and outcome interdependence and may assume either a synergistic or antagonistic role. Specifically, task interdependence contributes to higher reflexivity when it is

aligned with compatible levels of autonomy and outcome interdependence; when such alignment is absent, it may reduce the effectiveness of autonomy and hinder collective reflection.

Type of contribution Empirical

4 Results

The results are organized to reflect the analytical progression of the research questions: from the empirical landscape (RQ1) to conceptualization and measurement (RQ2), and finally to roles, mechanisms, and cross-domain comparisons (RQ3).

4.1 Empirical Landscape of Task Interdependence Research (RQ1)

This section addresses RQ1 by characterizing the empirical landscape of studies that explicitly engage with Kiggundu's

task interdependence theory. Rather than serving as a purely descriptive “demographic” overview, this analysis establishes the contextual foundation required to interpret subsequent findings on conceptualization, measurement, and outcome mechanisms. Specifically, it clarifies where, when, in which domains, and using which methodological approaches Kiggundu's theory has been mobilized over the last decade. The corpus comprises 23 primary studies published between 2013 and 2024 that explicitly cite or build on Kiggundu's (1981, 1983) work. Table 3 provides an overview of the included studies, including authorship, year, application domain, and methodological approach (see also Appendix A).

Table 3. Summary of Primary Studies

ID	Author(s)	Year	Domain/Industry	Method type
PS1	Kakar	2016	Software Development	Empirical, quantitative (survey)
PS2	Riasudeen, Srinivasan & Venkatesakumar	2014	IT/ITES	Empirical, quantitative (survey)
PS3	Barbosa <i>et al.</i>	2017	Software Engineering	Empirical, quantitative (survey)
PS4	Souza, da Silva & Seaman	2023	Software Development (Financial)	Empirical, qualitative case study
PS5	Barbosa <i>et al.</i>	2017a	Software Development (Public Sector)	Empirical, qualitative research
PS6	Kakar	2018	Software Development	Empirical, quantitative (survey)
PS7	Wong & van Gils	2022	Distributed agile teams in engineering, software, and consulting sectors (Norway, Asia, Europe)	Empirical, quantitative (survey)
PS8	Marsicano <i>et al.</i>	2018	Software Development (Agile Teams)	Empirical, qualitative case study
PS9	Lin	2015	Technology Industry (Taiwan)	Empirical, quantitative (survey)
PS10	Hsu	2018	Consumer Electronics Engineering Design (Greater China)	Empirical, mixed-method (quantitative and qualitative)
PS11	Golden & Gajendran	2018	General industry, Telecommuting context (USA)	Empirical, quantitative (survey)
PS12	Liao	2017	General industry (Virtual Teams)	Theoretical (Literature Review & Model Development)
PS13	Moussa, Bright & Varua	2017	Knowledge-intensive industries (broadly defined)	Theoretical (Literature review and conceptual analysis)
PS14	Griffin <i>et al.</i>	2022	General (organizational workgroups and teams)	Theoretical and methodological
PS15	Hsu	2017	Consumer Electronics, Engineering Design Teams (Taiwan)	Mixed-method (quantitative and qualitative)
PS16	Lee, Park & Lee	2020	Information Systems Development (ISD) Projects (South Korea)	Empirical, quantitative (structural equation modeling)
PS17	Černe <i>et al.</i>	2017	Manufacturing (Slovenia)	Empirical, multilevel quantitative (Hierarchical Linear Modeling)
PS18	Berntzen & Wong	2021	Distributed teams (IS, software development, e-commerce)	Empirical, quantitative (Multilevel modeling)

PS19	Yu, Zhao & Zhang	2013	Real estate company in China (property rental and sales)	Empirical, quantitative (survey)
PS20	Chin	2018	Controlled lab experiment (students at U.S. colleges)	Empirical, quantitative (lab experiment)
PS21	Berntzen & Wong	2019	Distributed work teams (Norwegian organizations)	Empirical, quantitative (multilevel modeling)
PS22	Uruthirapathy & Grant	2015	Public sector IT Shared Services Organization (Canada)	Empirical, quantitative (survey)
PS23	Sarich, Kiffin-Petersen & Soutar	2023	Service sector workforce (Australia)	Empirical, quantitative (structural equation modeling and MANCOVA)

4.1.1 Publication Venues and Temporal Distribution

Figure 1 presents the temporal distribution of the 23 primary studies. Publications appear intermittently over the review period, with notable concentrations in 2017, 2018, and 2023. These peaks suggest periods of heightened scholarly attention to task interdependence, potentially reflecting the maturation of related research streams or increased interest in coordination and collaboration issues across knowledge-work domains.

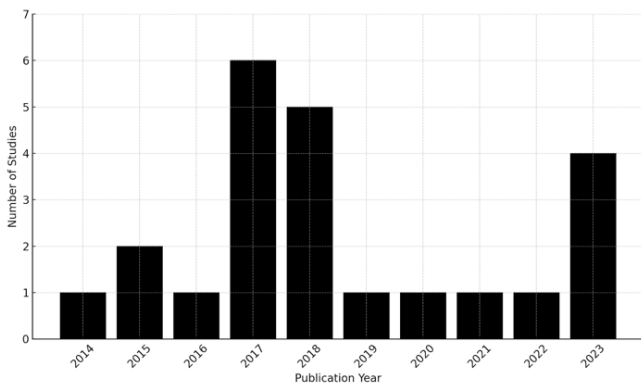


Figure 1. Temporal Distribution of Primary Studies

Conversely, years with sparse or no publications indicate temporal gaps that may be associated with shifts in research priorities or external constraints on empirical work (e.g., disruptions caused by the COVID-19 pandemic). Importantly, the temporal spread indicates that engagement with Kiggundu’s theory has been sustained but episodic, rather than continuous, underscoring the value of synthesizing how the theory has been selectively revisited and adapted over time.

4.1.2 Domains and Levels of Analysis

To examine where Kiggundu’s theory has been applied, we categorized the studies into five domain groups using open and axial coding, based on both the organizational context and the nature of the work performed (Table 4):

Domain/Industry	Primary Studies
Software and IT	PS1, PS2, PS3, PS4, PS5, PS6, PS8, PS9, PS16, PS18, PS21
Engineering and Design	PS10, PS15
Public Sector, Healthcare and Education	PS20, PS22
Sales, Marketing and Customer	PS19
General/Non-specified Knowledge Work	PS7, PS11, PS12, PS13, PS14, PS17, PS23

Figure 2 jointly maps domains and publication years, enabling a simultaneous view of contextual focus and historical distribution. This joint representation enables a simultaneous understanding of both the organizational contexts and historical periods in which the theory was most frequently applied, facilitating the identification of usage patterns over the past decade.

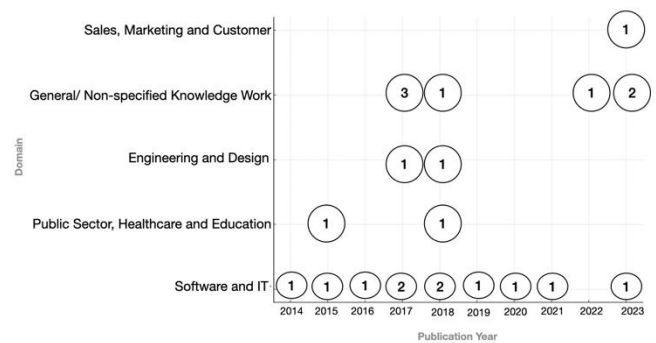


Figure 2. Distribution of Studies by Year and Domain/Industry

The analysis reveals a concentration of studies in the Software and IT domain (11 studies), distributed across multiple years. This pattern aligns with the field’s interest in understanding how task interdependence affects performance, coordination, and collaboration in software development teams, an environment characterized by complex and highly interdependent tasks (Kakar, 2018; Capretz, 2003; Conboy & Morgan, 2010; Niepce & Molleman, 1998; Hernaus & Vokic, 2014).

Table 4. Categorization of Domain/Industry

4.1.3 Research Designs, Methods, and Data

Sources

To support methodological comparison, we consolidated the original method labels into four higher-order categories: **Quantitative Empirical**, **Qualitative Empirical**, **Mixed-Method Empirical**, and **Theoretical/Conceptual** (Table 5), and plot their temporal evolution (Figure 3) and distribution across domains (Figure 4). Together, these mappings establish the scope and heterogeneity of the evidence base and set up the cross-domain and methodological comparisons that follow.

Table 5. Categorization of Research Methods

Method Category	Primary Studies	Data Collection Techniques
Quantitative Empirical	PS1, PS2, PS3, PS6, PS7, PS9, PS11, PS16, PS17, PS18, PS19, PS20, PS21, PS22, PS23	Quantitative questionnaires (surveys)
Qualitative Empirical	PS4, PS5, PS8	Interviews and document analysis
Mixed-Method Empirical	PS10, PS15	Questionnaires and Interviews
Theoretical/Conceptual	PS12, PS13, PS14	N.A.

We then linked the year of publication to the classification of research methods used in the primary studies (Figure 3). Quantitative empirical studies are present consistently throughout the entire time span, from 2013 to 2024, indicating a sustained preference for this method. In contrast, studies employing other research methods, such as qualitative, mixed-method, and theoretical/conceptual approaches, appear only in specific years, namely 2017, 2018, and 2023. This pattern suggests that while quantitative approaches have dominated the field, alternative methodological perspectives have emerged more sporadically.

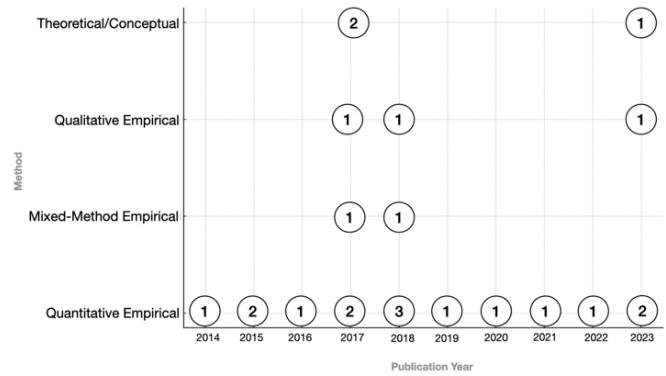


Figure 3. Distribution of Studies by Research Method

Figure 4 presents a cross-mapping of research methods and domain/industry. This visualization highlights the diversity and concentration of methodological approaches within each domain. Notably, the Software and IT and Engineering and Design domains exhibit a broader methodological spectrum, including both quantitative and qualitative empirical studies. This diversity likely reflects the complex, socio-technical nature of work in these fields, where human factors, collaboration dynamics, and technological interdependencies are frequently explored using in-depth qualitative or mixed-method approaches alongside statistical analyses.

In contrast, studies in the **Public Sector, Healthcare, Education**, and **Sales/Marketing and Customer** domains are exclusively quantitative within the reviewed corpus. Rather than interpreting this pattern as methodological superiority or deficiency, it suggests domain-specific research traditions and publication norms that favor generalizable, survey-based evidence.

Overall, this methodological mapping establishes the **scope, heterogeneity, and limitations of the existing evidence base**, providing essential context for interpreting how task interdependence is conceptualized (RQ2) and how it functions in shaping outcomes across domains (RQ3).

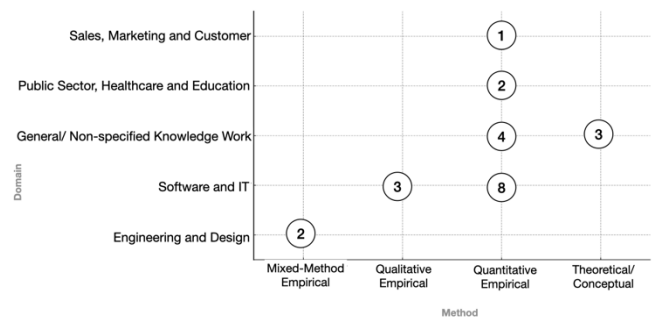


Figure 4. Distribution of Research Methods by Domain/Industry

4.2 Conceptualization and Measurement of Task Interdependence (RQ2)

This section addresses **RQ2** by examining how task interdependence has been **conceptualized, operationalized, and measured** in empirical studies that cite or build on Kiggundu’s theory. The analysis focuses explicitly on whether, and how, Kiggundu’s **directional and multidimensional framework** is preserved, adapted, or transformed across domains. By doing so, this section provides the conceptual and methodological basis required to interpret differences in empirical findings and theoretical claims across the reviewed literature.

4.2.1 Types of Interdependence and Conceptual Nuances

The primary studies exhibit substantial diversity in how task interdependence is defined and theorized, reflecting different analytical priorities and theoretical influences. Based on recurring conceptual patterns observed in the definitions and uses of the construct, we organized these approaches into **five conceptual categories**, using open and axial coding.

The first category, **Directional Interdependence**, derives directly from Kiggundu’s (1981, 1983) theory and explicitly distinguishes between **initiated** and **received** task interdependence. Studies in this category preserve the theory’s core emphasis on workflow directionality and asymmetric responsibility relations.

The remaining four categories were **inductively derived from the primary studies**, reflecting systematic departures from, or extensions of, Kiggundu’s original formulation:

- **Psychological or Perceptual States**, which conceptualize interdependence as a subjective experience constructed from individuals’ or teams’ perceptions of mutual dependence;
- **Cooperative Team Processes**, which emphasize interdependence as an emergent, relational process grounded in collaborative behaviors rather than task structure alone;
- **Outcome-Based Interdependence**, which defines interdependence in terms of shared goals or collective responsibility for outcomes;
- **Composite Interdependence**, which integrates directional, perceptual, and cooperative elements into a multidimensional construct.

Although only the Directional Interdependence category directly reflects Kiggundu’s original framework, the inductively derived categories reveal how subsequent research has selectively adapted or recombined elements of task interdependence to address domain-specific concerns. Table 6 summarizes the distribution of primary studies across these conceptual categories.

Table 6. Conceptual Categories

Conceptual Categories	Primary Studies
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Directional Interdependence	PS1, PS3, PS6, PS18, PS20, PS21
Composite Interdependence	PS2, PS4, PS5, PS7, PS8, PS14, PS16, PS19, PS22
Psychological/Perceptual States	PS9, PS13, PS17, PS23
Cooperative Team Processes	PS10, PS11, PS15
Outcome-Based Interdependence	PS12

4.2.2 Measurement Instruments and Adaptations

We next examined how task interdependence was **measured** in the primary studies, focusing on both the **type of instrument** used and the **treatment of directionality** in measurement. Four categories of instruments were identified (Table 7).

Table 7. Categorization of Instrument Type

Type of Instrument	Primary Studies
Standardized Scale	PS2, PS6, PS7, PS9, PS11, PS13, PS16, PS17, PS21
Adapted Scale	PS1, PS3, PS18, PS19, PS20, PS22, PS23
Qualitative Protocol	PS4, PS5, PS8, PS12, PS14
Mixed Instruments	PS10, PS15

Standardized scales, used in 9 studies, are generally based on the Work Design Questionnaire (WDQ) by Morgeson and Humphrey (2006) or on scales defined in the work of Kiggundu (1983). Their use signals an effort to align with widely recognized models and strong empirical validation.

Adapted scales, applied in 7 studies, reflect an effort to contextualize original instruments for specific domains (such as software, public sector, or services). Adaptations may include changes to items, instructions, or the structure of the questionnaire to enhance fit with the empirical setting.

Qualitative protocols, employed in 5 studies, consist predominantly of semi-structured interviews or interview guides based on Kiggundu’s theory. These instruments emphasize contextual and subjective understanding of interdependence and are common in case studies, exploratory research, and theoretical approaches. They are particularly valuable for capturing relational, emotional, and informal aspects of interdependence that are unlikely to be detected through quantitative instruments.

Mixed instruments, used in 2 studies, combine structured scales with interviews, integrating quantitative and qualitative methods in a complementary approach.

Beyond instrument type, we examined whether studies preserved Kiggundu’s emphasis on **directionality** in measurement (Table 8). Two measurement approaches were identified:

- **Directional measurement**, which explicitly distinguishes initiated and received interdependence.
- **One-dimensional measurement**, which treats interdependence as a single undifferentiated construct.

Table 8. Categorization of the Directionality of Measurement

Directionality of Measurement	Primary Studies
Directional (initiated and received)	PS1, PS3, PS4, PS5, PS6, PS8, PS14, PS18, PS19, PS21, PS22
One-dimensional	PS2, PS7, PS9, PS10, PS11, PS12, PS13, PS15, PS16, PS17, PS20, PS23

Eleven studies preserve directional measurement, allowing asymmetries in responsibility and dependency to be examined explicitly. Twelve studies, however, operationalize interdependence as a one-dimensional variable, potentially obscuring distinctions that are central to Kiggundu’s theory. This split highlights a key methodological and theoretical divergence in the literature, with important implications for how empirical results are interpreted and compared across domains.

4.3 Roles and Mechanisms of Task Interdependence in Work Outcomes (RQ3)

This section addresses **RQ3** by examining the roles task interdependence plays in shaping work outcomes across the reviewed studies, with particular attention to the **mechanisms through which interdependence operates** and to **cross-domain patterns**. Rather than treating interdependence as a uniformly positive or negative condition, the analysis focuses on how different forms of interdependence, especially initiated versus received, are associated with distinct outcome profiles depending on context, role configuration, and coordination demands.

To support this analysis, we first identify the **outcome variables** examined in the primary studies and organize them into thematically coherent outcome categories (Section 4.3.1). We then examine how task interdependence is positioned within empirical models, as a predictor, moderator, emergent construct, or component of broader mechanisms (Section 4.3.2). Finally, we compare patterns across domains to identify convergences and divergences in how interdependence influences work dynamics in different organizational contexts (Sections 4.3.3 and 4.3.4).

This progression enables a structured examination of **what outcomes are associated with task interdependence, how these associations are theorized and modeled, and under what conditions they vary**, directly reflecting Kiggundu’s emphasis on directionality, responsibility, and coordination mechanisms.

4.3.1 Outcome Themes and Dependent Variables

We begin by examining the **outcome variables** investigated in the primary studies. For each study, we extracted the variables explicitly linked to task interdependence, as reported in the empirical analyses (Table 9).

Table 9. Variables Related to Work Outcomes

Primary Studies	Variable Studied
PS1	Autonomy, Task Interdependence (Initiated), Outcome Interdependence, Team Reflexivity
PS2	Task Characteristics (including Interdependence), Task Process, Task Structure, Burnout
PS3	Autonomy, Initiated Interdependence, Received Interdependence, Stress
PS4	Perceptions of Task Interdependence (Initiated and Received), Autonomy, task variety, interpersonal relationships, collective task synchronization, work specialization, anxiety, distress, work underload
PS5	Initiated and Received Interdependence; Trust
PS6	Autonomy, Task Interdependence (Initiated and Received), Outcome Interdependence, Team Cohesion
PS7	Initiated and Received Task Interdependence, Role Clarity (Self and Others), Team Performance
PS8	Initiated and Received Task Interdependence, Team Performance, Mediating Constructs (Information Sharing, Synchronization, Mutual Help, etc.)
PS9	Teamwork Interdependence, Team Planning, Team Identity, Emotional Intelligence, Goal Commitment, Team Performance
PS10	Task Interdependence Types, Team Conflict Types, Cooperation Types, Loyalty Dimensions, Work Values
PS11	Telecommuting extent, Job Complexity, Problem Solving, Interdependence, Social Support, Job Performance
PS12	Task Interdependence, Virtuality, Leadership Behaviors (task-oriented and relationship-oriented), Team Processes and States
PS13	Task Interdependence (Initiated and Received), Work Design Features, Knowledge Worker Productivity, Organizational Context, Knowledge Sharing, Role-Breadth Self-Efficacy, Well-Being
PS14	Types of Interdependence (Input, Process, Outcome, Cognitive), SDI (Standardized Dependency Index), Network Metrics
PS15	Task Interdependence Types, Team Conflict, Team Cooperation, Loyalty, Work Values
PS16	Task Interdependence, Social Capital (Trust, Shared Vision, Network Ties), Knowledge Sharing, Project Performance

PS17	Knowledge Hiding, Mastery Climate, Task Interdependence, Decision Autonomy, Innovative Work Behavior
PS18	Initiated Task Interdependence, Received Task Interdependence, Team Self-Management, Team Coordination, Distributed Teams, Electronic Communication
PS19	Autonomy, Motivation, Responsibility, Task Interdependence, Initiated Task Interdependence, Received Task Interdependence, Self-Esteem, Trust
PS20	Coordination, Responsibility, Task Interdependence, Work Value, Synchronization, Communication, Interaction, Social Relationships
PS21	Task Interdependence, Initiated Task Interdependence, Received Task Interdependence, Coordination, Self-Management
PS22	Autonomy, Job Satisfaction, Motivation, Social Support, Task Interdependence, Task Variety
PS23	Autonomy, Task Interdependence, Work Design

Proactive & Innovative Behavior	PS16, PS17, PS19, PS23
Work Attitudes & Intentions	PS9, PS13, PS22

4.3.1.1 Outcome Themes Overview

Across the reviewed literature, **Cognitive Learning and Social and Relational Outcomes** are the most frequently examined themes, each appearing in eight studies. This pattern indicates that empirical research has focused not only on performance-related consequences of interdependence, but also on its **cognitive and social implications**, consistent with Kiggundu’s original emphasis on responsibility, awareness of others’ work, and coordination demands.

- **Cognitive Learning:** Studies in this category examine variables related to knowledge processing and integration in interdependent settings, including collective learning, role clarity (both self and others), task significance, and the development of cognitive skills. The findings consistently suggest that interdependence, particularly initiated interdependence, expands learning opportunities by requiring individuals to understand not only their own tasks but also how their work affects others. This aligns with Kiggundu’s proposition that initiated interdependence enhances responsibility and reflexivity, fostering deeper cognitive engagement with work.
- **Social and Relational Outcomes:** This theme includes variables such as interpersonal trust, social support, job satisfaction, and intrinsic motivation. The studies highlight how interdependence shapes interpersonal bonds and contributes to the development of social capital within teams. Higher levels of interdependence often require increased transparency, availability, and mutual responsiveness, which can strengthen trust and collaboration. However, several studies also report tensions arising from asymmetries in perceived dependence, suggesting that when received interdependence is high and not reciprocated, relational strain and negative affect may emerge.
- **Team Performance and Coordination:** Six studies focus on performance-related outcomes, including operational efficiency, task synchronization, conflict resolution, and goal alignment. These studies typically adopt an organizational or project-level perspective and emphasize the role of interdependence in shaping both formal and informal coordination mechanisms. A recurring concern is how interdependence interacts with autonomy: when coordination demands increase without corresponding discretion or clarity, managerial complexity and coordination overhead intensify.
- **Affective States:** Four studies address affective outcomes such as stress, anxiety, frustration, and affective engagement. The findings suggest that interdependence can have ambivalent emotional effects. In

The identified variables were then analyzed based on their conceptual content and grouped into **six major outcome themes** using open and axial coding guided by established literature work design and task interdependence, particularly Kiggundu (1981, 1983), Hackman and Oldham (1976), and Morgeson and Humphrey (2006).

The six outcome themes identified are:

1. **Team Performance and Coordination**
2. **Cognitive Learning**
3. **Social and Relational Outcomes**
4. **Affective States**
5. **Proactive and Innovative Behavior**
6. **Work Attitudes and Intentions**

This thematic structure is summarized in Table 8, which links each outcome theme to the corresponding primary studies. The categorization enables both the identification of recurring patterns in how task interdependence has been studied and the comparison of outcome emphasis across domains and theoretical perspectives.

Table 10. Categorization of Outcome Themes

Outcome Theme	Primary Studies
Team Performance & Coordination	PS1, PS6, PS7, PS10, PS11, PS21
Cognitive Learning	PS1, PS4, PS7, PS12, PS14, PS18, PS20, PS21
Social & Relational Outcomes	PS3, PS4, PS5, PS8, PS13, PS15, PS22, PS23
Affective States	PS2, PS4, PS19, PS23

contexts characterized by role clarity and social support, interdependence tends to foster belonging and engagement. In contrast, high levels of received interdependence, particularly under conditions of overload or low reciprocity, are associated with negative affective states.

- **Proactive and Innovative Behavior:** Also represented in four studies, this theme includes variables such as proactive behavior, innovative work behavior, knowledge hiding, and mastery climate. These studies examine how interdependence influences individuals' willingness to take initiative or contribute beyond formal role requirements. Initiated interdependence is often associated with heightened task significance and proactive engagement, whereas constrained autonomy or asymmetric dependence may trigger defensive responses, including information withholding.
- **Work Attitudes and Intentions:** Finally, three studies examine work attitudes and intentions, including goal commitment, role-breadth self-efficacy, and team identification. Although less frequently studied, these variables capture deeper attitudinal orientations that influence long-term engagement, retention, and perceptions of work meaningfulness, extending the analysis beyond immediate performance outcomes.

4.3.2 Interdependence as a Predictor, Moderator, or Emergent Construct

Beyond identifying outcome themes, we examined **how task interdependence is positioned within the analytical models** of the primary studies. This analysis focuses on the **functional role** attributed to interdependence in empirical and theoretical accounts, an issue that is central to RQ3 and directly related to Kiggundu's original propositions regarding causality, responsibility, and coordination mechanisms.

The classification was based on an interpretive reading of each study's objectives, hypotheses, research design, and analytical procedures. Six distinct roles were identified, reflecting varying assumptions about the causal status and analytical function of task interdependence.

First, task interdependence most frequently appears as a **Predictor**, where it is treated as an explanatory work-design characteristic influencing outcomes such as performance, coordination effort, cohesion, reflexivity, satisfaction, or intention to stay. Eight studies adopt this role (Table 11). This usage is closely aligned with Kiggundu's original theoretical stance, which conceptualizes interdependence as a structural property of work that shapes responsibility, motivation, and behavioral outcomes.

Second, in seven studies interdependence functions as a **Moderator**, altering the strength or direction of relationships between other variables, for example, between autonomy and performance or between social support and well-being. In these cases, interdependence is not assumed to exert a direct effect, but rather to condition how other work-design or relational factors operate. This role reflects a more

interactionist perspective, in which interdependence shapes outcomes indirectly by amplifying or constraining other mechanisms.

Third, six studies include interdependence as a **Control or Contextual Factor**, accounting for background variation in task structure without making interdependence the primary object of analysis. Although analytically secondary, this usage implicitly acknowledges interdependence as a structurally significant feature of the work environment that must be controlled for to avoid biased estimates of other effects.

Less frequently, interdependence appears in **Descriptive or Exploratory** roles, particularly in qualitative case studies and interpretive research. Four studies adopt this stance, allowing interdependence to emerge inductively through participants' accounts of coordination, dependency, and responsibility. This role is especially valuable for revealing experiential dimensions, tensions, and asymmetries that may remain hidden in hypothesis-driven quantitative designs.

In three studies, interdependence is used as a **Typology or Model Component**, forming part of broader conceptual frameworks, work-design typologies, or models of team functioning. In these cases, interdependence structures theoretical reasoning but is not empirically isolated or tested as an independent construct.

Finally, only one study positions task interdependence as a **Mediator**, explicitly modeling it as the mechanism through which antecedent variables influence outcomes. This relative scarcity suggests that, despite frequent acknowledgment of interdependence as a mechanism, it is rarely operationalized as an explicit explanatory pathway in empirical models.

Table 11. Categorization of the Role of Interdependence

Role of Interdependence	Primary Studies
Predictor	PS1, PS2, PS7, PS8, PS10, PS16, PS17, PS19
Moderator	PS1, PS6, PS7, PS8, PS17, PS18, PS21
Mediator	PS16
Control/Contextual Factor	PS3, PS9, PS11, PS13, PS15, PS22
Descriptive/Exploratory	PS4, PS5, PS8, PS23
Typology/Model Component	PS12, PS14, PS20

Overall, this distribution reveals a strong empirical tendency to treat task interdependence as either a **direct explanatory factor** or a **conditioning variable**, with comparatively limited use of interdependence as an explicitly modeled mechanism. This pattern has important implications for how closely empirical applications adhere to, or depart from, Kiggundu's original theoretical logic, an issue explored further in the cross-domain analysis and integrative synthesis.

4.3.2.1 Cross-Domain Patterns in the Role of Task Interdependence

To further deepen the analysis of how task interdependence is mobilized in empirical research, we examined the **relationship between application domains and the roles assigned to interdependence**, as illustrated in Figure 6. This cross-mapping allows us to move beyond frequency counts and identify **systematic patterns in how interdependence is analytically positioned across contexts**.

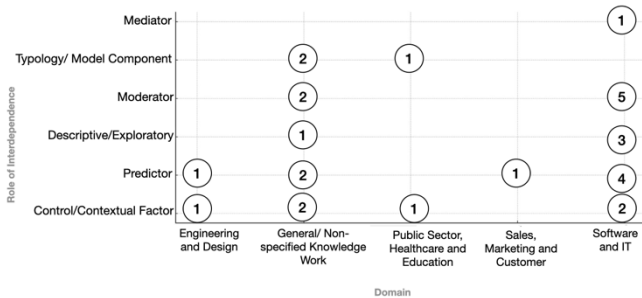


Figure 6. Relationship Between Domain/Industry and the Role of Interdependence

The **Software and IT domain** exhibits the broadest distribution of roles, encompassing Predictor, Moderator, Control or Contextual Factor, and Descriptive or Exploratory uses. This pattern reflects a multifaceted treatment of task interdependence, in which the construct is alternately modeled as a causal driver of outcomes (e.g., performance, coordination, cohesion), a conditioning factor shaping other relationships, or an emergent phenomenon explored through qualitative inquiry. The diversity of roles suggests that software development contexts serve as an empirical space in which interdependence is examined from multiple analytical angles, likely reflecting the socio-technical complexity and dense dependency structures characteristic of this domain.

In **General or Non-specified Knowledge Work**, task interdependence is more frequently positioned as a Control or Contextual Factor or as a Typology or Model Component, indicating that it is often treated as part of the background conditions of work rather than as a focal explanatory mechanism. Nevertheless, studies in this domain also include instances where interdependence functions as a Predictor or Moderator, as well as one Descriptive or Exploratory study. This distribution suggests methodological diversity, though interdependence is less consistently foregrounded as a central causal construct.

The **Engineering and Design** domain shows a more limited pattern, with task interdependence appearing exclusively as a Predictor or Control/Contextual Factor. This profile indicates an instrumental use of the construct, primarily aimed at explaining specific outcomes such as performance, coordination, or innovation, or at characterizing technical work contexts. In these studies, interdependence tends to be framed in functional terms, with comparatively less emphasis on perceptual, relational, or experiential dimensions.

In **Public Sector, Healthcare, and Education**, task interdependence is predominantly assigned the roles of Typology or Model Component and Control or Contextual Factor. This suggests an orientation toward conceptual modeling and institutional analysis, in which interdependence is treated as a structural feature of organizational arrangements rather than as a directly tested explanatory variable. In these contexts, interdependence is commonly mobilized to describe how policies, professional roles, and collective practices are organized and coordinated.

Finally, the **Sales, Marketing, and Customer** domain is represented by a single study that positions task interdependence as a Predictor. Although empirically limited, this case illustrates how interdependence can be operationalized as an explanatory variable in service-oriented settings, where collaboration and mutual dependence directly influence behavioral and performance outcomes.

Taken together, these cross-domain patterns highlight that **the role assigned to task interdependence varies systematically with application context**. Rather than indicating inconsistent use, this variation reflects different analytical priorities and assumptions about what interdependence explains, conditions, or constitutes within each domain. These patterns provide an important foundation for the integrative synthesis and discussion, where we examine how such differences relate to theoretical fidelity to Kiggundu’s original framework and to the boundary conditions of its application.

4.3.3 Domain-Specific Mechanisms

This subsection examines how task interdependence operates through different mechanisms across application domains, linking forms of interdependence to distinct outcome patterns (Figure 7). Rather than assuming uniform effects, the analysis highlights how the direction of interdependence (initiated vs. received) and the organizational context jointly shape cognitive, social, affective, and performance-related outcomes.

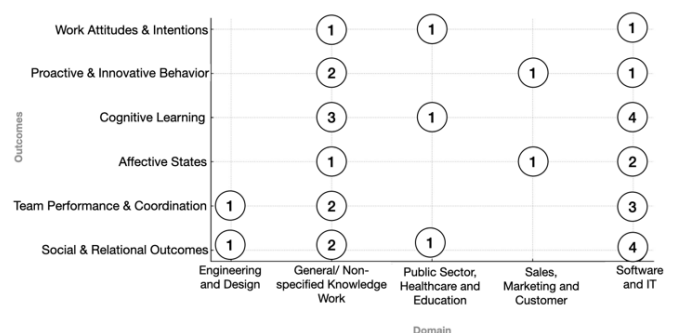


Figure 7. Relationship Between Domain/Industry and Outcome Themes

4.3.3.1 Software and IT

The **Software and IT domain** exhibits the broadest range of outcomes and the most consistent differentiation between initiated and received interdependence. Studies in this domain span all six outcome themes, with particular emphasis on Team Performance and Coordination, Cognitive Learning, and Social and Relational Outcomes.

Across these studies, initiated interdependence is most frequently associated with positive effects. For example, PS1 and PS3 show that initiated interdependence indicates team reflexivity and enhances perceptions of task meaningfulness, consistent with Kiggundu's proposition that initiating work for others heightens responsibility and engagement. PS6 further demonstrates that high interdependence combined with autonomy is associated with stronger team cohesion, particularly in agile contexts where coordination and discretion must be jointly managed.

Received interdependence shows more contingent effects. While it may increase coordination demands, studies such as PS5 indicate that when received interdependence is mediated by trust and role clarity, it may also contribute positively to relational outcomes. These findings suggest that in software development, interdependence functions through mechanisms of responsibility, learning, and coordination, with outcomes depending on how asymmetries in dependence are structured and managed.

4.3.3.2 General or Non-specified Knowledge

Work

In the General or Non-specified Knowledge Work domain, studies address all outcome categories, with a stronger concentration on Cognitive Learning and Proactive and Innovative Behavior. Here, Kiggundu's theory is primarily mobilized to examine subjective and cognitive mechanisms, such as perceived usefulness of work design (PS12) and representations of collaboration networks (PS13).

Although interdependence is linked to innovation, learning, and behavioral engagement, its direct effects on performance or well-being are less consistently examined. This pattern suggests that in these contexts, interdependence is often treated as a background condition shaping meaning-making and initiative rather than as a primary driver of measurable performance outcomes.

4.3.3.3 Engineering and Design

The Engineering and Design domain is represented by two studies (PS10 and PS15) that examine task interdependence in relation to coordination, cooperation, and relational dynamics in design-oriented teams. In both cases, interdependence is approached primarily as a structural and relational condition shaping how collective work is organized, rather than as an individual-level psychological experience.

PS10 analyzes virtual engineering teams and treats task interdependence as a moderating factor in the relationship between shared leadership and team cohesion, suggesting that interdependence may influence how leadership practices relate to relational outcomes in distributed settings. PS15 adopts a configurational perspective, examining how different patterns of task interdependence are associated with variations in cooperation, conflict, work values, and organizational loyalty in R&D and design teams.

Taken together, these studies suggest that in engineering and design contexts, task interdependence is most often

examined as part of coordination structures and collaborative arrangements that support collective work, with relational outcomes considered in conjunction with leadership practices and organizational configurations rather than as standalone affective or motivational effects.

4.3.3.4 Sales, Marketing, and Customer

In the Sales, Marketing, and Customer domain, only one study (PS19) was identified, addressing Affective States and Proactive and Innovative Behavior. This study provides a clear illustration of Kiggundu's directional logic: initiated interdependence is positively associated with task significance and proactive behavior, whereas received interdependence is linked to adverse effects, particularly among individuals with low self-esteem.

Despite its limited representation, this case demonstrates how task interdependence can influence motivation and initiative in service-oriented settings, where responsibility for outcomes and emotional engagement are closely tied to customer-facing activities.

4.3.3.5 Public Sector, Healthcare, and Education

Studies in the Public Sector, Healthcare, and Education domain focus primarily on Social and Relational Outcomes, Work Attitudes and Intentions, and Cognitive Learning. PS20 shows that the quality of social coordination directly influences team effectiveness, while PS22 demonstrates that task interdependence and social support affect satisfaction, performance, and intention to stay among IT and non-IT professionals in a public organization.

In these contexts, interdependence operates largely through institutional and relational mechanisms, shaping how professional roles, coordination practices, and motivational factors interact within structured organizational settings.

4.3.4 Divergences and Convergences Across Domains

The comparative analysis across domains reveals both consistent patterns and context-sensitive divergences in how task interdependence relates to work outcomes. These findings reinforce the view that the effects of interdependence are not uniform, but depend on how interdependence is structured (initiated, received, or undifferentiated), on mediating mechanisms (e.g., autonomy, role clarity, social support), and on the organizational and institutional context in which interdependent work is embedded.

4.3.4.1 Points of Convergence

A first point of convergence across domains is the positive association between task interdependence and collective performance-related outcomes in settings characterized by complex, collaborative work. In the Software and IT domain, studies such as PS1 and PS6 show that high levels of interdependence are associated with enhanced reflexivity, cohesion, and coordination, particularly when teams possess

sufficient discretion to manage dependencies. Similarly, in Engineering and Design, PS10 demonstrates that certain configurations of interdependence, especially when supported by trust and mutual assistance, facilitate effective collaboration and coordination.

A second convergence concerns the role of interdependence as a catalyst for cognitive learning. In software development, PS4 and PS19 indicate that horizontal coordination and initiated interdependence promote information sharing and proactive engagement, supporting both individual and collective learning. In General Knowledge Work, studies such as PS14 and PS7 show that interdependent structures, particularly when represented through network-based models or reinforced by role clarity, contribute to the development of shared understanding and cognitive work networks.

A third recurring pattern is the association between task interdependence and the development of social and relational resources, especially trust. In agile software teams, PS5 shows that successful interdependent interactions foster empathy, psychological safety, and perceptions of fairness. Complementarily, in Engineering and Design, PS15 highlights how interpersonal alignment enabled by specific interdependence configurations strengthens cooperation, loyalty, and conflict mitigation. Across these domains, interdependence appears to function as a relational intensifier, strengthening social bonds when coordination demands are effectively managed.

4.3.4.2 Points of Divergence

Despite these shared patterns, the analysis also reveals marked divergences in how interdependence is experienced and evaluated across contexts. In the Software and IT domain, studies consistently emphasize the importance of compensatory mechanisms, particularly autonomy and role clarity, in mitigating the coordination costs and stress associated with interdependence. For example, PS1 and PS6 show that teams with greater discretion in task execution are better able to absorb the complexity inherent in interdependent work.

Such compensatory mechanisms are less consistently present in Public Sector, Healthcare, and Education contexts. In studies PS20 and PS22, received interdependence is frequently associated with role ambiguity, overload, and dissatisfaction, especially in the absence of structured organizational support. In these settings, interdependence is more likely to be experienced as a constraint or stressor rather than as a facilitator of collaboration.

Another divergence concerns the affective experience of interdependence. While in software development interdependence is often associated with motivation and a strengthened sense of belonging (e.g., PS3, PS8), studies in General Knowledge Work report more ambivalent or negative affective responses, including frustration and perceived injustice (PS11, PS23). These differences are particularly pronounced in situations characterized by received interdependence without perceived reciprocity, highlighting the importance of symmetry and mutual accountability.

4.3.4.3 Transferable and Context-Bound Mechanisms

The analysis also identifies mechanisms that show potential for transfer across domains, albeit with contextual adaptation. One such mechanism is role clarity, which emerges as a central factor for managing interdependence across multiple settings. Studies PS7 and PS10 demonstrate that clarifying responsibilities and expectations helps teams navigate dependency relationships more effectively, regardless of domain.

Another broadly relevant mechanism is social and emotional support among peers. Evidence from PS4, PS5, and PS22 indicates that mutual support reduces the negative effects of received interdependence, contributing to improved performance and job satisfaction. These findings suggest that even in hierarchical or regulated environments, informal trust networks can enhance team resilience under interdependent conditions.

However, not all mechanisms are equally transferable. The combination of high interdependence and high autonomy, which yields positive effects in software development teams (PS1, PS6), may be counterproductive in highly regulated or bureaucratic contexts. In such environments, autonomous decisions may conflict with formal rules, hierarchical authority, or standardized procedures, undermining coordination and cohesion.

4.3.4.4 Summary

Taken together, these convergences and divergences indicate that task interdependence functions as a common organizing force in knowledge work, but with effects that vary systematically across contexts. Technical and creative domains tend to benefit from horizontal structures, autonomy, and interpersonal trust, whereas formal and regulated settings require more robust compensatory mechanisms, such as explicit role definitions and organizational support, for interdependence to generate positive outcomes. Recognizing these contextual contingencies is essential for developing theory-informed, context-sensitive models of task interdependence and for designing effective interventions in interdependent work settings.

4.4 Integrative Synthesis Across Dimensions

Building on the analyses reported in Sections 4.1–4.3, we developed an integrative synthesis that brings together findings across five analytical dimensions: research methods, conceptual approaches, measurement instruments, outcome themes, and the roles attributed to task interdependence. The purpose of this synthesis is not to introduce additional empirical results, but to enable cross-dimensional interpretation that is not visible when each dimension is examined in isolation.

To support this integrative perspective, the 23 primary studies were further grouped by domain of application, allowing systematic comparison of how Kiggundu's task interdependence theory has been operationalized, adapted,

and mobilized across Software Engineering and other knowledge-work contexts. This approach supports interpretation at the level of theoretical fidelity, adaptation, and boundary conditions, particularly in relation to Kiggundu’s original emphasis on directionality, responsibility, and motivational mechanisms.

The synthesis is presented in consolidated form in Table 12 which serves as a sensemaking artifact rather than a summary table. By juxtaposing domains, methodological choices, conceptual definitions, measurement strategies, and outcome patterns in a single analytical view, Table 12 makes it possible to identify systematic alignments and tensions across dimensions that are not apparent in the disaggregated analyses.

Across domains, the synthesis reveals a predominance of quantitative empirical studies, most frequently relying on standardized measurement scales derived from Kiggundu’s work or from established work-design instruments. At the same time, a gradual movement toward more integrative conceptualizations of interdependence is evident, particularly through composite definitions that combine directional, perceptual, and cooperative elements. In terms of analytical role, task interdependence is most commonly treated as a predictor or a moderator variable, but it also appears as a contextual factor, and, more rarely, as a mediator or component of broader conceptual models. With respect to outcomes, the most prominent themes include cognitive learning, team performance and coordination, and social-relational dynamics, while affective states and proactive behaviors are addressed in a smaller subset of studies.

A key pattern emerging from the synthesis is the greater methodological and conceptual diversity observed in the Software and IT domain relative to other knowledge-work contexts, which tend to exhibit more restricted combinations of methods, conceptualizations, and outcome focus. Importantly, this diversity should not be interpreted as an indicator of theoretical superiority or maturity. Rather, when viewed through the lens of the preceding analyses, it reflects

both the socio-technical complexity of software development work and ongoing experimentation in adapting Kiggundu’s theory to environments characterized by dense technical dependencies, evolving coordination practices, and shifting role boundaries.

At the same time, the synthesis also highlights points of theoretical drift, particularly in studies that operationalize task interdependence as a one-dimensional construct or treat it primarily as a contextual variable, thereby downplaying the directional asymmetries that are central to Kiggundu’s original formulation. These patterns underscore the need for careful alignment between theoretical assumptions, measurement choices, and analytical roles when applying task interdependence theory across domains.

5 Discussion

This review examined how Kiggundu’s task interdependence theory has been applied, operationalized, and linked to outcomes across knowledge-work settings, with particular emphasis on Software Engineering (SE). Across the 23 primary studies, the evidence suggests a predominance of quantitative empirical designs (15/23, 65%), reflecting a dominant tendency to treat interdependence as a measurable structural construct suitable for statistical modeling. Similar quantitative dominance has been reported in prior reviews of teamwork and coordination research (Mathieu *et al.*, 2008; Salas *et al.* 2018). By contrast, qualitative (3/23, 13%) and mixed-method (2/23, 8.7%) studies remain comparatively rare, limiting insight into the lived, relational, and context-dependent aspects of interdependence that have been emphasized in interpretive work on work design and collaboration (e.g., Wageman, 1995; Grant & Parker, 2009). The modest number of theoretical or conceptual contributions (3/23, 13%) further underscores the need for integrative frameworks that connect roles (predictor, moderator, mediator), directionality (initiated vs. received), and levels of analysis, as originally envisioned by Kiggundu

Table 12. Synthesis of systematic review findings across dimensions of analysis

	Software and IT	Engineering and Design	Public Sector, Healthcare, and Education	Sales, Marketing, and Customer	General/ Non-specified Knowledge Work
Method					
Quantitative Empirical	8	-	2	1	4
Qualitative Empirical	3	-	-	-	-
Mixed-Method Empirical	-	2	-	-	-
Theoretical/Conceptual	-	-	-	-	3
Conceptual Categories					
Directional Interdependence	5	-	1	-	-
Composite Interdependence	5	-	1	1	2
Psychological/Perceptual States	1	-	-	-	3
Cooperative Team Processes	-	2	-	-	1

Outcome-Based Interdependence	-	-	-	-	1
Instrument Type					
Adapted Scale	3	-	2	1	1
Standardized Scale	5	-	-	-	4
Qualitative Protocol	3	-	-	-	2
Mixed Instruments	-	2	-	-	-
Outcome Theme					
Team Performance & Coordination	3	1	-	-	2
Cognitive Learning	4	-	1	-	1
Social & Relational Outcomes	4	1	1	-	2
Affective States	2	-	-	1	1
Proactive & Innovative Behavior	1	-	-	1	2
Work Attitudes & Intentions	1	-	1	-	1
Role of Interdependence					
Predictor	4	1	-	1	2
Moderator	5	-	-	-	2
Mediator	1	-	-	-	-
Control/Contextual Factor	2	1	1	-	2
Descriptive/Exploratory	3	-	-	-	1
Typology/Model Component	-	-	1	-	2

Conceptually, the predominance of composite interdependence (9/23, 39%) suggests a movement toward integrative, context-sensitive models that combine structural, perceptual, and relational elements. This trend is consistent with broader developments in work-design and teamwork research that increasingly view interdependence as a multifaceted construct rather than a purely structural property (Morgeson & Humphrey, 2006). Directional interdependence (6/23, 26%), although central to Kiggundu's original formulation, remains underutilized relative to its theoretical potential for uncovering asymmetric motivational and coordination effects. Studies focusing on perceived or psychological interdependence (4/23, 17.4%) reinforce findings from organizational psychology showing that experienced dependence may diverge substantially from formal workflow arrangements, shaped by role clarity, trust, and prior collaboration (van der Vegt & Janssen, 2003; Chin, 2018). Yet, these perspectives remain underexplored in SE research.

Measurement choices mirror this conceptual balance. Standardized scales (9/23, 39%), most commonly derived from the Work Design Questionnaire (WDQ) or Kiggundu-based instruments, support comparability and statistical rigor, but tend to privilege structural aspects of interdependence. Adapted scales (7/23, 30.4%) improve contextual fit, a necessity in domains such as software development, but require transparent justification and additional validity evidence, a concern echoed in research on survey questionnaire construction in SE (Marsicano *et al.*, 2020). Qualitative instruments (5/23, 21.7%) surface subjective meanings, emotional tensions, and informal coordination mechanisms that are central to interdependence experiences, though their

limited use constrains generalizability. Mixed instrumentation (2/23, 8.7%) offers valuable triangulation but remains underexploited.

With respect to outcomes, cognitive learning and social/relational effects dominate (each 8/23, 34.8%), reinforcing prior arguments that interdependence simultaneously structures collective cognition and social capital (Aubé & Rousseau, 2005; De Jong & Bal, 2014). Team performance and coordination (6/23, 26%) remain prominent, while affective states, proactive/innovative behavior, and work attitudes appear less frequently. Analytically, interdependence is most often modeled as a predictor or moderator, consistent with Kiggundu's original causal framing, but is less frequently examined as a mediating mechanism, despite calls in the literature to unpack how work design features exert their effects (Hackman & Oldham, 1976; Grant & Parker, 2009).

Overall, the evidence base is robust with respect to quantitative modeling of structural aspects of interdependence, but thinner on perceived, directional, and context-sensitive accounts. This imbalance echoes critiques in both organizational research and SE that caution against over-reliance on static structural measures in dynamic, socio-technical settings (Herbsleb & Mockus, 2003; Cataldo *et al.*, 2006). Greater methodological plurality, particularly qualitative, mixed-method, and longitudinal designs, and clearer theorization of directionality and mechanisms would strengthen explanatory power and practical relevance for software engineering.

5.1 Implications for Software Development Practice

The findings of this systematic review suggest several implications for the management of software development teams, particularly with respect to how task interdependence, autonomy, social support, and coordination mechanisms may interact in practice. Given that work in software engineering is typically collaborative, knowledge intensive, and subject to frequent change (Kakar, 2018), prior research indicates that the way interdependence is structured and experienced can be associated with variation in both team performance and individual well-being (Courtright *et al.*, 2015; Golden & Gajendran, 2018; Yu, Zhao & Zhang, 2023).

Across the reviewed studies, those that explicitly consider directionality tend to report that initiated interdependence, where individuals recognize that their work enables the progress of others, is associated with a range of positive outcomes, including improved coordination, higher performance, stronger social and relational ties, and more favorable affective states. Examples include associations with greater team reflexivity (PS1), an enhanced sense of responsibility for downstream effects (PS4), and a stronger feeling of belonging (PS8). A plausible interpretation offered in these studies is that when individuals can see how their outputs contribute to others' work, engagement, commitment, proactivity, and awareness of impact may increase. From a practical perspective, this suggests that making initiated dependencies visible, such as clarifying who depends on whom and for what, may help team members better understand how their contributions support collective goals.

In contrast, several studies indicate that received interdependence, being dependent on others' inputs, can be associated with frustration and perceptions of workload inequity when not adequately supported (PS4, PS5). These effects appear to intensify under conditions of perceptual asymmetry, where individuals experience themselves as highly dependent while perceiving limited reciprocity. For example, PS4 links such asymmetries to anxiety and frustration, while PS5 reports impatience and a sense of wasted time among receivers when dependencies are not mutually acknowledged. These findings suggest that the emotional burden of interdependence may fall unevenly across roles, particularly on those waiting for inputs.

Taken together, the reviewed evidence indicates that managers and team leaders may benefit from paying attention to how responsibilities, handoffs, and dependencies are distributed and made visible, especially with respect to received interdependence. Providing channels for negotiating task timing and expectations, and explicitly acknowledging the emotional demands associated with dependency, may help support cohesion and adaptability in software development settings.

Another recurring theme concerns the relationship between interdependence and autonomy, with studies modeling this relationship both directly (PS1) and conditionally (PS6). While interdependence has been associated with increased coordination and alignment requirements

(Courtright *et al.*, 2015), autonomy has been linked to adaptation and individual creativity (Grabner, Klein, Speckbacher, 2017). Several studies suggest that when these dimensions are jointly considered, they may contribute to favorable outcomes such as team cohesion and performance. Conversely, poorly aligned configurations of high interdependence and low autonomy have been associated with role ambiguity, internal conflict, and increased managerial effort. In agile environments in particular, this pattern suggests that encouraging decentralized decision-making while maintaining visibility and synchronization of interdependent tasks may support a workable balance between individual discretion and collective responsibility.

The importance of social support and interpersonal trust also emerges across multiple studies. Evidence from PS2, PS3, PS5, and PS9 indicates that supportive relationships among co-workers can act as mediating or moderating factors, potentially mitigating negative effects of interdependence, especially received interdependence, while being associated with knowledge sharing, group cohesion, and employee retention. From a practical standpoint, these findings suggest that fostering collaborative environments that allow for informal exchanges and mutual support may help teams cope more effectively with interdependent work.

Role clarity is similarly highlighted as a relevant mediating factor, particularly in distributed or virtual contexts (PS4, PS7, PS18). Several studies suggest that unclear responsibilities can exacerbate coordination difficulties in interdependent settings, whereas explicit role definitions and shared representations of work may support synchronization and alignment. Practices such as clarifying roles, using visual task boards, and holding alignment meetings appear in the literature as mechanisms through which dependencies and responsibilities can become more transparent and negotiable.

Finally, the reviewed studies indicate that the effects of task interdependence extend beyond performance outcomes alone. Associations are also reported with affective (PS4, PS5), social (PS5, PS16), and motivational dimensions (PS9, PS6), underscoring that interdependence shapes not only how work gets done, but also how it is experienced. This suggests that practitioners designing and managing software development work may benefit from considering both technical requirements and the human factors that mediate interdependence experiences.

5.2 Implications for Software Engineering Research

Across the Software Engineering (SE) literature reviewed, task interdependence appears as a central but heterogeneously defined construct. It is modeled variously as a predictor, moderator, mediator, and contextual factor, often with differing conceptualizations and measurement approaches. This heterogeneity suggests challenges for cumulative knowledge building, as inconsistent definitions and instruments limit direct comparison across studies. One

implication of this pattern is that future research may benefit from greater construct clarity and alignment in measurement.

Several studies indicate that more explicit attention to directionality, distinguishing initiated from received interdependence, can yield analytically meaningful insights. Future work could explore convergence around a shared measurement core that captures this directionality, differentiates structural from perceived interdependence, and, where theoretically relevant, incorporates goal or outcome interdependence. Increased transparency in reporting item wordings, scale adaptations, and reliability and validity evidence may further support comparability. Testing measurement invariance across roles (e.g., developers, testers) and work settings (co-located, hybrid, distributed) could also help clarify whether observed effects reflect substantive differences or measurement artifacts. Over time, the development of an open, community-maintained instrument repository for SE research may facilitate cumulative progress, although such an initiative would require collective coordination and sustained uptake.

Methodologically, the reviewed corpus continues to be dominated by survey-based quantitative modeling. While this approach has generated valuable insights, several studies suggest that complementary qualitative and mixed-method designs, such as case studies, ethnographies, or critical incident analyses, may be particularly useful for capturing lived experience, asymmetries in dependence, and informal coordination practices that standardized instruments may not detect. To address common-method bias and to better illuminate mechanisms, future studies might also consider combining perceptual data with multi-source evidence, for example by linking surveys to repository data, issue trackers, CI pipelines, communication traces, or coordination artifacts. Stronger causal claims may be supported by temporal designs (e.g., panel studies, experience sampling) and from quasi-experimental or experimental strategies that are increasingly feasible in real software teams.

From a conceptual standpoint, the reviewed studies suggest that task interdependence can be modeled not only as an explanatory input but also as a mechanism that mediates or moderates relationships among leadership, autonomy, social support, virtuality, task complexity, and outcomes such as learning, safety, or burnout. Multilevel modeling approaches appear particularly promising for connecting individual perceptions with team-level structures and organizational context, and for examining when effects aggregate, or fail to do so. A distinctive opportunity in SE lies in integrating socio-technical dependency data, such as architectural graphs, code ownership maps, or microservice call graphs, with measures of perceived interdependence. Such integration could enable empirical tests of alignment or misalignment between technical and social dependencies, and help assess whether making initiated dependencies visible (“who unlocks whom”) is associated with changes in reflexivity, coordination efficiency, or delivery predictability.

Finally, broadening both the range of outcomes and the contexts studied may further sharpen theoretical contributions. Beyond performance-oriented metrics, SE research may benefit from more systematic attention to cognitive learning, relational states (e.g., trust, cohesion), affective outcomes (e.g., strain, sense of belonging), and proactive or innovative behavior. Under-studied contexts, including large-scale open-source projects, platform and DevOps teams, AI/ML pipelines, and globally distributed agile-at-scale environments, offer opportunities to stress-test interdependence theory under conditions of high dependency density and rapid change. A sustained research program that harmonizes measures, triangulates data sources, models mechanisms across levels, and bridges socio-technical structures has the potential to help clarify when interdependence appears to support coordination, when it may become problematic, and how work can be designed so that coordination scales without unduly constraining autonomy or well-being.

5.3 Limitations of this Review

This review has several limitations that qualify the findings and guide future replications. First, screening and data extraction were performed by a single reviewer with subsequent expert verification, rather than full duplicate review at all stages. Although this procedure partially follows the recommendations of Brereton *et al.* (2007), who emphasize the importance of independent cross-review to mitigate individual bias, the absence of duplicate review at all stages increases the risk of inadvertently excluding relevant studies.

Second, we relied exclusively on forward snowballing (Wohlin, 2014) from two seminal Kiggundu papers. While appropriate for tracing theory uptake, coverage depends on the seed set and citing communities, can favor more recent publications, and may miss older or non-citing yet pertinent work. To mitigate this, we used four databases (Google Scholar, Scopus, Web of Science, Emerald Insight) and started from widely cited foundational articles (Kiggundu, 1981; 1983).

Third, early screening necessarily used titles/abstracts and citation context, which can introduce exclusion bias. We therefore read introductions and conclusions for all candidates before final inclusion to ensure substantive engagement with Kiggundu’s conception of task interdependence.

Despite these constraints, the explicit protocol, multi-database search, clear inclusion criteria, and expert cross-check enhance transparency and reproducibility. The synthesis should nevertheless be interpreted within these methodological bounds.

6 Concluding Remarks

This systematic review synthesized 23 empirical studies published between 2013 and 2024 that cite or extend Kiggundu’s task interdependence theory, with particular attention to its application in Software Engineering (SE). Across the analyzed domains, task interdependence

consistently appears as a multifaceted construct that encompasses structural features of work (e.g., workflow and technical dependencies), directional relationships (initiated versus received interdependence), and perceived or psychological experiences of dependence. Together, these dimensions are associated in the literature with a range of outcomes, including team performance and coordination, cognitive learning, affective states, social cohesion, and everyday coordination practices.

From a practice-oriented perspective, the reviewed evidence suggests that task interdependence may be usefully approached as a work-design variable rather than as a fixed contextual constraint. Several studies indicate that making initiated dependencies more visible, clarifying who depends on whom and for what, can be associated with greater awareness of downstream effects and improved coordination. At the same time, findings related to received interdependence point to the importance of managing handoffs, expectations, and timing, particularly to mitigate frustration and perceived workload inequities. Across contexts, the literature suggests that aligning levels of interdependence with appropriate coordination mechanisms (e.g., communication frequency, feedback loops) while preserving room for autonomy, through modularization or flexible task allocation, may help teams cope with dependency-related demands. Social support and explicit recognition of the emotional load associated with dependency, especially for those waiting on others' inputs, also emerge as recurring considerations in the reviewed studies.

For research, the synthesis highlights the need for greater construct clarity and comparability across studies. Progress in this area would likely benefit from more consistent operationalizations that distinguish initiated from received interdependence and differentiate structural from perceived forms of dependence. Increased transparency in reporting measurement instruments, including item wordings and evidence of reliability and validity, would further support cumulative knowledge building. Methodologically, the literature would be strengthened by moving beyond predominantly cross-sectional survey designs toward greater triangulation of perceptual data with socio-technical dependency information (e.g., code ownership, architectural dependencies, issue and CI pipelines), as well as by increased use of temporal and quasi-experimental approaches. Conceptually, modeling task interdependence not only as an explanatory variable but also as a mediating or moderating mechanism, potentially within multilevel frameworks, offers a promising direction for clarifying how interdependence shapes outcomes in complex, socio-technical settings.

In summary, viewing task interdependence simultaneously as a property of work design and as a lived team experience provides a coherent lens for understanding coordination in contemporary software development. By mapping existing empirical evidence, identifying patterns of theory use and adaptation, and highlighting conceptual and methodological gaps, this review contributes a structured foundation for future research and for more reflective design and management of interdependent work in software

engineering, particularly in ways that seek to balance coordination demands with autonomy and well-being.

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Appendix A

ID	Descriptive Summary
PS1	Kakar (2016) conducted a quantitative survey with 167 graduate students in 34 software project teams to examine autonomy, task interdependence, and outcome interdependence as predictors of reflexivity. The study found positive effects for all constructs, with outcome interdependence moderating relationships, and showed that agile teams reported higher reflexivity than plan-driven teams.
PS2	Riasudeen, Srinivasan & Venkatesakumar (2014) conducted a quantitative survey with 302 IT/ITES professionals in India, mostly in teams of fewer than eight members, to examine the relationships between task characteristics, process, structure, and burnout. The study found that all hypotheses were supported, showing negative relationships between task characteristics, process, structure, and burnout.
PS3	Barbosa <i>et al.</i> (2017) conducted a quantitative survey with 185 software engineering professionals in Brazil, averaging ten years of experience, to examine the correlation between autonomy and initiated/received task interdependence. Results were partially supported, showing positive correlations for initiated interdependence but no negative correlations for received interdependence.
PS4	Souza, da Silva & Seaman (2023) conducted a qualitative case study with a 10-member software team in a Brazilian financial company to explore perceptions of initiated and received task interdependence in relation to autonomy. Based on semi-structured interviews, the study found that asymmetrical perceptions of interdependence generated anxiety and stress, with initiated interdependence perceived positively and received interdependence mostly negatively.
PS5	Barbosa <i>et al.</i> (2017a) conducted a qualitative study with a six-member agile software team from a public company in Recife, Brazil, to investigate perceptions of initiated and received task interdependence and their relationship to trust. Using semi-structured interviews, the study found that trust significantly shaped perceptions of interdependence, with team members' maturity and technical level directly influencing trust and, consequently, interdependence.
PS6	Kakar (2018) conducted a quantitative survey with 332 software developers across 34 industrial projects in the United States to examine how autonomy, task interdependence, and outcome interdependence affect team cohesiveness. Results showed that autonomy alone negatively influenced cohesiveness but had a positive effect when combined with task interdependence under conditions of high outcome interdependence. Agile teams also reported higher cohesiveness than plan-driven teams.
PS7	Wong & van Gils (2022) conducted a quantitative survey with 191 members of distributed agile software teams in Norway and Asia to examine how initiated and received task interdependence influence performance through role clarity. The study found that initiated interdependence enhanced role clarity of others, while received interdependence enhanced role clarity of self, with both mechanisms positively contributing to team performance.
PS8	Marsicano <i>et al.</i> (2018) conducted a qualitative case study with four software developers from an agile Scrum team in a Brazilian company to explore perceptions of task interdependence and its effects on teamwork dynamics. The study found that task interdependence fostered information sharing, mutual help, task synchronization, and knowledge redundancy, thereby improving teamwork. These effects were positively moderated by interpersonal relationships, sense of belonging, and individual competencies.
PS9	Lin (2015) conducted a quantitative study with 359 members across 93 teams in Taiwanese high-tech firms to examine how social, emotional, and motivational factors relate to teamwork interdependence and performance. Using a two-stage survey with team members and leaders, the study found that team planning and team identity fully mediated the effects of goal commitment, emotional intelligence, and teamwork interdependence on performance. Goal commitment positively moderated the link between team planning and performance but not between team identity and performance.
PS10	Hsu (2018) conducted a mixed-method study with 283 R&D engineering teams in consumer electronics firms across Greater China, combining questionnaires and semi-structured interviews with 32 teams, to examine the influence of task interdependence and cooperative conflicts. The study identified four distinct types of task

- interdependence, Reason & Pragmatics, Speed & Efficiency, Trust & Mutual Assistance, and Institutional Professionalism, each associated with specific patterns of cooperation, conflict, loyalty, and work values.
- PS11 Golden & Gajendran (2018) conducted a quantitative study with 273 matched pairs of telecommuters and their supervisors in the United States to investigate how telecommuting influences job performance, moderated by job complexity, problem solving, interdependence, and social support. Results showed that telecommuting was positively related to performance. Job complexity positively moderated this relationship, while task interdependence and social support negatively moderated it, contrary to expectations. Problem solving had no significant effect.
- PS12 Liao (2017) developed a multilevel theoretical model to examine how task- and relationship-oriented leader behaviors influence processes and outcomes in virtual teams. Based on a literature review, the study emphasized the role of leadership in shaping virtual collaboration, shared mental models, trust, conflict management, and shared leadership, highlighting their impact on both team and individual outcomes.
- PS13 Moussa, Bright and Varua (2017) conducted a conceptual analysis of work design theories, particularly Hackman and Oldham's Job Characteristics Model and Morgeson and Humphrey's Work Design Questionnaire (WDQ), to explore knowledge worker productivity in knowledge-intensive industries. The study proposed expanding the WDQ to include organizational contextual characteristics, such as valuing creativity, trust, and monetary rewards, as well as additional mediators and outcomes like knowledge sharing, role breadth self-efficacy, and employee well-being.
- PS14 Griffin *et al.* (2022) proposed a network-based perspective to conceptualize and measure interdependence in organizational workgroups and teams. Drawing on a selective literature review and simulation-based illustrations, the study introduced the Standardized Dependency Index (SDI), a method for capturing interdependence at node, dyad, and network levels. It further reviewed over 50 operationalizations of interdependence, classifying them across four types and three directionalities.
- PS15 Hsu (2017) conducted a mixed-method study with 339 R&D engineering design teams and 28 team leaders from consumer electronics firms in Taiwan to explore how different forms of task interdependence relate to cooperation, conflict, loyalty, and work values. The study identified four interdependence types, Concretes, Efficiency, Concordance, and Specialization, each associated with distinct patterns of cooperation (functional, project, matrix), conflict (cognitive, procedural, emotional), loyalty (duty, identification), and work values (autonomy, social recognition, benefits).
- PS16 Lee, Park & Lee (2020) conducted a quantitative study with 203 information systems development (ISD) project teams from five large South Korean firms to examine the effects of task interdependence on knowledge sharing and project performance, considering the mediating role of social capital. Using structural equation modeling, the study found that task interdependence did not directly affect performance but positively influenced social capital and knowledge sharing, which in turn significantly enhanced project performance.
- PS17 Černe *et al.* (2017) conducted a multilevel quantitative study with 240 employees across 34 teams in two Slovenian manufacturing firms to analyze how mastery climate, knowledge hiding, task interdependence, and decision autonomy influence innovative work behavior (IWB). Using hierarchical linear modeling with matched employee-supervisor surveys, the study found that knowledge hiding negatively affected IWB. A mastery climate buffered this effect, but only under conditions of either high decision autonomy or low task interdependence.
- PS18 Berntzen & Wong (2021) conducted a quantitative multilevel study with 101 individuals in 31 distributed teams from three Norwegian organizations to examine how initiated and received task interdependence moderate the link between team self-management and coordination. Results showed that high initiated interdependence enhanced coordination, while high received interdependence hindered it.
- PS19 Yu, Zhao & Zhang (2023) conducted a quantitative three-wave survey with 1,330 employees of a real estate company in Jiangsu, China, to examine how initiated and received task interdependence affect proactive work behavior, with task significance as mediator and self-esteem as moderator. Results showed that initiated interdependence was positively related to proactive behavior through task significance, while received interdependence had no direct effect. However, self-esteem moderated the relationship between received interdependence and task significance, indicating a moderated mediation pathway.
- PS20 Chin (2018) conducted a laboratory experiment with 260 U.S. college students, organized into 120 dyads, to test how resource and process interdependence affect evaluations of individual work contributions. Using a 2×2 factorial design, the study found that resource interdependence increased partner evaluations, while process interdependence increased both partner and self-evaluations. The interaction effect was not significant.
- PS21 Berntzen & Wong (2019) conducted a quantitative multilevel study with 110 individuals across 40 distributed teams in three Norwegian organizations to examine how initiated and received task interdependence moderate the relationship between team self-management and coordination. Findings showed that self-management was

positively associated with coordination under high initiated interdependence, but the relationship weakened under high received interdependence.

- PS22 Uruthirapathy & Grant (2015) conducted a quantitative survey with 105 employees (70 IT, 35 non-IT) from a Canadian public sector IT shared services organization to compare how motivational and social job characteristics influence satisfaction, performance, and turnover intentions. Results showed that non-IT professionals reported higher turnover intentions and lower task significance and outside interaction. Advisory group members reported lower satisfaction, reduced feedback, and higher turnover intentions. Task interdependence levels were similar across IT and non-IT roles.
- PS23 Sarich, Kiffin-Petersen & Soutar (2023) conducted a quantitative study with 308 Australian employees (part-time, involuntary part-time, and full-time) and a replication sample of 164 part-time student workers to examine how work design characteristics influence inclusion and engagement. Using structural equation modeling and MANCOVA, the study found that task interdependence was not related to job crafting or inclusion among part-time employees. Instead, autonomy and proactivity positively predicted inclusion and job crafting, which in turn improved engagement. Involuntary part-time employees reported significantly lower inclusion than part-time and full-time employees, while differences in engagement were not significant.
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