Perceived Benefits and Challenges of Implementing CMMI on Agile Project Management: A Systematic Literature Review

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Abstract—In an era where the agility and responsiveness of Agile project management are paramount, the integration of structured models like the Capability Maturity Model Integration (CMMI) presents a blend of unique opportunities and challenges. This study conducts a comprehensive systematic literature review of 23 scientific articles, chosen through the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology, to explore the benefits and challenges of CMMI and software development integration within the context of Agile project management. Emphasizing the enhancement of Agile project management maturity, the research delves into the role of CMMI, particularly CMMI-DEV, as a pivotal element in Software Process Improvement (SPI) models tailored to Agile environments. The study's novelty lies in its systematic and in-depth investigation of CMMI's integration with Agile project management methodologies, a critical yet underexplored area in the existing literature. Addressing the urgency highlighted by global trends of resource inefficiencies and project management challenges, this research offers timely insights for both academia and industry. This study also categorizes key benefits while identifying prevalent challenges, such as resource constraints and organizational resistance. Additionally, this research also suggests solutions and improvements to these challenges. By offering a comprehensive evaluation, the research significantly advances the understanding of the complexities and potential of CMMI and Agile project management integration. It provides valuable insights for practical applications in organizational settings, emphasizing the potential of integrating structured models like CMMI-DEV with Agile project management methodologies. This integration is essential for enhancing project management maturity, marking a significant step forward in academic research and practical applications in this vital domain.

Keywords—CMMI; SPI; Agile project management; systematic literature review; PRISMA

I. INTRODUCTION

In today's rapidly evolving business landscape, the agility and efficiency of project management have become pivotal for organizational success [1]. Agile project management, in particular, has emerged as a critical determinant in enabling companies across diverse sectors to navigate the complexities of fluctuating market demands [2]–[4]. However, the transition to agile methodologies is not without its challenges. Research and industry observations underscore significant inefficiencies in current project management practices, negatively impacting organizational performance [4].

The 2023 Pulse of the Profession survey by the Project Management Institute reveals a striking indicator of these challenges. This survey reports a global average loss of 5.2% in investment due to subpar project performance, marking a sustained trend of resource wastage over recent years [5]. Such findings signal a more profound, systemic issue in project management across various industries, calling for a strategic approach to enhance project management maturity [4].

In response to this need, frameworks like the Project Management Maturity Model (PMMM) have been developed, offering a structured way to evaluate and uplift an organization's project management practices [4]. Yet, in the face of the intricate challenges posed by the modern business environment, achieving maturity in project management alone is insufficient. The significance of Software Process Improvement (SPI) and frameworks like the Capability Maturity Model Integration (CMMI) becomes more evident in this context. They provide comprehensive methodologies to bolster an organization's software development and management prowess, crucial in the digital era [6], [7].

The CMMI model has evolved beyond its initial focus on software engineering to support organizations across various industries in enhancing their capabilities, measuring performance, and addressing common business challenges. The CMMI Model represents a set of established best practices that can be applied globally to help organizations develop key capabilities [15]. It is designed to be user-friendly, adaptable, and compatible with other methodologies, such as Agile, SAFe, and DevSecOps, among others [8], [14], [15]. However, integrating CMMI with other methodology such as Agile project management is not straightforward, often requiring significant investment and grappling with the stringent requirements of these frameworks [8], [9]. This indicates that the integration process is complex and resource intensive.

Despite these hurdles, many organizations, especially those prioritizing high-quality outputs, are increasingly exploring the synergies between agile methods and CMMI [8], [10], [11]. The latest CMMI V2.0 has been recognized for its improvements in project management performance [4], [12], [13], as acknowledged by professionals worldwide [6]. Therefore, it is essential to examine both the benefits and challenges of integrating CMMI with Agile project management to fully understand the value of such a combination.

Previous research has examined the relationship between the challenges of combining CMMI and Agile. Henriquez et al. [8] conducted a study to determine how much CMMI addresses these challenges. They focused on two significant CMMI artifacts for integration and emphasized vital issues that organizations must address [8]. Additionally, Ferdinansyah et al. [10] compiled experiences from combining software and explored the challenges involved in the collaborative implementation process. Their research also delved into the compatibility between CMMI and Agile Development [10]. Henriquez et al. [14] also conducted another research that focuses on analyzing and identifying agile artifacts that align with CMMI-DEV V2.0 practices, aiding Agile organizations in adopting or transitioning to this latest model from CMMI-DEV V1.3, with a particular emphasis on Planning and Managing Work Practice Areas and Practices. However, it is worth noting that previous studies have not explicitly examined the Perceived Benefits and Challenges of Implementing CMMI in Agile project management.

This research analyzes the potential benefits and challenges associated, that comes from the integration of CMMI-DEV and Agile project management. The aim is to leverage the advantages of implementing CMMI and Agile project management. Moreover, the study will also identify the challenges and recommend solutions accordingly. Both academic research and organizational practice can benefit from this research. The proposed solutions for these challenges can serve as valuable guidance for senior managers considering the joint implementation of CMMI and Agile project management. Additionally, it provides the most recent literature review, which can be utilized to enhance research on CMMI and agile project management in academic research. This study aims to address the subsequent research questions:

RQ1: What are the benefits of integrating CMMI and Agile Project Management?

RQ2: What are the challenges and the corresponding solution of integrating CMMI and Agile Project Management?

II. LITERATURE REVIEW

A. Agile Project Management

Agile project management (APM) methodology, a methodology that was developed approximately two decades ago predominantly for the software sector, draws its principles from the Agile Manifesto. These principles prioritize individual interactions, the functionality of software, cooperation with customers, and flexibility in adapting to change [3]. Originally for software development, APM is now utilized in various fields, characterized by team autonomy, iterative development, and equality within teams [1], [2]. It aims to deliver high-value products within time and budget constraints by integrating planning with execution and fostering teamwork and customer collaboration. APM manages paradoxical dynamics, balancing team flexibility with procedural rigor, and is recognized for effectively responding to evolving project requirements and customer needs [16].

Research and practitioner experiences indicate that APM positively impacts behavioral, affective, and cognitive outcomes, with a more pronounced effect on behavioral aspects like performance and innovation. This effectiveness is not limited to software development; APM shows slightly greater effectiveness in non-software domains [3]. The adaptability and broader application of APM highlight its role in enhancing project management practices and fostering positive changes in workplace behavior and performance. These insights reflect APM's comprehensive impact across different industries. The pervasiveness of APM's influence underscores its potential to revolutionize project management practices and drive organizational success across diverse domains [1], [3].

B. Software Process Improvement (SPI)

It is vital to enhance both the efficiency and effectiveness of software development and management processes. In this regard, the role of Software Process Improvement (SPI) is pivotal for accomplishing such improvements [7], [17]. SPI involves developing and honing a set of collective knowledge and practices specific to software development, with a continuous commitment to improving these processes [6]. This ongoing improvement helps organizations increase their development performance and adapt efficiently to evolving business environments, thereby gaining a competitive edge. SPI is a critical enabler for ensuring that software development and management processes are aligned with business goals and objectives [17], [18].

A range of SPI (Software Process Improvement) models are employed within the software industry. These include the Capability Maturity Model (CMM), Capability Maturity Model Integration (CMMI), People Software Process (PSP), SPI, Capability Determination (SPICE), and BOOTSTRAP. [6]. These models address various challenges, including projects exceeding budgets and timelines, subpar software quality, and unmet requirements. Different SPI models, including CMMI, PSP, SPICE, MSF, RUP, ISO, IDEAL, and Six Sigma, are employed to tackle these issues [6], [19]. The CMMI model is particularly notable for its wide-ranging application across different sectors, extending beyond software. It helps organizations improve their processes, leading to better quality and efficiency in software development projects [6], [7], [20].

C. CMMI-DEV

CMMI was developed as a process improvement model to help many organizations improve performance, achieve process maturity, and achieve organizational goals [14], [21]. The CMMI model encompasses three different categories. CMMI-DEV focuses on product and service development; CMMI-SVC is dedicated to establishing and managing services; and CMMI-ACQ pertains to acquiring products and services. This paper explicitly centers on CMMI-DEV, the model used in computer programming, underscoring its two essential cycle regions for necessities [22], [23].

Additionally, the CMMI Institute recently introduced version 2.0 of the CMMI. With its emphasis on continuous improvement and process optimization, CMMI-DEV V2.0 empowers organizations to enhance their software development capabilities and deliver exceptional products that meet stakeholder needs [14], [24]. This updated version integrates practices from the three version 1.3 constellations (DEV, ACQ, and SVC) and the People Capability Maturity Model (PCMM). In CMMI V2.0, CMMI for Supplier

Management (CMMI-SPM) will replace CMMI-ACQ from V1.3 [25]. The mapping between CMMI 1.3 and CMMI 2.0 models is shown in Fig. 1.

Moreover, the latest version of CMMI introduces several new practice areas, with project management being a key area predominantly addressed in CMMI-DEV [24]. The practice areas consist of Estimating (EST), Planning (PLAN), Risk and Opportunity Management (RSK), Monitor and Control (MC), Implementation Infrastructure (II), Requirements Development and Management (RDM), Supplier Agreement Management (SAM) [26]. Therefore, this paper focuses on the new version of CMMI, particularly CMMI-DEV.
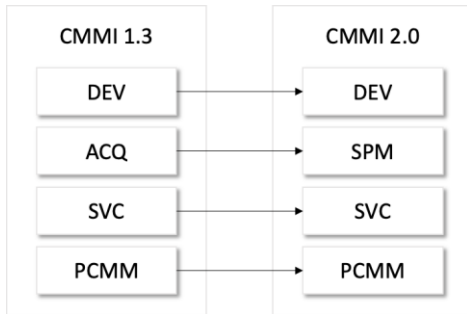

Fig. 1. CMMI 1.3 and CMMI 2.0 models mapping.

D. Project Management Category of CMMI

In CMMI, several process areas target the project management domain. The project management encompasses several areas, such as project planning, monitoring and control, and many others [9], [27]. This paper primarily centered on project management, specifically the management activities associated with project planning, monitoring, and control. Table I maps process areas in CMMI 1.3 to practice areas in CMMI 2.0 relevant to project management based on its definition for each process areas accordingly.

TABLE I.   CMMI PROCESS AREAS AND PRACTICE AREA MAPPING RELATING TO PROJECT MANAGEMENT

Process Area CMMI 1.3 [20]	Process Area CMMI 2.0 [26]
Project Planning (PP)	Estimating (EST), Planning (PLAN), Risk & Opportunity Management (RSK)
Project Monitoring and Control (PMC)	Monitor & Control (MC), RSK
Integrated Project Management (IPM)	PLAN, Implementation Infrastructure (II), MC
Risk Management (RSKM)	RSK
Requirement Management (REQM)	Requirements Development & Management (RDM)
Supplier Agreement Management (SAM)	Supplier Agreement Management (SAM), PLAN, MC

III. RESEARCH METHOD

Systematic Literature Reviews (SLRs) are commonly employed to conclude, gather evidence, and produce concise summaries. In this research, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology is employed [28]. PRISMA is known for its transparent and concise approach, making it preferable over other methods. While initially developed for healthcare

research, PRISMA has also proven effective in Information System studies [28]. The PRISMA Workflow for this research is depicted in Fig. 1, providing a visual representation of the process.

A. Planning the SLR

In this stage, keyword generation is conducted based on the main keywords obtained at the beginning of the research, namely CMMI and Agile Project Management. The keywords ("CMMI" AND "Agile" AND "Project Management") were identified. These keywords were used to construct queries on each database. The query formats were subsequently modified to align with the specific query requirements on the advanced search function of each database.

The online database with extensive collections of SPI papers relevant to the problem domain and criteria of the studies was selected based on specific considerations. The reason is due to the relevant search results available, the appropriate field usually provided by the online database, and the reputation of the online database itself. For this research, the selected databases include the ACM Digital Library, IEEE Xplore, Scopus, and Science Direct. The criteria applied in the study selection process are detailed in Table II.

TABLE II.   CRITERIA FOR THE STUDY SELECTION

Inclusion Criteria (IC)	IC1	The research was written in English.
	IC2	The research was published between 2018 and 2023.
	IC3	The research in the computer science problem domain.
	IC4	The research is academic research, such as a journal or conference paper.
Exclusion Criteria (EC)	EC1	The research was not relevant to CMMI implementation in Agile settings.
	EC2	The research does not mention the challenges or benefits of CMMI implementation in Agile settings.

B. Implementation of SLR

In this stage of the SLR, a meticulous and expansive search was conducted to identify pertinent literature. Sections relevant to the formulated research questions underwent thorough analysis. The analysis entailed an in-depth examination of the entire text, specifically emphasizing investigations related to combining CMMI and Agile Project Management methodologies.

Fig. 2 delineates the SLR workflow using PRISMA, illustrating the systematic selection process. This process commenced with the initial data acquisition from various databases, adhering to the inclusion and exclusion criteria outlined in Table I, and was completed with the identification of results that corresponded with the predefined research criteria. The identified studies were then subjected to rigorous quality assessment to ensure the validity and reliability of the findings.

A total of 23 scientific articles, sourced from a range of highly ranked journals and conference proceedings, as per Scimago, have been selected for in-depth analysis regarding the challenges and effects on project management.
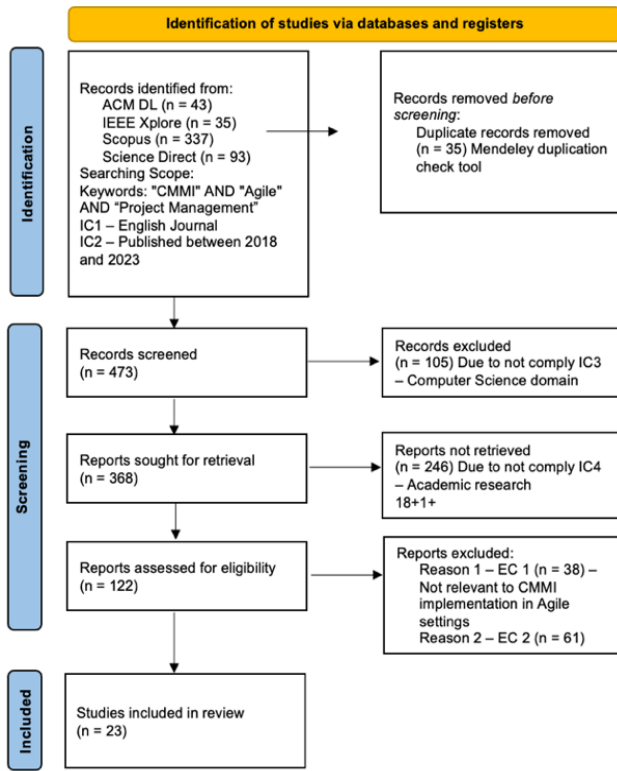
Fig. 2. Workflow of literature review (PRISMA).

C. Reporting the SLR

The final stage of the SLR involves the presentation of findings. First, Table III is a comprehensive reference guide, summarizing all relevant articles aligned with the research goals. This table includes article titles, publication years, journal index information, and reference citation coding.
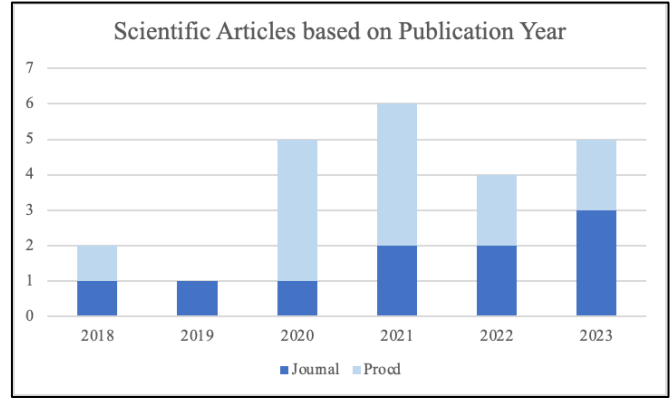

Fig. 3. Distribution of scientific articles per publication year.

Secondly, Fig. 3 visually represents scientific papers categorized according to their publication years. Table III and Fig. 3 enhance the presentation and comprehension of the SLR's outcomes, ensuring a robust and comprehensive exploration of the research area.

TABLE III. SUMMARY OF ALL RELEVANT ARTICLES

No	Title	Year	Index	Code
1	Agile-CMMI Alignment: Contributions and To-Dos for Organizations	2021	Q2	[8]
2	Bringing to Light the Agile Artifacts Pointed Out by CMMI	2022	Q1	[14]
3	A model for defining project lifecycle phases: Implementation of CMMI level 2 specific practice	2022	Q1	[29]
4	Software project management in high maturity: A systematic literature mapping	2019	Q1	[30]
5	Does agile methodology fit all characteristics of software projects? Review and analysis	2023	Q1	[31]
6	Software Requirement Analysis: Research Challenges and Technical Approaches	2018	Procd	[23]
7	Abandonment of a Software Process Improvement Program: Insights from Case Studies	2020	Procd	[32]
8	A Conceptual View for an Enhanced Cloud Software Life-Cycle Process (CSLCP) Model	2020	Procd	[33]
9	Reconciliation of scrum and the project management process of the ISO/IEC 29110 standard-Entry profile—an experimental evaluation through usability measures	2021	Q2	[34]
10	Practical Suggestions to Successfully Adopt the CMMI V2.0 Development for Better Process, Performance, and Products	2023	Procd	[12]
11	Crafting a CMMI V2 Compliant Process for Governance Practice Area: An Experiential Proposal	2020	Procd	[24]
12	Challenges in Combining Agile Development and CMMI: A Systematic Literature Review	2021	Procd	[10]
13	A new scrum and CMMI level 2 compatible model for small software firms in order to enhance their software quality	2022	Procd	[11]
14	The CMMI-Dev Implementation Factors for Software Quality Improvement: A Case of XYZ Corporation	2020	Procd	[35]
15	The Improvement Process for The Software Development and Requirements Management to Achieve Capability Level 3 of CMMI	2022	Procd	[36]
16	Improving the Quality of Requirements Engineering Process in Software Development with Agile Methods: A Case Study Telemedicine Startup XYZ	2021	Procd	[37]
17	Model-driven gap analysis for the fulfillment of quality standards in software development processes	2023	Q2	[38]
18	Software quality models: Exploratory review	2023	Q3	[39]
19	Agile Governance Guidelines for Software Development SMEs	2021	Procd	[27]
20	A Novel model to adapt CMMI Level 2 by Assessing the Local SMEs of Bangladesh	2023	Procd	[40]
21	Towards Implementation of Process and Product Quality Assurance Process Area for Saudi Arabian Small and Medium Sized Software Development Organizations	2018	Q2	[41]
22	Evaluation of Maturity Level of the Electronic based Government System in the Department of Industry and Commerce of Banjar Regency	2020	Q3	[42]
23	Software Process Improvement During the Last Decade: A Theoretical Mapping and Future Avenues	2021	Procd	[43]

IV. RESULTS AND DISCUSSION

The eligible studies underwent a process of screening and analysis to extract relevant information. While screening the complete text, the problem domain and research questions were identified concurrently.

A. Perceived Benefits of CMMI and Agile Project Management Integration

In exploring the symbiosis between CMMI and Agile Project Management, it's essential to delve into the tangible benefits this integration brings to project management. This chapter categorizes these benefits into five core practice areas within CMMI: Estimating, Planning, Risk and Opportunity Management, Monitor and Control, and Requirements Development and Management.

1) Estimation: Enhanced Accuracy and Predictability. Studies have shown that integrating CMMI with Agile methodologies can significantly refine budget and schedule predictions. Alqadri et al. [35], Saputra et al. [42], and Galvan-Cruz et al. [34] highlight CMMI's effectiveness in this regard. Degerli, M. [12], [24] citing CMMI Institute [13], reports a remarkable 17% increase in estimation accuracy following the adoption of CMMI V2.0. These enhanced estimation processes reduce project uncertainties and bolster the likelihood of successful project execution. Importantly, Albuquerque [32] and Itzik et al. [31] note the role of CMMI in providing greater predictability in costs and deadlines, contributing to reduced costs and increased productivity.

2) Planning: Streamlined Project Management. The incorporation of CMMI into Agile methodologies elevates the process of work planning and management. As outlined by Valeria et al. [8], [35], CMMI's structure enables the creation of comprehensive forecasts concerning workload, costs, and schedules. This foresight is crucial in preventing budget or timeline overruns [8], [14]. The synergy of Agile and CMMI also improves goal attainment. It minimizes rework, as evidenced by the significant reduction in rework (70%) and the increase in on-time delivery rates (97%) reported by Degerli, M. [12], [24] referencing the CMMI Institute [13].

3) Risk: Mitigating Risks with Informed Strategies. In Agile environments, effectively handling requirement changes is critical. CMMI's quality models play a significant role here, as they aid in risk reduction and quality enhancement [23], [37]. The model promotes a proactive approach to identifying and evaluating risks and opportunities, as noted by Degerli, M. [12], [24]. This approach encompasses establishing performance benchmarks derived from historical data, facilitating early identification of variances, and supporting informed choices in project management.

4) Monitor and control: Ensuring Quality and Compliance. CMMI's role in monitoring and controlling project and organizational processes is pivotal [10]. It provides a framework for analyzing and managing critical subprocesses, particularly in high-maturity project management scenarios, as discussed by Cerdeiral, C. T., & Santos, G. [30] Keshta et al. [41]. This supervisory function ensures that software quality is upheld during its development and that the end products fulfill users' expectations.

5) Requirements development and management: Optimizing Product Quality and Customer Satisfaction. A vital aspect of CMMI is its guidance on requirement development and management [23]. This element holds particular significance in Agile Project Management, given its focus on flexibility and adaptability. According to several studies, CMMI enhances customer satisfaction by improving product quality and aligning closely with customer needs [29], [31], [35], [36]. Furthermore, CMMI's principles can be seamlessly amalgamated with Agile's emphasis on customer collaboration and adaptability to change [36], [39].

B. Classification of Challenges of CMMI and Agile Project Management Integration

The eligible studies highlighted several challenges faced by organizations. A thematic categorization focusing on tactical and organizational challenges was employed, as delineated by Valeria et al. [8].

1) Resource and Time Constraints: Integrating CMMI into Agile projects presents significant resource and time challenges. Ferdinansyah et al. [10] highlight that this integration demands additional resources, effort, and time beyond the scope of standard project activities. Adopting new concepts and practices within an Agile framework requires careful planning and considerable investment. These constraints are particularly impacting Small and Medium-sized Enterprises (SMEs), as observed by Henríquez et al. [27] and Saheel et al. [11]. SMEs often operate with limited budgets and resources, making it challenging to sustain the additional demands of integrating CMMI [33], [38], [40], [41], [43]. This challenge can lead to difficulties in maintaining the balance between the pursuit of quality improvement and the practical realities of project management within these organizations.

2) Organizational Resistance and Change Management: Resistance to adopting new methodologies is a common challenge within organizations. This resistance often stems from a lack of knowledge or experience with the new systems, as noted by Valeria et al. [8], Ferdinansyah et al. [10], Albuquerque et al. [32], and Demirel & Das [23]. Frequent leadership changes or past experiences with unsuccessful management initiatives can further exacerbate such resistance. This skepticism and disinterest, especially among long-standing employees, can pose significant hurdles to successfully integrating CMMI and Agile methodologies. Moreover, the lack of support from top management in enforcing new processes can lead to demotivation among practitioners and quality assurance teams, hampering the overall adoption process [8], [10], [23], [32].

3) Balancing Agility with Control: A critical challenge in integrating CMMI with Agile methodologies is balancing the structured approach of CMMI with the flexibility of Agile [8].

As organizations strive to achieve higher maturity levels within the CMMI framework, they may find that agility is compromised, as pointed out by Valeria et al. [8]. Ferdinansyah et al. [10] further elaborate that the control and accountability emphasized by CMMI can clash with the core principles of Agile, which values adaptability and minimal bureaucratic overhead. This challenge concerns managing project processes and aligning organizational culture and values with these contrasting methodologies.

4) Knowledge, Training, and Expertise Gaps: The successful adoption of CMMI in an Agile setting relies heavily on sufficient knowledge, training, and expertise. Valeria et al. [8] and Albuquerque et al. [32] highlight the challenges organizations face due to a lack of in-depth understanding of CMMI and Agile methodologies. The deficiency in specialized training covering the full spectrum of development activities can hinder the effective implementation of these methodologies. Furthermore, the absence of support from specialists in statistical and process management knowledge can leave project managers and process groups struggling to align organizational and project goals with critical subprocesses [30], [38].

5) Scaling and Knowledge Dissemination: Scaling and disseminating practices aligning with CMMI and Agile across an organization is a significant challenge, especially at higher maturity levels. Valeria et al. [8] emphasized that without the active support of upper management, experiences, and practices beneficial to integrating CMMI and Agile often remain confined to specific teams or projects. This limitation prevents these practices from being adopted more widely throughout the organization. Scaling experiences effectively requires documentation of successful practices and a concerted effort to share and institutionalize these practices across various teams and departments [8], [30].

C. Challenges and Solution Mapping

This paper aims to align the solutions by drawing on the identified challenges. Table IV presents the mapping of the challenges and their corresponding potential solutions. This structured approach facilitates a clearer understanding of how each solution directly addresses the specific challenges, thereby enhancing the overall effectiveness of the proposed solutions. Additionally, this alignment ensures that the proposed solutions effectively address the identified challenges, paving the way for a more robust and impactful implementation strategy.

TABLE IV. Solution Mapping

No	Challenges	Solution
1	Resource and Time Constraints	Senior managers must decisively commit to process improvement initiatives, defining the scope and allocating the right resources. The success of these efforts often hinges on continuous investment in process improvements and addressing barriers such as resource limitations, inexperienced staff, organizational politics, and time pressure. The CMMI model, increasing popularity, can be a crucial tool for such improvements. However, understanding how to sustain these improvements post-appraisal, especially under time and budget constraints, remains vital for long-term success. Both higher and lower-level management's support and commitment play a critical role in this regard [8], [12], [27].
2	Organizational Resistance and Change Management	Addressing human issues like resistance and acceptance is essential for senior managers. Strong management support is vital in implementing changes, especially adopting an Agile philosophy. This support helps facilitate cultural change and overcome initial resistance from factors like lack of human resources and work overload. Agile teams may show resistance even with management support, indicating the need for a more comprehensive approach to change management [8], [27], [32].
3	Balancing control and agility	Effective integration of CMMI with Agile processes requires tools that automate control and accountability. This approach helps align traditional governance processes with Agile teams and addresses the additional work CMMI might introduce. Constant monitoring of agility is crucial during this alignment. Developing prescriptive guidelines for Process Areas aligned with business goals can help manage the impact on skill [8], [10], [27], [36].
4	Knowledge, Training, and Expertise Gaps	Senior management must play an active role in contextualizing governance and providing organizational training for Agile practices. Addressing knowledge and experience gaps in CMMI and Agile Development is critical, especially for higher CMMI Maturity Levels. The lack of training for new employees in process improvement is a significant issue that needs to be addressed to bridge knowledge and expertise gaps. Practices from CMMI V2.0 and SAFe 5.0 can support this process [8], [27], [36].
5	Scaling and Knowledge Dissemination	Senior managers should adopt Agile strategies that decentralize decision-making and organize work based on business value. Implementing quality standards and tools for verifying development processes, alongside a model-driven approach, can enable a comprehensive assessment of software development. Addressing Agile's scaling, training, and organizational policy limitations is critical. Knowledge dissemination poses a challenge in large organizations, necessitating the development of non-bureaucratic processes that meet organizational needs. Software Process Improvement (SPI) methodology can extend Agile to enhance product innovation, quality, and efficiency [8], [27], [36], [38].

V. Conclusions

This paper has explored the perceived benefits and challenges of this integration. Integrating CMMI with Agile Project Management presents a promising avenue for enhancing project management practices. Based on further analysis, this integration can lead to more accurate estimations, streamlined project planning, effective risk mitigation, improved quality control, and optimized requirement development and management. However, this integration comes with challenges such as resource constraints, organizational resistance to change, and the need to balance control and agility. Bridging knowledge gaps and scaling integrated practices across the organization are notable hurdles.

Senior management must play a pivotal role by committing to process improvement initiatives, providing necessary resources, and supporting cultural change to overcome challenges. Automation tools for control and accountability, along with continuous monitoring of agility, are essential for

maintaining the balance between CMMI and Agile. Additionally, addressing knowledge gaps through training and promoting non-bureaucratic knowledge dissemination processes are vital steps towards successful integration. Overall, a strategic and committed approach from senior management is crucial to realizing the full potential of the CMMI and Agile integration and improving project management practices for better project outcomes.

A. Limitations of Study

The study's primary limitation lies in integrating CMMI-DEV and software development within Agile project management. The literature review's scope, constrained by the time frame (2018-2023) and language of the publications (English), may also limit the comprehensiveness of the findings.

B. Future Works

Future research should focus on empirical studies to validate the findings of this systematic literature review. Investigations involving case studies or surveys in various organizational settings would offer deeper insights into the practical implementation challenges and benefits of combining CMMI-DEV and software development within Agile project management. Additionally, exploring the evolution of these frameworks in rapidly changing technological landscapes will provide more dynamic and current insights into their integration and application.

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