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 SURVEY

Agile's Anatomy: How Agile's Core Concepts and Contextual Factors Influence Benefits and Issues

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ABSTRACT Agile software development (ASD) methodologies can deliver various benefits but may also provide issues for software development projects. While research has identified numerous benefits and issues, it remains unclear how ASD's core characteristics contribute to the different outcomes. Additionally, little attention has been paid to the project context factors that shape these outcomes. Building on the ASD core concepts framework by Baham and Hirschheim (2022) and 12 contextual factors, we conduct a qualitative systematic literature review of 122 studies to examine relationships between ASD core concepts, contextual characteristics, and the different outcomes (benefits and issues) of ASD. The implementation of core concepts like communication represents cornerstones for desirable benefits, while an inadequate realization of core concepts such as customer involvement can imply various issues. In addition, balancing their execution seems essential, as the highly-paced iterative nature of development and frequent inspections can imply negative consequences, besides their intended beneficial outcomes. Furthermore, we show that certain context factors, including high staff turnover, legacy systems, and volatile requirements can be problematic for ASD projects. Based on these insights, we develop a reconceptualized version of an agile sweet spot to determine an ideal setting for ASD projects. For academia, our work strengthens the theoretical core framework by identifying relationships among the core concepts and outcomes, while a research agenda guides future investigations into how ASD delivers its outcomes. Concerning practical implications, the findings can enable practitioners to improve the application of ASD by highlighting aspects that require dedicated attention to avoid issues.

INDEX TERMS Agile software development, benefits of ASD, issues of ASD, project context factors, literature review, research agenda.

I. INTRODUCTION

Agile software development (ASD) methodologies, including Scrum or Extreme Programming (XP), have transformed the software development (SD) industry and received continuous attention from various research domains [1], [2], that examine how they provide advantages over traditional approaches. To characterize the value of these methodologies, prior studies identified a large range of benefits that result from ASD [3], [4], while other works determined a considerable spectrum of potential issues [5], [6]. Examples of desirable benefits include better requirements meeting [7],

better product quality [8], and improved communication [9]. Frequently reported issues are technical debt [10], stress for the developers [11], or high requirement volatility [12]. While prior research has made progress in clarifying and systematizing the benefits and issues that ASD methodologies entail, e.g., [3], [4], [13], [14], and [15], current knowledge still struggles to explain how they are being created from the perspective of agility. In its current state, related literature lacks answers to the questions of “if, how, why and when ASD impacts outcomes” [2, p. 107]. An important factor that has contributed to these difficulties seems to be the missing ‘theoretical glue’ to conceptualize agility [16] in the particular context of ASD, which was lacking in early studies. While ASD research has recognized that agility

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generally “[contributes] to customer value (economy, quality, and simplicity)” [16, p. 340], it remains unclear how ASD methodologies and their fundamental concept of agility shape the different outcomes identified in previous research.

To this end, recent work by Baham and Hirschheim [2] that conceptualizes agility in the context of ASD methodologies enables a more unified perspective. Several conceptualizations have been proposed before in ASD literature, e.g., [16], [17], and [18]. While such studies mostly agree on the characteristics of agility in their definitions, they vary substantially in regard to the facets, antecedents, and dimensions that agility entails. In contrast, the recently proposed theoretical core for ASD by [2] identifies “a basic, parsimonious, and common set of concepts found across virtually all ASD methods that enable agility” [2, p. 118]. According to this conceptualization, which is based on prior theoretical contributions from the ASD domain and insights from the practical application of the methodologies [2], agility is defined by four theoretical core concepts. These core concepts entail “incremental design and iterative development”, “inspect and adapt cycles”, “working cooperatively / collaboratively / in close communication”, and “continuous customer involvement” [2, p. 118]. With these concepts, the suggested theoretical core captures the essence of what agility entails in the context of ASD. It can therefore serve as a lens to examine how ASD creates its outcomes and assess “which concepts might yield the greatest impacts on desired outcomes such as time to market and software quality” [2, p. 119]. In analogy, understanding how undesirable outcomes result from agility in ASD seems realizable by adopting the framework. In sum, this novel conceptualization appears suitable to investigate how certain characteristics of agility in ASD contribute to the different outcomes. Doing so seems both timely and relevant, since a plethora of benefits and issues have been identified in extant literature [3], [4], [13], [14], [15], yet how these outcomes are realized from the perspective of agility remains to be studied in more detail. Meanwhile, from a practical stance, practitioners would also profit from such insights, as they can enable them to perform a more goal-oriented application of ASD methodologies.

In addition, also “understanding ASD’s project context” [2, p.107] and how it impacts benefits or issues is another key prerequisite to explain the double-sided nature of outcomes. Important contextual factors for ASD projects include the degree of customer involvement and required documentation [19], the distribution of the team, or the project size [20]. These and other contextual factors, however, have often been neglected in extant work, especially due to the frequently employed reductionist strategies in ASD literature that “often miss more context-rich research” [2, p. 108], despite a substantial influence of context factors on the outcomes of SD processes [21]. While prior work proposed a vague ‘agile sweet spot’ [20] that hints at how an ideal environment for ASD projects could be defined, the current knowledge of how different contextual factors affect ASD’s outcomes is limited.

In sum, ASD research exhibits the following shortcomings. Generally, research struggles to determine how agility in ASD shapes the spectrum of different outcomes. Identifying how the suggested core concepts of ASD [2] contribute to these outcomes would enhance our understanding in this regard. In addition, ASD research lacks thorough insights into the role of contextual factors that influence these outcomes. Thus far, little is known about which context factors affect the outcomes of ASD, and how different manifestation forms of the factors benefit ASD projects or increase the likelihood of failure. Gaining such an understanding appears required, though, to maximize the value of ASD projects and avoid settings that cause issues. Guided by these present shortcomings, this study investigates the following research questions (RQ):

- **RQ1:** How do the four theoretical core concepts behind ASD methodologies contribute to benefits or issues?
- **RQ2:** How do different contextual factors of ASD projects shape the realization of benefits or issues, and how is an ideal setting for ASD methodologies defined?

To answer the RQs of this study, we conducted a qualitative systematic literature review (SLR) in line with [22] and [23], and analyzed 77 articles on the benefits of ASD and 45 articles on potential issues. For RQ1, we rely on the four dimensions of the socio-technical systems theory (STS) [24] to map 27 identified benefits and 29 issues to the specific constituent of ASD (actors, their interaction structure, the SD tasks, and the technology / SD process) that seems to be primarily affected by the different outcomes. Employing the theoretical core concept framework for ASD by Baham and Hirschheim [2], we then investigate how the core characteristics of agility in ASD methodologies appear to contribute to these outcomes.

Our study contributes the following insights: First, it finds communication/collaboration and frequent inspections to be cornerstones of ASD, together with customer involvement, which may, however, imply various issues if not adequately realized. To add, benefits primarily appear to result from the interaction of several core concepts, while issues in most cases relate to the inadequate execution of one specific core concept of ASD. We also find that while some core concepts imply substantial benefits, concurrent issues may result, suggesting that a balanced execution of the core concepts is required. Especially too frequent inspections and an excessively high cadence in iterative development stand out here, as they can promote various problems if not executed adequately, despite their importance for ASD. Informed by these findings, we develop five propositions on the role of the core concepts in the realization of the spectrum of outcomes in ASD. We also suggest a future research agenda to address questions that yet remain to be answered regarding the origins of these different outcomes. The propositions and the future research agenda can guide scholars towards further developing explanations for the outcomes of ASD methodologies. As regards practice, these findings can help to understand

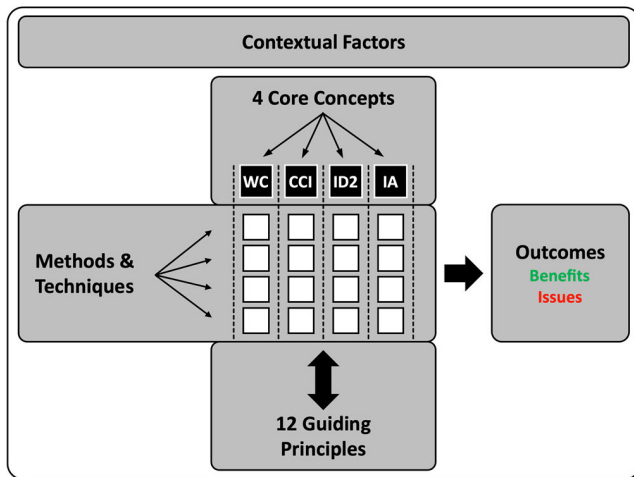


FIGURE 1. Agility in agile software development, adapted from [2].

why certain problems occur in ASD and how to avoid them to conduct successful projects.

To assess the role of the contextual setting in ASD projects for RQ2, we rely on 12 context factors from related literature [19], [20], [21], analyzing how different manifestation forms of these factors appear to influence the outcomes of ASD. Our findings show that low customer involvement, legacy systems, excessive requirement volatility, and frequent staff turnover are context factors that can be especially problematic for ASD projects, as they provoke various issues. In contrast, an ideal setting seems to entail a stable, experienced, and co-located team that develops new applications with low to medium complexity and criticality for highly involved customers, who avoid excessive and erratic requirement changes. Building on these insights, we reconceptualize the previously vague ‘agile sweet spot’ [20]. With this redefined sweet spot, practitioners are equipped with a new framework that highlights contextual factors that need to be carefully considered to avoid settings that can be problematic for ASD projects. Scholars can meanwhile adopt the redefined agile sweet spot framework to provide more comprehensive assessments of the contextual settings in their studies and reflect in more detail how the context factors influence their findings. In so doing, also more attention can be shifted to the influence of contextual factors, as they often appeared neglected in previous studies [2], [20].

To address the posed RQs, we proceed as follows: in section II, we delineate theoretical foundations of ASD, introduce the main lenses of analysis, and discuss related work. Section III contains the research methodology. In section IV, we present the findings on the relationships of ASD core concepts with benefits and issues and the role of contextual factors for these outcomes. Section V defines five propositions on relationships among ASD and its outcomes that can be derived from our analysis and proposes a redefined sweet spot for ASD projects. We also discuss implications for academia along with a future research agenda and

highlight practical implications, followed by potential limitations. Section VI concludes the paper.

II. THEORETICAL BACKGROUND AND RELATED WORK

A. THE THEORETICAL CORE CONCEPTS BEHIND AGILITY IN ASD METHODOLOGIES

ASD methodologies have introduced new approaches for SD projects. Generally, ASD methodologies rely on the concept of agility, which implies an “[SD] team’s ability to anticipate, create, learn from and respond to changes in user requirements through a process of continual readiness” [2, p. 112], to “deliver business value and, in turn, customer satisfaction” [2, p. 114]. However, ASD agility is a frequently debated concept in related literature. Several previous studies have proposed conceptualizations for agility in the ASD context, e.g., [16], [18], [25], [26], and [27], and others listed in Table 1. These prior studies are mostly consistent in their definitions of the term, overall suggesting that agility in ASD entails anticipating, generating, reacting to and learning from changes that occur in SD. Still, a certain conceptual heterogeneity is apparent when comparing their perspectives on the agility concept. As can be inferred from Table 1, such studies vary in the specific facets that agility entails, suggest different dimensions of the notion, and differ in the factors or antecedents that contribute to agility in ASD. To add, some of these conceptualizations, such as [16], draw upon prior research from related, but non-ASD-specific domains. Therefore, they may not fully capture all aspects of agility relevant to the ASD context. Related ASD research corroborates these observations, suggesting that the agility concept and “its exact definition and conceptualization [...] are debated” [28, p. 2], since “only a few studies have explored the theoretical underpinnings of [ASD]” [29, p. 913].

To address these conceptual issues in ASD research, Baham and Hirschheim [2] proposed a theoretical core for the concept of agility, capturing its essential characteristics found across all ASD methodologies. The suggested theoretical core framework denotes the key properties of the agility concept, i.e., the “hallmark of ASD methods” [2, p. 112]. Based on previous findings, including those listed in Table 1, the Agile Manifesto [30], and informed by over two decades of ASD being applied in practical settings [2], the proposed theoretical framework consists of four characteristic core concepts that define agility. Fig. 1 presents the framework by Baham and Hirschheim [2]. The four core concepts include “incremental design and iterative development” (ID2), “inspect and adapt cycles” (IA), “working cooperatively / collaboratively / in close communication” (WC) as well as “continuous customer involvement” (CCI) [2, p. 118]. ID2 refers to the continuous delivery of product increments in iterative cycles by breaking the SD process down into small steps and “allowing the team to solicit feedback and course-correct as they gain new knowledge” [2, p. 113]. IA entails the inspection of the SD process and the work done by the team [2], and the consequent adaptation of aspects that “deviate outside acceptable limits or if the

TABLE 1. Overview of conceptualizations of the notion of agility in the context of ASD methodologies.

Authors	Definition of Agility	Suggested Characteristics of Agility	Contribution to Knowledge on Agility
Baham & Hirschheim [2] (used in this study)	“A software development team's ability to anticipate, create, learn from and respond to changes in user requirements through a process of continual readiness” (p. 112).	Anticipation, creation, learning from and responding to changing user requirements, enabled by four core concepts of agility (ID2, IA, WC, CCI), which are implemented via the application of ASD methods and techniques / practices.	Proposes a unified theoretical core to conceptualize agility by identifying the most common characteristics among all ASD methodologies that realize agility in SD, uniting prior academic findings on the concept with practical perspectives.
Batra et al. [18]	“The creation of or reaction to changes in user requirements for a software development project” (p. 2).	Sensing and responding to changes, combined with emergent planning and routinized learning as agility dimensions, while several facilitators contribute to these four agility dimensions.	Proposes a framework with nine distinct agility facilitators, enhanced with further sub-dimensions of these facilitators.
Conboy [16]	“Continual readiness of an ISD method to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment” (p. 340).	Creation of, proaction and reaction to, as well as learning from change to contribute to customer value, while minimizing cost and time in doing so.	Develops a frequently cited definition for agility in the context of ISD based on a literature view and step-wise synthesis, subsequently proposes a taxonomy of characteristics that components of an ISD methodology need to fulfill to be considered as agile / agility-enabling.
Lee & Xia [35]	“The software team's capability to efficiently and effectively respond to and incorporate user requirement changes during the project life cycle” (p. 90).	The agility dimension of response effectiveness implies embracing change with measures by SD teams, while response efficiency suggests “doing so with high speed and low cost” [35, p. 90].	Suggests how two agility dimensions, enabled by key antecedents for ASD such as SD team diversity and autonomy, contribute to SD project performance.
Qumer & Henderson-Sellers [36]	“Agility is a persistent behaviour or ability of a sensitive entity that exhibits flexibility to accommodate expected or unexpected changes rapidly, follows the shortest time span, uses economical, simple and quality instruments in a dynamic environment and applies updated prior knowledge and experience to learn from the internal and external environment” (p. 505).	The specific features of agility include flexibility to accommodate change, speed of providing results, leanness with regard to economic factors, quality and simplicity, learning from experience, and responsiveness.	Proposes an analysis model with four dimensions to evaluate and compare ASD methodologies along four dimensions (method scope characterization, agility characterization along five specific features, agile values characterization, and software process characterization).
Rathor et al. [25]	“Software development agility is the capability to manage various kinds of changes during the development process” (p. 1).	Sensing, responding and learning from different changes (e.g., requirements, or budget / schedule), with communication, collaborative decision-making and iterative development as antecedents of agility, contributing to project outcomes.	Proposes a conceptual model linking key antecedents in agile processes to three dimensions of agility, which is suggested to provide beneficial project outcomes such as customer satisfaction or efficiency.
Rathor et al. [17]	“The ability of a software development team to sense, respond, and learn from frequent business and technology changes” (p. 1).	Sensing, responding and learning from change as agility dimensions, enabled by team autonomy, team competence and iterative development, which contribute to communication and collaborative decision making that ultimately stimulate agility.	Introduces and validates a model of agility antecedents (team, methodological and process factors), confirming they support agility in general, while also assessing the effects on three agility dimensions.
Sarker & Sarker [27]	Refers to a definition by [37], defining agility as “the ability of information systems development and deployment methods to swiftly adapt to the changing business requirements” (p. 442).	Multifaceted concept with three main dimensions (resource agility, process agility, and linkage agility), where each dimension has further facets.	Identifies three agility dimensions as part of a conceptual framework and applies the concept in a distributed ASD setting, while revealing project and team contingencies that affect the three agility dimensions.
Vial & Rivard [26]	No explicit definition given, instead refers to prior definitions, e.g., [16], [36].	Flexibility, cooperation, learning and leanness as essential dimensions of the agility concept.	Identifies four facets related to the debated concept of agility in the ISD context.

resulting product is unacceptable” [31, p. 4]. Meanwhile, **WC** and **CCI** entail how ASD emphasizes ‘individuals and interactions’ and ‘customer collaboration’ [30]. **WC**, that is, the communication among team members and customers, represents the key mechanism for information sharing [32] and interaction in ASD [33]. Also embedded in **WC**, the collaboration within the team and with the customer allows to “to frequently release product features” [34, p. 522]. Lastly, **CCI** implies continuous involvement of customer representatives to foster “constant focus on customer needs [and] enhance an [SD] team’s ability to deliver business value” [2, p. 114]. Table 2 further outlines the core concepts

and summarizes characteristics that they contribute to agility.

In contrast to previous conceptualizations in Table 1, which seem to differ in various aspects, the proposed theoretical core entails “the most basic, parsimonious, and [...] common set of concepts found across virtually all ASD methods that enable agility” [2, p. 112]. It provides a more unified perspective on the concept, while addressing the conceptual heterogeneity of prior conceptualizations. In addition, the suggested theoretical core was explicitly developed for the ASD context [2], capturing the specificities of agility in this domain. In contrast, other prior studies, e.g., [16],

TABLE 2. Theoretical core concepts of agility in ASD methodologies by Baham and Hirschheim [2].

Acronym	ASD Core Concept	Focus of Core Concept, based on Baham & Hirschheim [2]	Exemplary Practices
ID2	Incremental Design and Iterative Development	Iterative development in short delivery cycles under constant cadence with a focus on a reduced subset of requirements delivered per iteration to allow for frequent inspections of performed SD work and facilitate upcoming iterations, based on the learnings from previously delivered increments.	Small Releases, Sprint-based Development, Iteration / Sprint Backlogs, Iteration Planning, Review and Retrospective Meetings
IA	Inspect and Adapt Cycles	Continuously reflecting on delivered work during and after an iteration to improve the product and the process by detecting and adjusting to issues that may impede the constant delivery of value to the customer.	Daily Meetings, Review Meetings, Retrospective Meetings, Testing, Continuous Integration, Refactoring
WC	Working Cooperatively / Collaboratively / in Close Communication	Operating and collaborating on development tasks as a small, cohesive, autonomous team in constant communication exchanges (ideally face to face), with the customer being part of development team.	Open Office Space, On-Site Customer, Pair Programming, Daily Meetings, Co-Location, Retrospective Meetings
CCI	Continuous Customer Involvement	Constantly involving the client / business to build a close relationship, establish a mutual understanding of requirements, present deliverables from the last development iteration and collaboratively assess change.	On-Site Customer, Review Meetings, Iteration Planning Meetings, Planning Game, Product Backlog Grooming

have usually drawn from agility aspects suggested in related domains, e.g., “management, manufacturing, organizational behavior, and other relevant business research” [16, p. 334], in their definitions of the concept, potentially neglecting facets of particular importance for the ASD context. Meanwhile, by “theorising exclusively to ASD” [2, p. 108], Baham and Hirschheim [2] offer an ASD-specific conceptualization of the debated notion of agility. Consequently, employing the theoretical core framework to examine “if, how, why and when ASD impacts outcomes” [2, p. 107] represents a well-founded, promising approach.

As shown in Fig. 1, the four core concepts, indicated as black boxes, are “operationalized using a set of [agile methods and] techniques” [2, p. 117] and informed by the 12 principles of the Agile Manifesto [30]. These techniques, also referred to as ASD practices, are depicted as white boxes. ASD practices are key parts of each ASD methodology and can be classified into project management (PM) and software engineering (SE) practices [2], [38]. These ASD practices differ regarding their individual contributions to the four core concepts, e.g., daily meetings as a typical PM practice as part of Scrum [31] foster communication and collaboration in teams [9]. Meanwhile, refactoring, being an SE practice from XP [39], implies iterative development and inspections, as well as adaptations of the code [2]. Further examples are provided in Table 2.

As shown in Fig. 1, the realization of agility, embedded in the four core concepts **ID2**, **IA**, **WC**, and **CCI**, which is achieved with the use of ASD methodologies and associated practices, leads to different outcomes. These outcomes can be positive (benefits) [3] or negative (issues) [40], while both sides entail a large spectrum of aspects. In this vein, ASD can provide benefits such as improved job [38] and customer satisfaction [41], higher productivity [42], better meeting of requirements [43], and improved collaboration within the team [44], as well as with customers [45]. Simultaneously, negative implications of ASD include stress for developers [46], [47], interruptions of developers’ workflow [48], technical debt [10], or difficult customer communication [49].

Besides its beneficial or problematic nature, the spectrum of outcomes also implies socio-technical characteristics, as will be illustrated in section II-B. Lastly, as shown in Fig. 1, ASD and its outcomes depend on contextual factors that define the setting in which ASD projects are being performed [2]. These factors strongly affect SD processes [21] and influence the realization of beneficial or negative outcomes, depending on whether the contextual factors are in line with an ‘agile sweet spot’ [20] for ASD projects. Section II-C further elaborates on the role of contextual factors to understand *when*, i.e., under which circumstances, different outcomes result from ASD.

B. A SOCIO-TECHNICAL PERSPECTIVE ON BENEFITS AND ISSUES IN ASD METHODOLOGIES

Besides developing a unified conceptualization of agility [2], research has intensified its investigations of ASD from a socio-technical perspective [50]. Research considers ASD as a socio-technical system [51], as it implies a “socio-technical phenomenon, where human and technological interactions are tightly coupled” [50, p. 7]. The underlying STS theory is based on Bostrom and Heinen (1977) [24] and entails a work system with a social and a technical subsystem that “work together to accomplish tasks” [52, p. 453]. Based on “joint interactions between these two systems” [24], outcomes such as “greater performance in agile development [can be] achieved” [51, p. 327]. The technical subsystem contains “processes, tasks, and technology needed to transform inputs to outputs” [24, p. 17], where tasks are the subtasks required to produce goods, and technology entails processes (such as the SD-process) to solve tasks [53], i.e., developing an information system (IS) [54]. The social subsystem implies actors and their mutual structure of interactions [24]. Actors are an “organization’s members and its main stakeholders who carry out or influence the work” [54, p. 596], i.e., the developers, the team, and the customers. Structure, meanwhile, refers to the communication among these actors, and their decision-making structures [53], [54].

When combining the spectrum of outcomes with the STS perspective on ASD, it becomes apparent that these

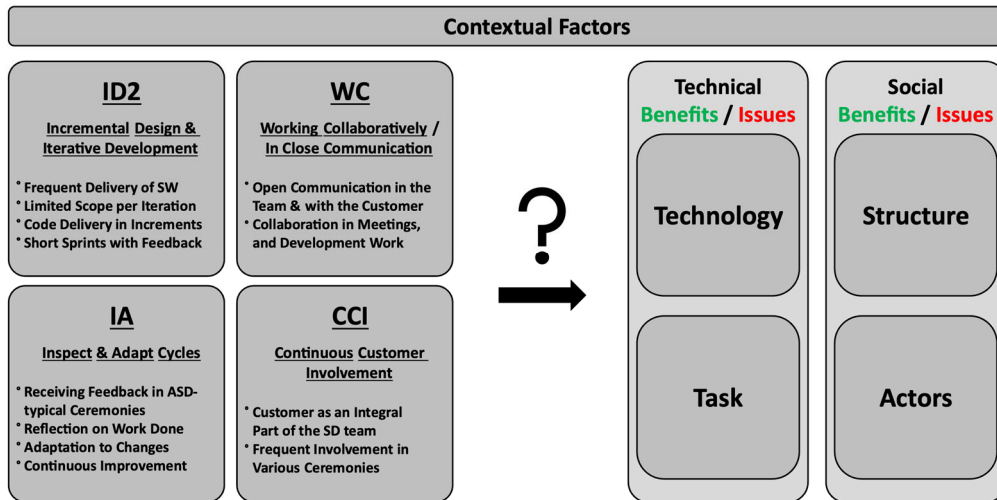


FIGURE 2. Lenses of analysis: ASD theoretical core concepts and dimensions of the STS-theory as a classification of ASD's outcomes.

different outcomes can be mapped to the four dimensions of the STS. As such, job and customer satisfaction [38], [41], as well as stress [46], concern the developers and clients, who are the actors in ASD. Meanwhile, improvements in team/customer collaboration [45], and difficulties in communication with clients [49], relate to the structure between these actors. Furthermore, improved transparency about the development status [55], continuous improvement of the way of working [56], and interruptions during SD [48] relate to the process, which is the technology as the key delivery mechanism of SD [51]. Lastly, better requirements meeting [8], [43], higher software quality [44], but also technical debt [57], concern the task of delivering working software with ASD methodologies.

Given these apparent linkages and how the outcomes can be mapped to the STS dimensions, using the STS theory as a classification lens to structure the spectrum of outcomes of ASD appears suitable. This also seems timely, as STS-inspired perspectives on ASD recently received more attention in SE research, e.g., in [50]. For this study, we therefore employ the STS dimensions of actors and structure to categorize outcomes related to the social side of ASD, and technology and tasks to segment rather technical outcomes, as illustrated in Fig. 2.

As of yet, however, it remains unclear “which core concepts might yield the greatest impacts on desired outcomes such as time to market and software quality and why” [2, p. 119]. This is also the case for issues, given the lack of systematic analyses from the perspective of agility being embedded in the four core concepts. Fig. 2 visualizes this current situation. In this regard, other questions on the connections between the core concepts and the spectrum of outcomes also remain unanswered: Which of the core concepts are required to realize benefits in which dimension? Which interactions of core concepts contribute to specific beneficial outcomes? Are certain core concepts more important for distinct desirable

outcomes than others? Which core concept(s), if not adequately realized, may imply issues?

Given that these and other questions remain to be addressed, a profound understanding of the linkages between ASD's core concepts and the spectrum of outcomes is lacking. Developing this understanding is required, however, to explain “if, how, why, and when ASD impacts outcomes” [2, p. 107]. Therefore, our first goal is to examine *how* the characteristics of agility in ASD that are embedded in the four theoretical core concepts (WC, IA, ID2, and CCI) lead to different outcomes.

Besides the key question of *how* ASD contributes to its outcomes, the question of *when*, i.e., under which contextual settings ASD leads to different outcomes, also remains to be answered, as will be described in the following section.

C. THE ROLE OF CONTEXT FACTORS FOR BENEFITS AND ISSUES IN ASD METHODOLOGIES

Contextual factors have a considerable impact on SD projects [21] and their outcomes. Typical factors that characterize the situational setting of SD projects include project size, team distribution, rate of change, project budget, team experience, or customer involvement [19], [20], [21]. SD projects are generally “dependent on the situational characteristics of individual software development settings” [21, p. 433]. ASD-based projects, however, are particularly susceptible to the characteristics of the situational setting. Kruchten [20] vaguely defined the optimum characteristics of a contextual setting as an “agile sweet spot” (p. 356) for successful ASD. In this regard, ASD is suggested to be best situated in a setting with a “collocated team, of less than 15 people, doing greenfield development for non-safety-critical systems, in [a] rather volatile environment; [where] the system architecture is defined and stable, and the governance rules [are] straightforward” [20, p. 356]. While ASD can still be effective in settings that diverge from this agile

sweet spot, such settings require adaptation [20] and dedicated management attention.

Thus far, however, the key role of contextual factors seems neglected, as prior studies in the ASD research domain often employ reductionist strategies “that often miss more context-rich research” [2, p. 108], resulting in a mostly fragmented, piecemeal manner of reporting of the contextual factors. In this vein, comprehensive analyses that examine how specificities of contextual factors are related to beneficial or undesired outcomes of ASD are lacking. Hence, it also seems difficult to both precisely define and validate the proposed ‘agile sweet spot’ [20]. In addition, this sweet spot only covers a limited set of potentially relevant contextual factors, despite other studies, including Clarke and O’Connor [21], having identified a larger set of context factors that affect SD projects and their outcomes. Comprehensively defining this sweet spot is required, though, to explain *when*, i.e., under which specific circumstances benefits result, or issues are likely to occur due to a potential incompatibility between ASD and the respective contextual setting. In this line of thought, as ASD is a “highly diverse, adaptable, contextual, situated practice” [2, p. 108], “scholars also stress the importance of understanding ASD’s project context” [2, p. 107] when examining these outcomes. Still, systematic analyses in this direction are yet missing.

Considering these shortcomings, our second goal is to assess how contextual factors, and their manifestations forms, appear related to both benefits and issues. We also aim to redefine the ‘agile sweet spot’ [20] to determine an ideal setting for ASD. Based on prior works focusing on contextual factors [19], [20], [21], we synthesize a comprehensive set of 12 contextual criteria with relevance to ASD methodologies. The selected 12 criteria are described below and represent the foundation for the analysis of the role of context factors in the realization of benefits and issues with ASD methodologies, while all individual manifestation forms of these 12 contextual factors can be found in Table 12 in section IV-B.

1) PROJECT/APPLICATION SIZE

Aspects that determine the size of a project include, among others, the number of teams involved, the size of the code for the application that is being developed, the budget, or the estimated duration [20], [21].

2) PROJECT COMPLEXITY

The project complexity depends on aspects such as hardware architecture, the complexity of tasks involved, and potential dependencies with other systems [21].

3) CRITICALITY OF SYSTEM IN DEVELOPMENT/RISK

This factor implies how people are affected by a project, especially how severe the consequences are in case of a project failure [20].

4) SYSTEM AGE/DEVELOPMENT PHASE

The age of the system, the developmental stage in its life cycle, and potentially inherited technical liabilities from legacy systems are important determinants of this contextual factor [20], [21].

5) RATE OF CHANGE/REQUIREMENTS VOLATILITY

The stability of requirements, changes in up-front defined needs, scope creep, and a lack of clarity in requirements determine the volatility and the rate of change in SD projects [20], [21].

6) PREREQUISITES/DOCUMENTATION NEEDS

ASD emphasizes minimum documentation [30], however, bureaucratic environments or projects with public safety risks may require more documentation [19], [20], which can affect the SD team in performing their development work.

7) CONTRACT DESIGN/PAYMENT ARRANGEMENTS

The project budget represents a central contextual constraint that has a considerable impact on SD processes, ranging from time and materials, fixed prices, to other budget forms [21]. ASD and fixed-bid contracts are often difficult to combine [19].

8) DEGREE OF CUSTOMER INVOLVEMENT/COMMITMENT

ASD relies on the customer being strongly involved [30], which can be problematic if involvement is lacking [19]. This factor is critical to ensure successful ASD projects [34].

9) TEAM SIZE

ASD teams should consist of less than 10 members to increase the dexterity of the team and to facilitate communication [31]. Very large teams can prove problematic.

10) TEAM DISTRIBUTION

This factor determines how teams are geographically arranged, ranging from co-located teams to distributed teams or offshore scenarios [19], [20].

11) EXPERIENCE/MATURITY/SKILL/EXPERTISE

This factor describes the experience of the team, the members’ experience with specific methodologies (such as ASD), or technologies [21]. Novice teams can be risky for ASD projects [20].

12) TURNOVER/TEAM STABILITY

This factor indicates whether the team’s personnel is stable without excessive turnover [21], which can be problematic for ASD teams [58].

D. IDENTIFIED RESEARCH GAPS IN RELATED WORK

Guided by neglect spotting [59] in the analysis of related research on ASD and the benefits, as well as the issues it can contribute, **four** shortcomings can be identified.

First, related studies on outcomes of ASD methodologies have not yet systematically examined them from a dedicated

TABLE 3. Related secondary studies on benefits and issues in the context of ASD methodologies.

Secondary Study	Goal of Study	Research Questions	# of Studies & Search Period	Contributions to Knowledge on Benefits and Issues of ASD
Our Study	Examine the relationships among four core concepts of ASD agility [2] and outcomes (benefits and issues), combined with an analysis of 12 context factors that affect the realization of outcomes.	<i>RQ1</i> : How do the four theoretical core concepts behind ASD methodologies contribute to benefits or issues? <i>RQ2</i> : How do different contextual factors of ASD projects shape the realization of benefits or issues, and how is an ideal setting for ASD methodologies defined?	122 studies, 2006-2024	27 benefits and 29 issues, allocated according to the 4 dimensions of the STS, identified relationships among core concepts and outcomes, developed an agile sweet spot model.
Alzoubi et al. [64]	Identify issues and challenges related to communication in geographically distributed agile development (GDAD) and find measures to address them.	<i>RQ</i> : What is empirically known about GDAD communication? <i>RQ1</i> : What are the challenges or factors that limit GDAD communication? <i>RQ2</i> : Which techniques have been used to overcome these challenges and enhance GDAD communication?	21 studies, up to July 2014	Identifies 6 categories of GDAD communication challenges and suggests several subsequently occurring issues / impacts resulting from these challenges.
Dybå & Dingsøy [61]	Examine the state of research on benefits and limitations of ASD methodologies in empirical studies and determine the strength of existing evidence.	<i>RQ1</i> : What is currently known about the benefits and limitations of agile software development? <i>RQ2</i> : What is the strength of the evidence in support of these findings? <i>RQ3</i> : What are the implications of these studies for the software industry and the research community?	36 studies, up to and including 2005	Several benefits found, e.g., product quality, productivity, or job satisfaction, while issues include inefficiency of pair programming, or lacking attention regarding design and architecture aspects.
Fitriani et al. [14]	Identify challenges of ASD methodologies in general.	<i>RQ</i> : What are the challenges of agile software development?	20 studies, 2012-2016	Generic list of 30 challenges related to ASD.
Gustavsson [15]	Identifies the benefits that ASD methodologies can provide in other contexts besides SD and assesses challenges reported in the literature.	<i>RQ1</i> : What benefits are experienced from using agile project management in non-software development contexts? <i>RQ2</i> : What challenges are experienced from using agile project management in non-software development contexts?	21 studies, 2001-2015	17 benefits that ASD can provide in other contexts than SD, also finding 11 challenges that can occur, suggesting correspondence with Manifesto's values.
Huck-Fries et al. [62]	Evaluate the state of research on the frequently highlighted benefit of job satisfaction in ASD and guide future efforts.	<i>RQ</i> : What is the effect of agile ISD practices on team members' job satisfaction?	21 studies, not specified, includes studies from 2004-2020	State of research laid out, job satisfaction model with antecedents, moderators and consequences.
Inayat et al. [65]	Systematize findings on the specific challenges and issues associated with ASD requirements engineering practices.	<i>RQ1</i> : What are the adopted practices of agile RE according to published empirical studies? <i>RQ2</i> : What are the challenges of traditional RE that may get alleviated by agile RE? <i>RQ3</i> : What are the challenges of agile RE?	21 studies, 2002-June 2013	Identify challenges of requirements engineering in ASD, enhanced with an identification of their negative consequences.
Meckenstock [5]	Structures and synthesizes findings on issues occurring in ASD and identifies relationships among such issues to determine especially critical problems.	<i>RQ1</i> : What are the specific issues that characterize the dark side of ASD methodology application and what are the constituents in SD that are primarily affected by them? <i>RQ2</i> : How do various issues occurring in ASD methodology use relate to each other and how do potential relationships define the complexity of the dark side of ASD?	70 studies, 2006-2022	90 issues systematized into 18 overarching themes on 6 different manifestation levels, analysis of 65 relationships among issues to identify the most critical issues.
Meckenstock et al. [3]	Identify and systematize benefits of ASD found in IS research and conceptualize the term business value in the ASD context.	<i>RQ1</i> : Which forms of business value can the use of ASD methodologies create? <i>RQ2</i> : In which ways do these business values contribute to ASD project success?	34 studies, 2006-2021	43 benefits grouped into 14 themes, organized to 5 manifestation levels, definition for the ASD business value concept.
Rytkönen et al. [60]	Assess empirical findings on the benefits and challenges of ASD.	<i>RQ</i> : What evidence do we have on benefits and downsides of agile methods?	15 studies, up to January 2024	7 benefits and 7 challenges identified.
Santos & de Carvalho [13]	Synthesize findings on benefits and issues of scaling ASD to larger projects and identify relationships among benefits and issues.	<i>RQ1</i> : What are the key barriers to scaling APM to large projects? <i>RQ2</i> : What are the main benefits observed for adopting APM for large projects? <i>RQ3</i> : What is the relationship between barriers and benefits?	76 studies, not specified, includes studies from 2003-2019	32 benefits clustered into three main categories, 53 issues organized into six categories, relationships between barriers / issues and benefits identified.
Sfetsos & Stamelos [63]	Systematize findings on the beneficial implications of ASD practices for quality, especially related to code and products.	<i>RQ1</i> : What is the current state of knowledge on quality in agile practices? <i>RQ2</i> : Which are the most significant practices for achieving quality in agile development?	46 studies, up to and including 2009	Finds benefits of several ASD practices for quality, e.g., defect density, code and product quality, alongside a few issues.

agility perspective, e.g., by using an agility framework such as the theoretical core for ASD by [2]. Prior secondary studies on the benefits or issues of ASD, e.g., illustrated in Table 3, have contributed valuable knowledge on positive and negative outcomes. As such, several studies, e.g., [3], [5], [14], [60], or [61], developed systematizations of benefits and issues to enable comprehensive overviews of the outcome spectrum of ASD. These studies enabled ASD researchers to grasp what is generally known about the outcomes of ASD methodologies. Other works focus on specific benefits, e.g., job satisfaction [62], or product quality [63]. Similarly, distinct issues, such as communication challenges in distributed ASD [64], as well as issues related to specific ASD practices [65] have been systematically examined. Such works offer deeper insights by aggregating findings on how ASD and practices contribute to outcomes. To add, several studies systematized findings on benefits and issues of ASD when employed in contexts besides the development of software [15], or when ASD is practiced in large project environments [13]. These studies thus emphasize how ASD has transcended to other domains, with benefits and issues comparable to those in the SD context.

However, previous studies generally lack explanations as to how benefits or issues appear to result from the underlying concept of agility in ASD methodologies. In this regard, prior studies primarily systematized identified outcomes, yet did not assess how the characteristics of ASD agility, for instance, embedded in the four core concepts, appear to influence them. Therefore, how characteristic core concepts of ASD contribute to positive outcomes persists to be clarified, as suggested by [2]. Similarly, it remains unclear how negative outcomes of ASD can also be related to these characteristic core concepts, which was somewhat neglected in [2]. Together, systematic knowledge on how the different outcomes found in prior work relate to the essential characteristics of agility underlying all ASD methodologies is still limited. Consequently, examining the benefits and issues from the perspective of characteristic core concepts of ASD seems worthwhile to better understand how this outcome spectrum is created, thereby going beyond only systematizing them, as was done by prior related studies.

As a **second** shortcoming, the contextual factors that shape the realization of benefits or issues appear mostly neglected in prior literature. While early research on ASD methodologies has provided some insights into how context factors affect the SD process and its outcomes, e.g., [19] and [20], an in-depth analysis of the relationship between the manifestation forms of certain context factors and ASD's outcomes is lacking. In addition, these contributions only assessed a limited range of factors, despite various other relevant aspects that should be considered. More generic, non-ASD exclusive literature, such as [21] and [66], focuses on a wider range of such factors. However, these works only address *what* factors generally influence SD projects and their outcomes, thereby neglecting *how* different nuances of the contextual factors (such as high / medium / low customer commitment) affect

the projects. As such, it remains unclear *how* an ideal setting is defined and *when* benefits are most likely to be achieved. While Kruchten [20] proposed a vague "agile sweet spot" (p. 356) for ASD, a thorough analysis of how different nuances of these context factors jointly form this sweet spot for ASD is still missing.

A systematic clarification of an ideal setting for ASD seems necessary, though, to determine contextual characteristics that enable successful ASD projects. Similarly, identifying settings that must be avoided to minimize issues seems important to maximize the potential of ASD in practical applications. Hence, a comprehensive analysis of the role of contextual factors in the realization of benefits or issues appears valuable, which can improve the application of ASD in practice and provide answers for scholars who aim to understand *when*, i.e., in which contexts, ASD delivers different outcomes [2].

Third, validating the proposed theoretical core for ASD [2] can advance the debate on theoretical foundations of agility. Thus far, studies that suggest relationships among agility and outcomes, e.g., [25], did not subsequently validate these suggested relationships, e.g., [17]. In a similar vein, studies citing the theoretical core did not operationalize it with regard to the creation of outcomes, while the authors themselves [2] also "did not [...] test the framework" [17, p. 841]. Validating the framework and examining relationships between agility and outcomes of ASD with a theoretical lens, e.g., [2], is important, though, to establish a common ground for future studies that examine how ASD creates its outcomes. Also, the characteristics of ASD agility, e.g., captured by the four core concepts, are interlinked [2] and seem to contribute to these outcomes through interaction. This interaction has not been assessed yet, but is necessary to understand how agility creates ASD's outcomes. A systematic analysis of the core concepts in outcome creation would thus validate the framework and enable research to better understand the mechanisms by which ASD generates these outcomes. Practitioners can also benefit from this approach by better understanding the characteristics of agility that require attention for successful ASD application.

Fourth, the socio-technical nature of ASD and its outcomes remains to be explored in detail. While recent studies have discussed ASD from a socio-technical stance, including [51], [67], and [68], analyses of the connections among ASD's core concepts and the socio-technical spectrum of outcomes appear necessary to explain effect-creation in ASD. In combination with the recent suggestions by [50] to conduct STS-oriented investigations on ASD, examining the methodologies and their outcomes in light of the STS appears worthwhile. In so doing, researchers could better understand which benefits or issues may result for the actors, structure, technology, and tasks in ASD, and explain how these outcomes come about.

To conclude, we **a)** aim to examine *how* ASD's outcomes are influenced by the core concepts, and **b)** assess the context factors that shape these outcomes, thereby thoroughly

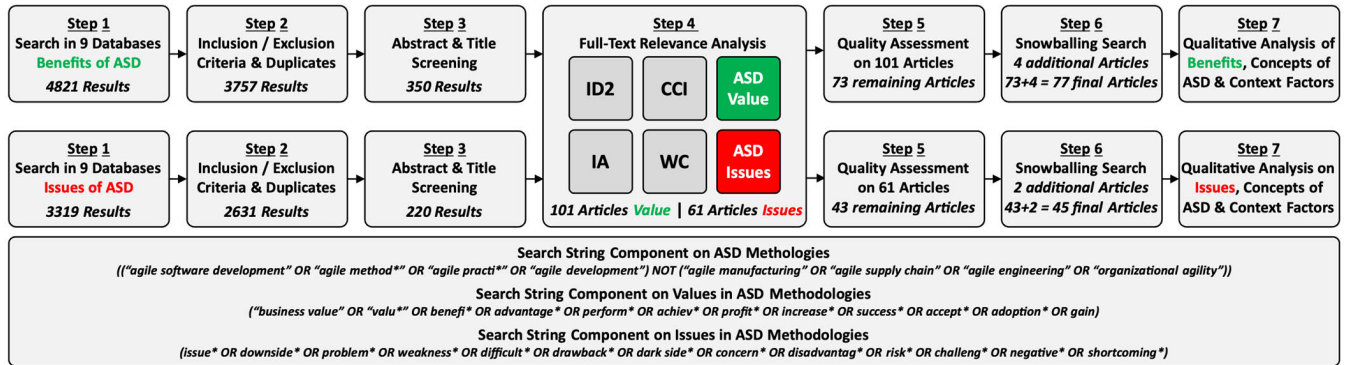


FIGURE 3. Literature search and analysis process with search strings.

defining the agile sweet spot to answer *when* ASD works best (and *when* not). Furthermore, *c*), employing the ASD core concepts as a lens of analysis represents the first application of its kind, which can help to verify and validate the theoretical core, as well as establish a common ground for future inquiries into the nature of ASD and its outcomes. Lastly, *d*) assessing the socio-technical nature of the benefits and issues of ASD will help to advance STS-oriented inquiries called for in related literature.

III. METHODOLOGY

A. TYPE AND GOAL OF THE REVIEW

To address the described shortcomings in extant literature, we conducted a qualitative systematic review [22], [23]. Our goal is to examine the role of the core concepts in shaping benefits and issues to understand how the broad spectrum of different outcomes comes into existence. This also entails the analysis of contextual factors that influence the outcomes. Employing a qualitative systematic review appears suitable, as it allows us to “integrate prior empirical (qualitative and quantitative findings)” [23, p. 579] on the outcomes of ASD and to assess “what works best” [23, p. 579] to realize ASD’s benefits, and consequently also what does *not* work, to address the issues in ASD. The search and selection process to identify literature relevant to our RQs follows the recommendations by Kitchenham and Charters [69]. For the subsequent content analysis [22], we adopt a multipronged approach along the dimensions of the STS theory [24], the theoretical core concept framework for ASD [2], and the 12 context factors derived from [19], [20], and [21]. This multipronged approach is described in section III-C. To ensure transparency in SLRs [70], we report in detail on the process behind this review. The steps in the selection and analysis process in Fig. 3 and Fig. 4 can be retraced with an online appendix via the following link: <https://doi.org/10.6084/m9.figshare.29900132>

B. LITERATURE SEARCH, SELECTION OF RELEVANT STUDIES, AND QUALITY ASSESSMENT

Guided by the requirement for a comprehensive search strategy in qualitative systematic reviews [22], we based our

search on nine databases. To represent the recent growth of work on ASD from the SE domain [2], we selected ScienceDirect, ACM’s digital library, SpringerLink, and IEEE Xplore. For IS literature, we employed AISEL and Taylor & Francis. For management research, we relied on the Web of Science, EBSCO Host, and WILEY. We then defined two separate search strings to perform two disjunct searches, of which one focused on the beneficial aspects of ASD, while the other string addressed the issues. As such, both search strings share the same search terms for the main component on ASD methodologies, which excludes terms that relate to the word agile, yet do not align with the focus of our research. Concatenated with an AND-operator, the two search strings either concern benefits or issues, as displayed in Fig. 3.

We first searched all databases with the two search strings, which were adapted to the individual characteristics of the search engines. In the initial step, 4821 articles resulted from the search on benefits, while 3319 articles were identified with the string on issues. A listing of all results from each database is depicted in Appendix A. In line with [69], we applied inclusion and exclusion criteria to limit the initial sample in the second step. In this vein, only journal or conference proceedings published in English were selected. In addition, since ASD research experienced a first peak of publications in 2006 [1], we only included studies from 2006 up to 2024. All further inclusion and exclusion criteria are listed in Appendix A, Table 16. Within this step, we also excluded 125 duplicates that were identified with both search strings. After applying the inclusion and exclusion criteria and removing duplicates, the sample on benefits contained 3757 articles, while the sample on issues consisted of 2631 articles. In the third step, we performed an abstract and title-based screening with two independent researchers assessing whether the articles focused on ASD and its outcomes. This screening procedure left 350 articles in the sample on benefits and 220 studies on issues. We also calculated the inter-rater agreement score with a value of 0.80 in this step, which indicates substantial agreement [71]. Potential disagreements were meanwhile discussed with all participating authors. In the fourth step, two authors conducted a full-text relevance analysis. Here,

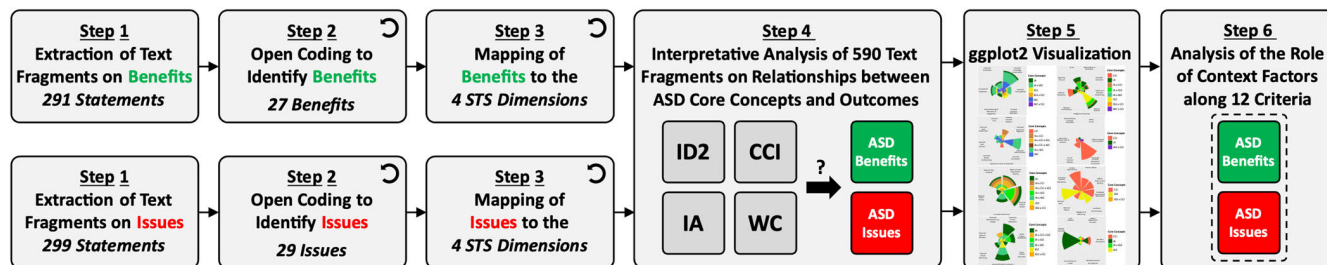


FIGURE 4. Qualitative content analysis on ASD core concepts and context factors.

articles of relevance had to elaborate on at least one of the core concept characteristics of ASD and discuss beneficial or unfavorable consequences (see Fig. 3). Consequently, 101 articles on benefits and 61 articles on issues in ASD remained. We calculated an inter-rater-agreement score of 0.91 in this step, which suggests an almost perfect agreement [71]. In line with [22] and [69], the fifth step included a quality appraisal of all selected studies. We relied on eight criteria from prior SLRs in the ASD domain, e.g., [61], and only included studies that received at least four of eight points [72]. The quality assessment results can be found in the online appendix, while Table 17 in Appendix A shows the employed criteria. As a result, 73 articles on benefits remained, along with 43 articles on issues. In addition, we evaluated the two samples based on the German JOURQUAL 3 and the international ABDC ranking, which highlighted the quality of the selection, considering the scores in the quality assessment and the ratings in the two employed rankings. In the sixth step, we performed a snowballing-based back-and-forward search following [73] to identify further relevant studies. We used Scopus and Web of Science’s citation search, identifying four further articles for the benefit sample and two studies for the issue sample. Hence, 77 articles form the final sample on ASD’s benefits, while 45 articles are included in the final issue sample. Four articles are assigned to both samples, given their focus on both positive and negative outcomes of ASD. All studies are shown in Appendix B and Appendix C, with individual IDs (B1-B77 for studies on benefits) and (D1-45 for publications on issues / downsides), while further details of the studies can be found in the online appendix. The seventh step comprised the qualitative content analysis, which will be explained next.

C. MULTIPRONGED APPROACH BEHIND THE QUALITATIVE CONTENT ANALYSIS

For the qualitative content analysis, a multipronged approach with six steps involving the four authors was adopted, as illustrated in Fig. 4. This multipronged approach employs open coding techniques by Saldana [74] to first identify benefits and issues as outcomes of ASD in the literature sample. Second, it adopts the four dimensions of the STS theory (actors, structure, technology, and task) [24] to classify the outcomes to their respective level of manifestation. Third, it utilizes the ASD core concepts (WC, IA, ID2, CCI) of the theoretical framework by Baham and Hirschheim [2] to examine how

the key characteristics of agility shape the different outcomes. Fourth, it employs 12 contextual factor criteria from [19], [20], and [21], to determine the role of context factors for benefits and issues. All steps in the qualitative content analysis are described next:

In the first step, the two first authors individually extracted 291 text fragments from the literature samples that illustrated a benefit, and the characteristic(s) of ASD embedded in the four core concepts that appeared to lead to this beneficial outcome. In analogy, the two authors extracted 299 statements on issues and the core concept behind them.

In the second step, the two authors individually assessed all text fragments with an open coding technique [74] and grouped similar statements to distill 27 benefits and 29 issues as outcomes of ASD, while iteratively revisiting these outcomes in joint discussions with all other authors to reach theoretical saturation [75] for the subsequent steps.

In the third step, we mapped the identified outcomes to the four dimensions of the STS theory (actors, structure, technology, and task) [24]. In three iterations, we assigned the 27 positive and 29 negative outcomes to the dimension that seemed primarily affected by them. The first iteration entailed an individual allocation of benefits and issues by two authors to a corresponding STS-dimension, followed by a refinement in the second iteration. In the third iteration, all authors were involved to resolve disagreements and achieve consensus on the allocation. As an example, the issue of *stress* primarily relates to the developers, who are important actors in ASD. Consequently, this issue was allocated to the actors dimension of the STS. To name another example, *better requirements meeting* concerns the delivered product, i.e., the task to be fulfilled with ASD. Therefore, this benefit was assigned to the task dimension. This joint refinement helped to ensure that the benefits and issues are assigned to a semantically matching dimension of the STS, necessary for the following analysis.

For the interpretative analysis in the fourth step, we utilized the four core concepts (ID2, IA, WC, and CCI) of the ASD agility framework by [2] to interpret how the different outcomes seem to be related to the key characteristics of ASD. All 590 statements were analyzed individually by two authors to determine which specific ASD core concept, or interaction of several core concepts, appeared to lead to a certain benefit or issue. As an illustrative example of a benefit and the

specific core concept(s) that seem to contribute to it, [76, i.e., B10, p. 260] described that “developers noted that short sprints combined with more emphasis on customer feedback led to better agility and efficiency in responding to changing requirements”. This first example suggests that **ID2**, **IA**, and **CCI** in interaction lead to *improved responsiveness to change*, as sprints that define the iterative way of working (**ID2**) and the frequent evaluation of the current status of development together with the customer (**IA** and **CCI**) during these iterations jointly seem to contribute to this benefit of ASD. In analogy, for an issue, [77, i.e., D3, p. 68] reports that “team members were under constant pressure to deliver and the presence of short feedback loops within each work iteration increased the time pressure and the debilitating effects of stress that accompanied it”. This example illustrates how **ID2** and **IA** in interaction seem to lead to *stress* for the developers, as short iterations (**ID2**) with the goal of delivering new working software at the end of each iteration and the need to present progress in daily meetings or sprint reviews (**IA**) seem to imply a source of pressure that developers face in ASD, which consequently stresses them. For each apparent relationship, the driving core concept(s), the outcome, and the reporting study were noted by the individual authors, e.g., (**ID2** x **IA** x **CCI** → *improved responsiveness to change*, (B10 [76]), or in analogy, (**ID2** x **IA** → *stress*, (D3 [77])). To validate the identified apparent relationships, after having completed the initial analysis iteration by the first two authors, all four authors collaboratively evaluated the analysis results in a joint meeting. Here, we assessed disagreements in the interpretation of statements and also jointly discussed statements that were flagged as difficult to interpret. Also, only relationships that were identified at least twice in the set of extracted statements were retained for the next steps. While this analysis approach ultimately cannot prove causality due to the literature-based nature of our study, the joint discussions and the iterative analysis ensured a valid interpretation of the data and derived reliable conclusions from the selected primary studies. Still, this implies an inherent limitation of our study, which will also be acknowledged in the threats to validity section (V.F).

In the fifth step, we counted the frequency of each identified relationship between a benefit or issue and the core concept(s) behind it. Based on the counts of identified relationships, we developed stacked bar plots in Fig. 5-8 using the R package *ggplot2* to visualize associations between the core concept(s) and the benefits and issues they appear to contribute to. The sections IV-A1 to IV-A4 elaborate on these relationships in detail, separated into the four dimensions of the STS. Table 4 to Table 11 feature the benefits as well as issues and their relationships to the different ASD core concepts, together with studies that illustrate them. For Table 4 to Table 11, we refer to the IDs assigned to the secondary studies in alphabetical order, separated into the studies on benefits, e.g., [B10], and on issues, i.e., [D3], as listed in Appendix B and Appendix C.

In the final sixth step, we analyzed the role of the contextual factors by extracting the context descriptions from the selected studies to understand how context factors shape benefits and issues. We investigated 12 factors from ASD-specific works of Hoda et al. [19] and Kruchten [20], along with factors from the situational factors framework by Clarke and O'Connor [21]. We selected the 12 most common contextual factors in the literature sample to enable a manageable examination. Furthermore, we focused our analysis on single/multiple case studies, interview studies, and grounded theory approaches, as these types of research allow for a more detailed examination of the specific contextual factors, compared to, e.g., surveys with a large variety of participants and, therefore, differing contextual backgrounds. Multiple case studies were separated into the unique cases they described, resulting in 148 case organizations in 122 studies.

For this analysis, we defined different manifestation forms for the contextual factors, e.g., *Team Distribution* with the nuances “co-located, partly distributed, fully distributed” or *Project Complexity* with “low, medium, or high”. These manifestation forms were informed by Table 2 and Fig. 4 in [20, p. 358], or inductively derived in the analysis in cases where no manifestation form was defined by prior literature. Table 12 in section IV-B lists all 12 contextual factors and their forms of manifestation. Regarding the foundation of this analysis step, the online appendix features 661 identified descriptions of individual contextual factors extracted from 148 cases in 122 studies with illustrative statements from the literature. To determine how these manifestation forms of contextual factors seem related to either beneficial or undesirable outcomes, we assessed which manifestation forms were described as present when benefits or issues were reported and compared both sides of outcomes to identify favorable or problematic contextual factor manifestation forms for ASD. We also developed a coloring scheme to emphasize the suitability of the different manifestation forms for ASD projects, as will be explained in section V-B. As a final step that synthesizes the findings on the role of the contextual factors, we developed Fig. 9 in section V-B to reconceptualize the ‘agile sweet spot’ [20]. In so doing, we determine how an ideal context setting for ASD projects can be characterized, while also pointing out contextual aspects that should be avoided due to their criticality for ASD.

IV. FINDINGS

In the following, we present the findings from our analysis. Sections IV-A1 to IV-A4 elaborate on the benefits and issues identified in the qualitative content analysis and illustrate how these different outcomes are related to the four theoretical core concepts. Subsequently, section IV-B illustrates the role of contextual factors for beneficial or undesirable outcomes.

A. FINDINGS ON THE RELATIONSHIPS BETWEEN ASD CORE CONCEPTS AND OUTCOMES

The description of findings on the outcomes of ASD and their relationships with the four core concepts is separated into the

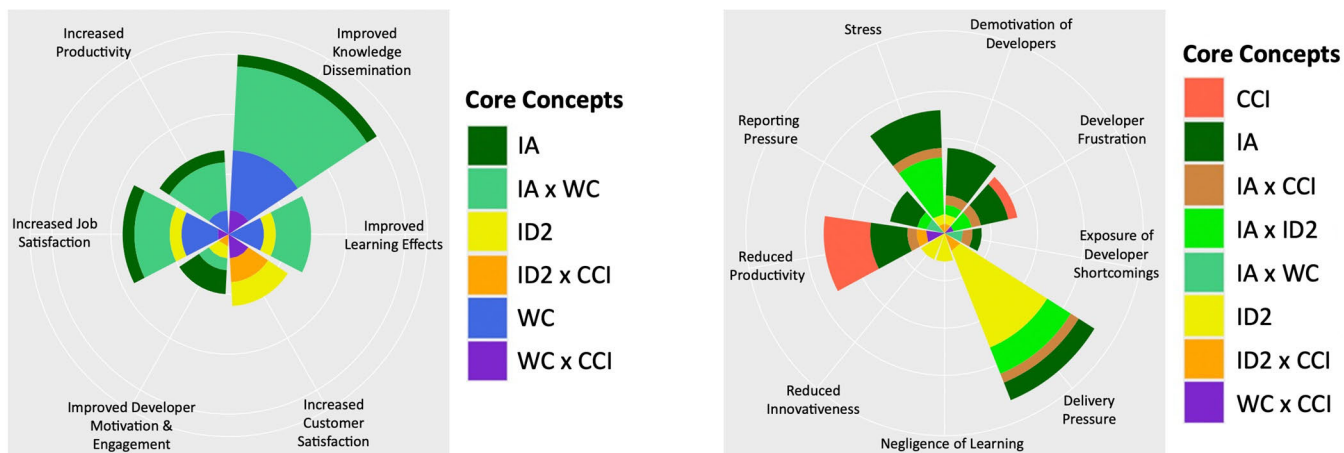


FIGURE 5. Relationships of ASD core concepts and outcomes in the actors dimension.

TABLE 4. Actor benefits, related studies, and identified core concepts.

Actors Benefit	ID2	IA	WC	CCI
Improved Knowledge Dissemination		[B8,B19,B31,B34,B44,B50,B51,B56,B65,B66]	[B2,B19,B31,B34,B44,B49,B50,B51,B56,B65,B74,B75]	[B49,B50,B56,B66]
Improved Learning Effects	[B39]	[B2,B19,B74]	[B2,B19,B33,B74]	
Increased Productivity		[B33,B45,B54,B57]	[B33,B46,B54,B67]	
Improved Developer Motivation & Engagement	[B12,B48,B76]	[B2,B12,B15,B63,B76]	[B63]	[B12]
Increased Customer Satisfaction	[B27,B64,B72]		[B6,B64]	[B6,B64,B72]
Increased Job Satisfaction	[B74]	[B47,B54,B55,B58]	[B19,B33,B41,B47,B49,B54,B55]	[B47]

TABLE 5. Actor issues, related studies, and identified core concepts.

Actor Issue	ID2	IA	WC	CCI
Demotivation of Developers	[D4,D28]	[D28,D35,D39]		[D28,D39]
Developer Frustration	[D28,D32]	[D28,D32,D35]	[D35]	[D19,D35]
Exposure of Developer Shortcomings		[D9,D28,D35,D41]	[D28,D41]	[D9]
Delivery Pressure	[D2,D3,D5,D10,D15,D21,D28,D30,D31]	[D3,D5,D15,D24,D28,D31]		[D24,D28]
Negligence of Learning	[D5,D21,D32]			
Reduced Innovativeness	[D4,D5,D23]			
Reduced Productivity	[D42]	[D22,D28,D29,D32,D35]	[D9,D11,D35]	[D12,D19,D35,D40,D42]
Reporting Pressure	[D31]	[D28,D29,D31,D39,D41]	[D29,D41]	
Stress	[D3,D5,D31,D39,D43]	[D3,D5,D24,D31,D39,D41]		[D24,D43]

four dimensions of the STS (actors, structure, technology, and task). For each dimension, we provide a bar chart (Fig. 5 - Fig. 8) to visualize the identified relationships between benefits or issues with the four core concepts (WC, IA, ID2, CCI). Each bar corresponds to a specific outcome, while the colored segments within the bars indicate the frequency of a distinct relationship identified between the outcome and one or more ASD core concepts. As such, large segments show frequent relationships, while smaller segments within the bars point out less frequently identified relationships. Comparing

the segment sizes provides insights into which core concepts appear particularly influential for certain outcomes of ASD.

1) BENEFITS AND ISSUES FOR THE ACTORS DIMENSION IN ASD METHODOLOGIES

The benefits identified for the actors involved in ASD, such as the SD team members or the client, comprise *improved knowledge dissemination*, *improved learning effects*, *increased productivity*, *increased employee motivation & engagement*, *increased customer satisfaction*, and

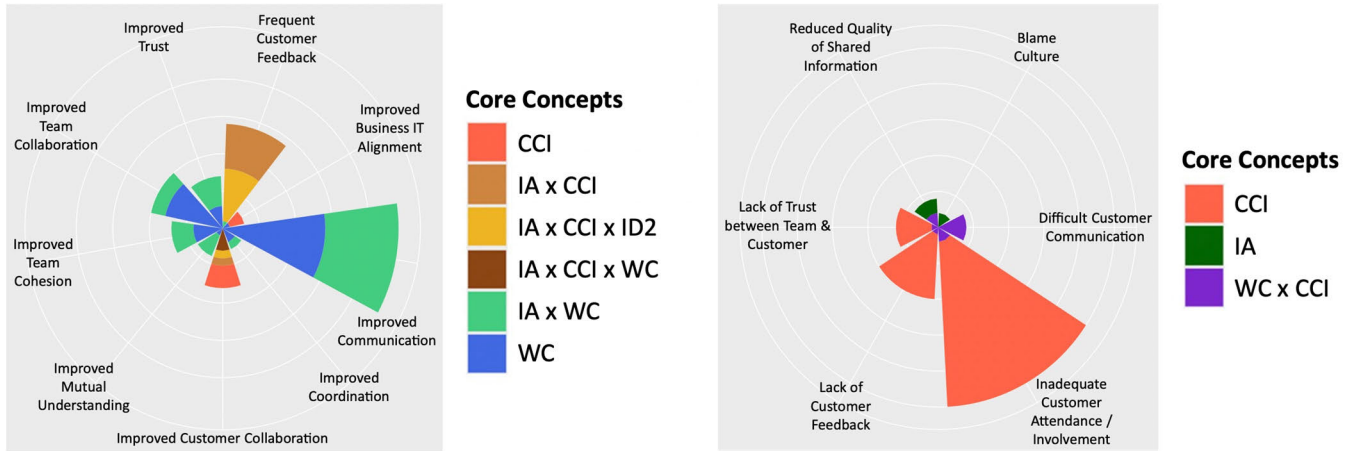


FIGURE 6. Relationships of ASD core concepts and outcomes in the structure dimension.

TABLE 6. Structure benefits, related studies, and identified core concepts.

Structure Benefit	ID2	IA	WC	CCI
Frequent Customer Feedback	[B5,B26,B31,B34,B39,B65,B68,B77]	[B2,B5,B22,B26,B34,B39,B40,B65,B68,B77]	[B40]	[B2,B5,B22,B31,B34,B39,B65,B68,B77]
Improved Business IT Alignment			[B16,B46]	[B16,B51,B70]
Improved Communication		[B30,B31,B34,B44,B49,B52,B53,B57,B75]	[B2,B5,B10,B18,B24,B30,B31,B33,B34,B44,B46,B49,B52,B53,B57,B60,B74,B75]	
Improved Coordination		[B49]	[B24,B46,B49,B51]	
Improved Customer Collaboration	[B64,B68,B72]	[B22,B30,B31,B57,B68]	[B22,B30,B31]	[B3,B22,B30,B31,B57,B59,B64,B67,B68]
Improved Mutual Understanding		[B29,B56]	[B25,B29,B56]	
Improved Team Cohesion		[B19,B29,B48]	[B19,B29,B36,B37,B43,B46,B48,B60,B76]	
Improved Team Collaboration		[B34,B50]	[B2,B34,B35,B40,B43,B47,B50,B51,B74,B75]	
Improved Trust		[B30,B44]	[B11,B30,B44,B76]	

TABLE 7. Structure issues, related studies, and identified core concepts.

Structure Issue	ID2	IA	WC	CCI
Blame Culture		[D9,D39,D41]		
Difficult Customer Communication			[D10,D11,D18,D35]	[D10,D11,D18,D35]
Lack of Customer Feedback			[D35]	[D2,D19,D29,D35,D37,D42]
Lack of Trust between Team & Customer			[D37]	[D37,D38]
Reduced Quality of Shared Information		[D39]	[D11,D35]	[D11,D35]
Inadequate Customer Attendance / Involvement			[D35,D43]	[D1,D12,D13,D16,D19,D33,D35,D37,D38,D40,D42,D43]

increased job satisfaction. The identified issues include demotivation of developers, developer frustration, exposure of developer shortcomings, delivery pressure for developers, reduced innovativeness, negligence of learning, reduced productivity, reporting pressure, and stress.

For the actors, WC is essential, since collaboration fosters knowledge dissemination and learning processes (B49 [7]),

(B66 [78]), and increases job satisfaction (B49 [7]). More importantly, IA x WC, e.g., realized in pair programming, appears to satisfy the developers and enhances productivity (B54 [79]), (B55 [80]), while also facilitating knowledge dissemination and learning (B19 [81]). The interaction of IA and WC in daily meetings, pair programming, sprint reviews, or retrospectives (B47 [82]), furthermore contributes

TABLE 8. Technology benefits, related studies, and identified core concepts.

Technology Benefit	ID2	IA	WC	CCI
Continuous Process Refinement	[B39]	[B5,B7,B8,B12,B26,B31,B35,B39,B58,B62,B63,B69]	[B5,B12,B26,B31,B63]	
Earlier Problem Identification	[B16,B18,B23,B38,B39]	[B5,B7,B8,B18,B38]	[B9,B18,B33,B39]	
Faster Problem Resolution		[B8,B38,B65]	[B65]	
Improved Process Transparency	[B47,B53,B56]	[B5,B23,B29,B40,B42,B48,B49,B50,B53]	[B5,B42,B48,B49,B53]	[B29]
Improved Project Monitoring	[B10,B53]	[B5,B10,B34,B53,B65,B69]	[B34,B65]	[B10,B53]
Improved Resource Utilization	[B32,B38]	[B57]	[B57]	
Improved Responsiveness to Change	[B3,B10,B17,B50,B59]	[B10,B39,B50,B59]	[B39]	[B3,B10,B50,B59]

to job satisfaction, as well as improved SD performance (B58 [83]), and higher levels of trust (B11 [84]). Conducting frequent reviews (IA) at the end of an iteration (ID2) with the customer, as well as the team (CCI x WC), additionally stimulates the motivation of developers (B15 [85]), (B76 [86]), as this combination of core concepts allows them to constantly see the value of their work (B12 [87]), (B63 [88]). Considering the satisfaction of the customer, CCI and the iterative nature of delivery (ID2) allow the clients to inspect the progress and constantly receive new deliveries, which consequently satisfies them (B27 [89]), (B72 [90]). Additionally, the collaboration with the team (WC x CCI) boosts client satisfaction (B6 [91]), (B64 [45]). Concludingly, WC and IA are key to the realization of benefits for the developers. Meanwhile, CCI and ID2 are important to ensure the satisfaction of the customer.

For the downsides, ID2 was frequently reported to imply issues for the actors, especially for the developers. Above all, ID2 seems responsible for delivery pressure (D2 [92]) and stress for the SD team (D4 [93]), (D21 [94]). This constant pressure was also found to reduce the creativity and innovativeness of the team (D3 [77]), (D23 [95]). Combined with IA, which implies frequent meetings such as daily meetings or sprint reviews, further pressure and stress are observable for the developers (D31 [96]). IA was also frequently observed to be a source of problems on its own. Especially the need to frequently report progress stresses the team (D39 [11]) and takes away time for development, which reduces progress (D32 [58]). To add, the meetings can cause frustration and demotivation (D28 [97]), e.g., due to the need to report (D31 [96]), especially in case of limited progress (D39 [11]), or when being unfocused and unproductive (D29 [98]). While CCI only seems related to a few issues, the most critical outcome of insufficient CCI lies in the reduced productivity of the team, especially when product owners or clients do not provide information in time (D40 [99]), (D42 [100]). This highlights that the team is dependent on CCI to perform the required work (D35 [101]), as inadequate CCI was also found to affect the structure between the actors, as is described later. In sum, ID2 and IA can provoke a range of issues for the developers, similar to inadequate CCI with

negative implications for the productivity of the team, while WC rarely implies issues for the actors.

2) BENEFITS AND ISSUES FOR THE STRUCTURE DIMENSION IN ASD METHODOLOGIES

This section describes the benefits and issues for the structure between the involved actors. We found *frequent customer feedback, improved business-IT alignment, improved communication, improved coordination, improved customer collaboration, improved mutual understanding, improved team cohesion, improved team collaboration, and improved trust* as benefits of ASD. The issues featured in this dimension include *blame culture, difficult customer communication, lack of customer feedback, inadequate customer attendance and involvement, lack of trust between team and customer, as well as reduced quality of shared information.*

For the structure between the actors in ASD, we found two predominant themes of core concepts giving rise to beneficial outcomes. Especially WC represents a key core concept, while its interactions with both IA and CCI also benefit the structure of the involved actors. Above all, the collaborative nature of ASD embedded in WC contributes to improved communication and collaboration of the team (B31 [9]), (B74 [43]). These benefits are mostly realized through social ASD practices, including daily meetings (B52 [102]) and retrospectives (B26 [56]), (B30 [103]), but also pair programming and rotation (B74 [43]), (B75 [104]) facilitate the realization of these benefits. Similarly, WC contributes to team cohesion (B19 [81]), (B37 [105]), (B43 [106]) and morale (B18 [8]), e.g., by working in co-located small teams, which fosters coordination (B24 [107]), (B46 [108]). In combination, IA x WC reinforces these outcomes, e.g., via retrospectives that stimulate communication, cohesion, and mutual understanding (B25 [68]), (B29 [109]). Meanwhile, CCI and IA are essential for the relationship with the client. We found that involving the client (CCI), for example in review meetings (IA), improves collaboration with the customers (B22 [110]), (B67 [111]). Consequently, also the alignment between the business and the IT side can be enhanced (B16 [112]). Furthermore, the combination of IA x CCI x ID2 contributes to the provision of valuable feedback (B5 [113]), (B77 [114]).

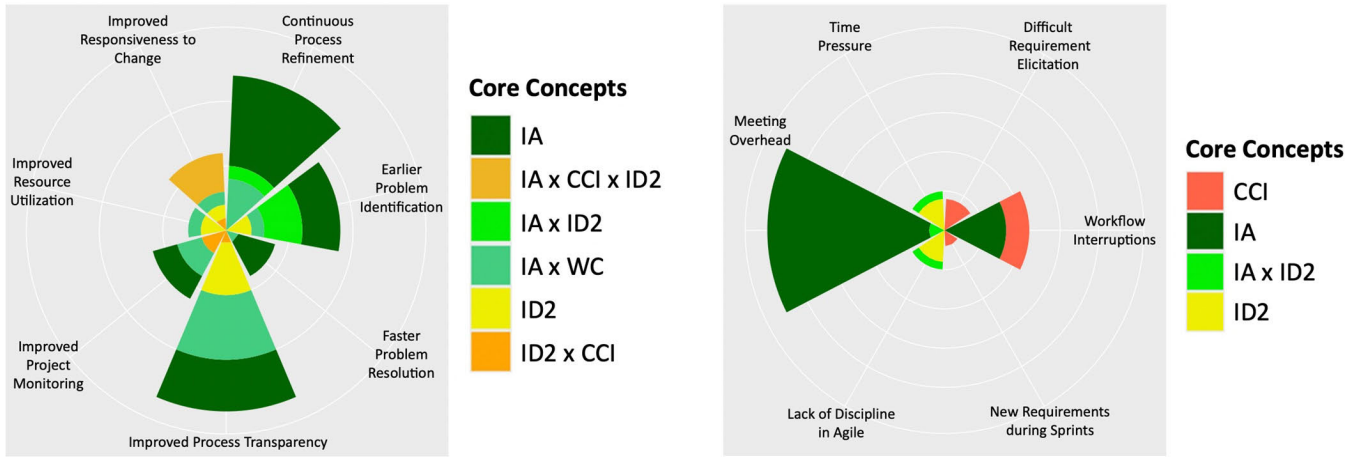


FIGURE 7. Relationships of ASD core concepts and outcomes in the technology / SD process dimension.

TABLE 9. Technology issues, related studies, and identified core concepts.

Technology Issue	ID2	IA	WC	CCI
Difficult Requirements Elicitation				[D19,D38,D42]
Workflow Interruptions		[D28,D32,D39,D41,D45]		[D45]
New Requirements during Sprints				[D10,D20,D44]
Lack of Discipline in Agile	[D8,D32]	[D32]		
Meeting Overhead	[D32,D43]	[D1,D27,D28,D32,D36,D39,D41,D43,D45]		
Time Pressure	[D25,D26,D28,D31,D34,D35]	[D31]		

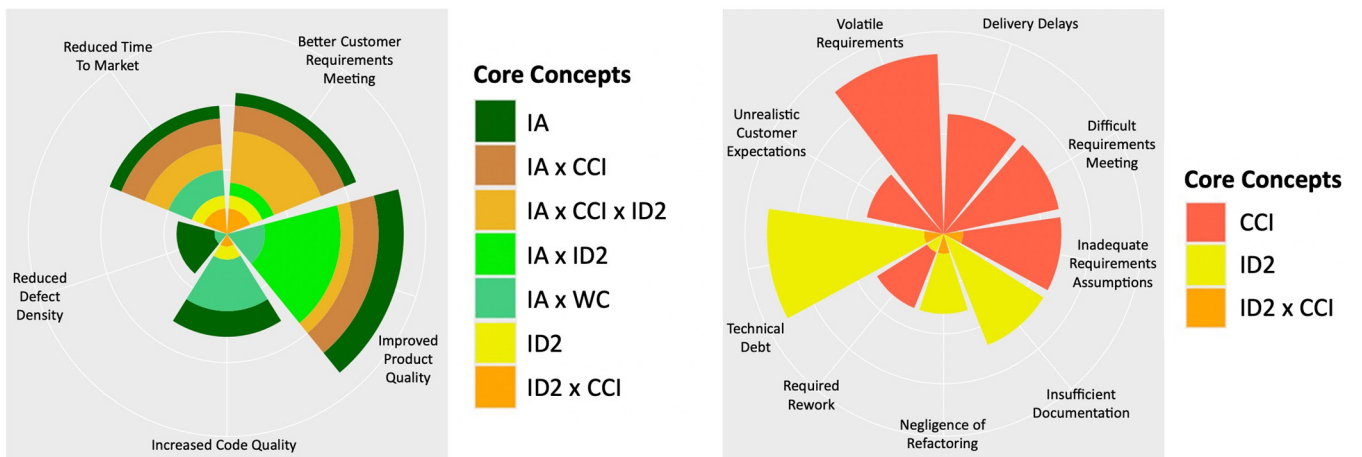


FIGURE 8. Relationships of ASD core concepts and outcomes in the task dimension.

Based on this feedback, further benefits seem realizable, for example, meeting customer requirements (B26 [56]), and delivering higher product quality (B2 [44]). In sum, WC benefits the structure within the SD team, while the combinations of IA, ID2, and CCI stimulate the relationships between the team and the customer.

Issues in the structure dimension meanwhile seem primarily related to an insufficient execution of CCI, WC, and IA.

Above all, inadequate CCI can be very problematic. Under inadequate CCI, it is especially difficult for the team to acquire the necessary feedback (D19 [34]), (D37 [115]).

Furthermore, the communication, both within the team and with the customer (WC x CCI), can be affected (D33 [116]), (D43 [117]). Other issues stemming from CCI concern the lack of trust between team and customer, should the client not comply with the agile way of working (D37 [115]).

TABLE 10. Task benefits, related studies, and identified core concepts.

Task Benefit	ID2	IA	WC	CCI
Better Customer Requirements Meeting	[B2,B4,B19,B35, B51,B68,B73,B74]	[B2,B16,B19,B35, B45,B50,B68,B73]		[B2,B3,B4,B6,B16, B19,B50,B51,B68,B73]
Improved Product Quality	[B17,B19,B47, B48,B52,B61,B65]	[B2,B17,B19,B23, B47,B48,B52,B54, B61,B64,B65]	[B54,B64]	[B2,B17,B23]
Increased Code Quality	[B2,B32]	[B1,B10,B13,B32]	[B1,B10,B13]	[B2]
Reduced Defect Density		[B8,B18,B21,B71]	[B18]	
Reduced Time to Market	[B3,B17,B20,B38,B59]	[B14,B18,B20,B28, B38,B48,B59]	[B18,B28,B33]	[B3,B14,B29,B59]

TABLE 11. Task issues, related studies, and identified core concepts.

Task Issue	ID2	IA	WC	CCI
Unrealistic Customer Expectations				[D6,D13]
Delivery Delays				[D1,D19,D20,D35,D42]
Difficult Requirements Meeting				[D12,D19,D42]
Inadequate Requirements Assumptions	[D42]			[D1,D12,D19,D42]
Insufficient Documentation	[D7,D13,D31,D37,D39]			
Negligence of Refactoring	[D25,D26,D30]			[D25]
Required Rework	[D34]			[D12,D19,D42]
Technical Debt	[D8,D12,D17,D26,D32]			[D12]
Volatile Requirements				[D2,D11,D20,D30,D35,D42,D44]

Overall, **CCI** appears to be a very challenging aspect for the structure dimension, as reported in (D13 [118]), (D14 [6]), (D38 [119]). In addition, **IA** also bears the potential for structural issues. Despite **IA** in continuous meetings being key for information exchange, these ceremonies can also create a blame game between the developers (D41 [120]) and expose potential shortcomings (D9 [121]). In this vein, the quality of shared information can also be affected (D39 [11]). In sum, **CCI** and **IA** bear the potential to affect the structure among actors, if not correctly executed, while **WC** and **ID2** play a minor role.

3) BENEFITS AND ISSUES FOR THE TECHNOLOGY DIMENSION IN ASD METHODOLOGIES

For technology-related benefits, i.e., in the SD process, we identified *continuous process refinement, earlier problem identification, faster problem resolution, improved process transparency, improved project monitoring & coordination, improved resource utilization, and improved responsiveness to change*. The issues entail *difficult requirements elicitation, workflow interruptions, new requirements introduced during sprints, lack of discipline in agile environments, meeting overhead, and tight deadlines with time pressure*.

For the benefits in the SD process, **IA**, **ID2**, and **IA x WC** seem essential. **IA** and **ID2** promote process transparency, which is enabled by the meetings (**IA**) that are conducted daily or at the end of an iteration (**ID2**), such as retrospectives and sprint reviews, in collaboration with the team (**WC**) (B36 [122]), (B42 [123]), (B53 [124]). Moreover, **IA** and **WC**

foster continuous improvement of the process in joint retrospectives that enable reflection and adaptation (B12 [87]), (B58 [83]). With practices that implement **IA**, **ID2**, and **WC**, potential problems and risks can also be identified earlier (B9 [125]) and mitigated faster (B33 [126]), (B65 [127]). Also, testing, which implies **IA** and **ID2**, can help to identify and solve issues (B7 [128]), (B23 [129]). To add, **IA** and **ID2** enable responsiveness to change in combination with **CCI**, as changes can be addressed after (B17 [49]) or even within an iteration (B39 [130]). Lastly, we found that **ID2** and **IA** facilitate the monitoring of the process (B10 [76]), (B34 [131]) and balance the utilization of resources, especially for testing (B32 [132]), (B38 [133]), given that these core concepts imply a breakdown of the SD process. Overall, the process especially benefits from **IA** and **ID2**. To add, **WC** facilitates the collaborative aspects of **IA**, while **CCI** seems less influential.

Regarding the downsides, especially **IA**, **ID2**, and in some instances **CCI**, create different issues in the process of ASD. Most importantly, **IA**-related meetings, particularly daily meetings, imply disruptions to the workflow of the developers (D45 [48]), (D36 [134]). To add, participating in **IA**-related meetings can imply meeting overhead (D1 [135]), (D32 [58]), which steals valuable time required for SD tasks. Besides **IA**, **ID2** can also give rise to distinct issues, causing tight deadlines, time pressure (D28 [97]), (D31 [96]), and a lack of discipline in performing development work, as the delivery of features is more important (D8 [10]), (D32 [58]). Lastly, **CCI** may lead to new requirements being introduced during

an active sprint (D10 [136]), (D44 [137]), which can result in sprint cancellations (D20 [138]). Inadequate CCI may also hinder requirements elicitation and thus harm the productivity of the SD team (D19 [34]). In sum, process-related issues seem primarily related to IA-related meetings, while ID2 can provide time pressure and may contribute to a lack of discipline. In addition, CCI can imply different issues, whereas WC again seems less problematic.

4) BENEFITS AND ISSUES FOR THE TASK DIMENSION IN ASD METHODOLOGIES

The benefits for the ASD tasks include *better requirements meeting, improved product quality, increased code quality, reduced defect density, and reduced time to market*. The issues comprise *unrealistic customer expectations, delivery delays, difficult requirements meeting, inadequate requirements assumptions, insufficient documentation, negligence of refactoring, required rework, and technical debt*.

For the task dimension, we find that IA and ID2 are critical to benefit realization. CCI and WC to perform tasks are generally important, yet the effects of IA and its interaction with other concepts appear essential for task-related benefits. IA is especially important to improve product quality in terms of defect density or code quality, where different ways of inspecting the code and removing defects, including test-driven development, code refactoring, or continuous integration, play a key role (B1 [139]), (B13 [140]), (B21 [141]), (B71 [142]). To add, interactions of IA and WC, for instance, in pair programming (B18 [8]), also benefit the product quality. Still, the importance of IA x ID2 in interaction for quality-related benefits needs to be emphasized more. Meanwhile, reduced time to market and better requirements meeting depend on CCI in iterative cycles (ID2) with constant reviews of the product (IA). Meeting the client's requirements especially profits from short SD cycles (ID2) and the provision of feedback in IA cycles (B4 [143]), (B68 [144]), (B73 [145]). Generally, ensuring CCI in ASD represents the foundation of improved requirements meeting (B3 [146]), (B51 [147]). Finally, shorter delivery times depend on several concepts. We find that IA represents the most influential concept, also combined with ID2 and CCI. Frequently releasing new product increments (ID2) generally benefits time to market (B18 [8]), (B38 [133]), yet involving the customer (CCI), e.g., in sprint reviews (IA) is key to developing a product in a timely fashion (B59 [4]). The literature also shows WC's role in faster deliveries, e.g., by working in pairs (B18 [8]). Still, above all, IA, ID2, and CCI seem essential for task-related benefits.

While CCI is key to product-related benefits, an inadequate execution of CCI is a frequent driver of various issues in the task dimension. As such, delivery delays (D42 [100]), difficult requirements meeting (D19 [34]), (D12 [148]), unrealistic customer expectations (D6 [149]), inadequate requirements assumptions (D1 [135]), and volatile requirements (D11 [12]), (D44 [137]), primarily result from insufficient CCI. Also, in contrast to the positive impacts

of ID2 for the product, the constant pressure to deliver new code embedded in ID2 can introduce technical debt due to shortcuts taken to meet the deadline of an iteration (D12 [148]), (D26 [150]). ID2 was also reported to affect the documentation of tasks (D37 [115]), (D7 [151]), as no time is left to adequately document important aspects. Similarly, ID2 can prevent developers from refactoring (D26 [150]), (D30 [152]), as delivering new features per iteration is more important. Concludingly, while CCI and ID2 benefit the task dimension, their potential negative implications should not be neglected. IA and WC do not seem to imply issues for the SD tasks, while excessive IA can entail various other problems, as was described before.

B. FINDINGS ON THE ROLE OF CONTEXTUAL FACTORS FOR BENEFITS AND ISSUES IN ASD

For the second analysis step, we present the findings on 12 selected contextual factors that affect ASD's outcomes. We discuss each contextual factor concerning its relationship with either benefits or issues, focusing on the role of different manifestation forms. Due to the large data set extracted from the literature for this analysis step, all 661 identified individual observations are depicted in the online appendix. Meanwhile, the different manifestation forms for the 12 context factors that have been derived from the literature are shown in Table 12. Besides serving as a means to assess the influence of context factors on the outcomes of ASD methodologies in this study, the provided collection of factors can also enable researchers to report more comprehensively on the respective contextual settings in their studies, as the contextual factors were often reported in a fragmented manner in the literature sample. This deficiency in extant research can also be inferred from the tables in the online appendix, showing that only in a few studies a full set of relevant context factors was provided to characterize the contextual setting, as was also criticized by [2]. Lastly, the 12 selected context factors and their different manifestation forms presented in Table 12 will also be used to reconceptualize the 'agile sweet spot' [20] for ASD projects.

1) PROJECT SIZE/APPLICATION SIZE

We found the size of an ASD-based project to be less influential in shaping benefits or issues, given the almost even distribution of medium to large-sized projects. ASD can generally support small to large projects, as approaches for large scenarios, such as SAFe (B9 [125]) or LeSS and the Spotify Model [153], have successfully supported projects with large applications, long durations, and various SD teams being involved. Based on our findings, we conclude that ASD is not exclusively applicable to small projects, but with scaled agile approaches, large scenarios can also be facilitated. Project size is still a key factor, as it is related to other context aspects, yet all manifestation forms can be supported by ASD, with a preference for smaller projects.

TABLE 12. 12 selected contextual factors relevant to ASD methodology-based projects and individual manifestation forms.

Context Factor Criterion	Manifestation Forms of Context Factors		
Project Size / Application Size	High	Medium	Low
Project Complexity	High	Medium	Low
Criticality of System in Development / Risk	High	Medium	Low
System Age / Development Phase	Legacy Application	Mid-Life-Cycle	New Application
Rate of Change / Requirements Volatility	Volatile	Medium	(Mostly) Stable
Prerequisites / Documentation Needs	Strict	Medium	Relaxed
Contract Design / Payment Arrangements	Fixed-Price		Time & Materials
Degree of Customer Involvement	Low	Medium	High
Team Size	Large (>50)	Medium (10-50)	Small (4-9)
Team Distribution	Fully Distributed	Partly Distributed	Co-Located
Experience / Maturity / Skill / Expertise	Low (<2 years)	Medium (2-5 years)	High (>5 years)
Turnover / Team Stability	Unstable	Medium	Stable

2) PROJECT COMPLEXITY

For this criterion, it appears that ASD can work well with mostly all types of complexity. Complex projects with challenging requirements (B2 [44]), (B19 [81]), large project organizations (B24 [107]), and different business stakeholders (B36 [122]), (B37 [105]), can be handled with ASD. However, projects, where complexity stems from complicated legacy code (D3 [77]), (D4 [93]), (D5 [154]), or dependencies with other systems (D15 [155]), appear difficult to manage. Hence, ASD methodologies can support the development of complex systems, albeit other complexity-enhancing factors may prove problematic.

3) CRITICALITY OF SYSTEM IN DEVELOPMENT/RISK

Our findings indicate that the criticality of a system rarely conditions the occurrence of benefits or problems. As such, ASD has been shown to successfully support the development of critical products such as biosecurity emergency response systems (B19 [81]). Other critical applications, e.g., medicine prescription systems for therapy (B32 [132]), or cybersecurity solutions (B57 [156]), were also successfully developed with ASD. Studies that illustrate the occurrence of issues rarely attributed them to the criticality of the system that was to be developed. Instead, issues in projects with critical systems were mostly related to other factors such as volatile requirements, unstable teams, or legacy software (D3 [77]), (D4 [93]), (D5 [154]). Apparently, critical systems can hence be developed well with ASD, but may require additional attention.

4) SYSTEM AGE/DEVELOPMENT PHASE

Our findings suggest that legacy systems can be a potential source of issues in ASD. Complex, old code or monolithic architectures seem difficult to handle with ASD (D5 [154]), (D13 [118]), (D16 [107]), (D17 [157]), as they can hinder the proper execution of ASD practices, e.g., refactoring and testing (D25 [158]). New applications developed in a greenfield setting [20] appear less susceptible to issues (B2 [44]), (B34

[131]), (B68 [144]). In such cases, liabilities from legacy applications are not present, as ASD is “originally meant for rather small and isolated systems” (D33 [116], p. 79). Thus, ASD projects are best tasked with the development of new software without legacy.

5) RATE OF CHANGE/REQUIREMENTS VOLATILITY

ASD methodologies are conceived to embrace change [30], [159] and were found to support low to medium requirement volatility well (B29 [109]), (B31 [9]), (B40 [160]), (B63 [88]). However, ASD projects that encountered issues with requirements often attributed them to volatile customer demands and erratic changes in the defined requirements (D11 [12]), (D17 [157]), (D45 [48]). Some cases with high volatility and frequent changes in requirements were manageable, e.g., reported by (B19 [81]), (B60 [161]), but represent a rather rare exception. Consequently, while moderate volatility in requirements is well manageable with ASD (and even necessary, since not all the requirements are defined from the beginning and only emerge over time), exceptionally volatile requirements changes should be avoided to prevent problems.

6) PREREQUISITES/DOCUMENTATION NEEDS

For this factor, ASD values less documentation [30]. While the level of need for documentation was not frequently reported, e.g., in (D3 [77]), (D4 [93]), (D5 [154]), (B6 [91]), (B35 [162]), (D43 [117]), extensive documentation seemed problematic, as it may imply additional overhead (D14 [6]), (D33 [116]). In some cases, detailed documentation was a critical element of success (B6 [91]), e.g., in regulated or public environments (B18 [8]), (D33 [116]). Still, it is recommended to minimize documentation needs or assign a documentation person (B17 [49]), (B19 [81]), to alleviate teams from additional overhead.

7) CONTRACT DESIGN/PAYMENT ARRANGEMENTS

While this factor was rarely described in the literature, e.g., in (B6 [91]), (D19 [34]), (B23 [129]), (D25 [158]), (D43 [117]), a tendency towards the unsuitability of fixed-price

models was recognized. As such, a fixed-budget contract was mostly described as problematic for ASD-based projects (D19 [34]), (D25 [158]). As stated by (D19 [34]), “agile practitioners see fixed-bid contracts as a major limitation that the customers impose on them” (p. 526), and that ASD “can’t do fixed price projects with changes coming in” (p. 526). Therefore, a time and materials approach seems advisable to allow changes to be handled comprehensively, especially given the problematic influence of requirements volatility, as was described before.

8) DEGREE OF CUSTOMER INVOLVEMENT

This contextual factor appears to be a primary source of problems for ASD. In analogy to the role of **CCI** in the first analysis step, studies that reported on issues identified low customer involvement as a key concern, e.g., (D19 [34]), (D21 [94]), (D25 [158]). ASD initiatives that do not gain sufficient customer or stakeholder involvement thus seem more likely to encounter issues. Studies with strong attendance by the client, in contrast, reported various benefits (B31 [9]), (B57 [156]), (B64 [45]), (B74 [43]), suggesting that customer involvement is a key contextual factor for successful ASD projects.

9) TEAM SIZE

This factor does not appear to shape the outcomes of ASD projects too strongly, given the even distribution of small and medium teams across the analyzed studies. Most studies reported adherence to the recommended size of less than ten members per team [31]. Therefore, it is advisable to follow this recommendation and only exceed it slightly if required, or alternatively use a scaled approach.

10) TEAM DISTRIBUTION

For this contextual factor, all degrees of distribution were found to be generally feasible. Co-located settings, e.g., in (B32 [132]), (B36 [122]), (B37 [105]), and distributed teams, for instance, in (B9 [125]), (B29 [109]), (B44 [97]), appeared equally frequently mentioned, with distributed ASD teams working well in several cases (B9 [125]), (B11 [84]), (B60 [161]). However, in studies where ASD teams faced issues, e.g., (D5 [154]), (D10 [136]), (D35 [101]), fully/partially distributed scenarios often seemed to be one of the main reasons for problems. Distributed ASD can contribute to problems in requirements communication (D11 [12]), affect team collaboration (D33 [116]), and make communication difficult (D40 [99]), or reduce developers’ awareness, as “nothing can substitute face-to-face interaction” (D10 [136], p. 10). Co-location, in contrast, rarely seems to cause any issues and is considered essential to fostering communication (B31 [9]). Still, while co-location of teams is highly recommended, distributed development can be feasible when adequate measures such as frequent staff rotations between sites are performed (B11 [84]).

11) EXPERIENCE/MATURITY/SKILL/EXPERTISE

Contrary to [20] stating that novice teams can be a risk for ASD projects, we find that the experience of ASD teams is a less prominent contextual factor. Novice teams and more experienced teams were mentioned equally often in the cases, e.g., (B12 [87]), (D30 [152]), (B31 [9]), (D44 [137]), with no tendency for any type of experience to be more or less likely to imply issues. In general, an experienced team would be preferable for very complex projects. However, we also found several instances where relatively inexperienced teams performed well in projects with high complexity (B44 [97]), (B53 [124]), (B57 [156]). Thus, while experience is an important factor, it does not seem to affect ASD projects too much, even in cases where the team is somewhat less mature.

12) TURNOVER/TEAM STABILITY

Lastly, high turnover of team members in ASD projects was suggested as a particularly problematic aspect in several studies (D3 [77]), (D4 [93]), (D5 [154]), (D11 [12]), (D14 [6]), (D15 [155]). ASD projects that experienced issues comparatively often cite unstable teams as a source for problems such as productivity losses (B46 [108]), the loss of domain knowledge (D11 [12]), or difficulties in “establishing a mutual understanding of agile” (D14 [6], p. 98). We identified a few cases where ASD tolerated a higher level of staff turnover (B18 [8]), (B32 [132]), however, the negative impacts of unstable teams suggest that staff turnover in ASD projects should be minimized to avoid problems such as productivity and knowledge losses.

V. DISCUSSION

A. KEY TAKEAWAYS ON THE CORE CONCEPTS AND THEIR ROLE FOR ASD'S OUTCOMES

From our findings, we develop five propositions on apparent relationships between the four ASD core concepts and beneficial or undesirable outcomes. With these propositions, we address our first RQ on how ASD, based on the four core concepts, appears to contribute to the spectrum of outcomes.

P1: Communication (WC) is required to realize benefits for actors and their interaction structure while ensuring adequate WC is generally necessary for ASD to function.

Our findings identify **WC** as the central concept to achieve beneficial implications for the involved actors and to improve the interaction structure between them, thus corroborating the first instruction of the Agile Manifesto to focus on ‘individuals and interactions’ [30]. The need for **WC** to stimulate the interaction structure seems essential, considering its beneficial implications for team collaboration (B74 [43]), communication (B31 [9]), and cohesion (B48 [58]). In addition, **WC** is indispensable for the dissemination of knowledge (B50 [55]) and contributes to the satisfaction of the team (B41 [163]), thereby benefitting the involved actors. Most

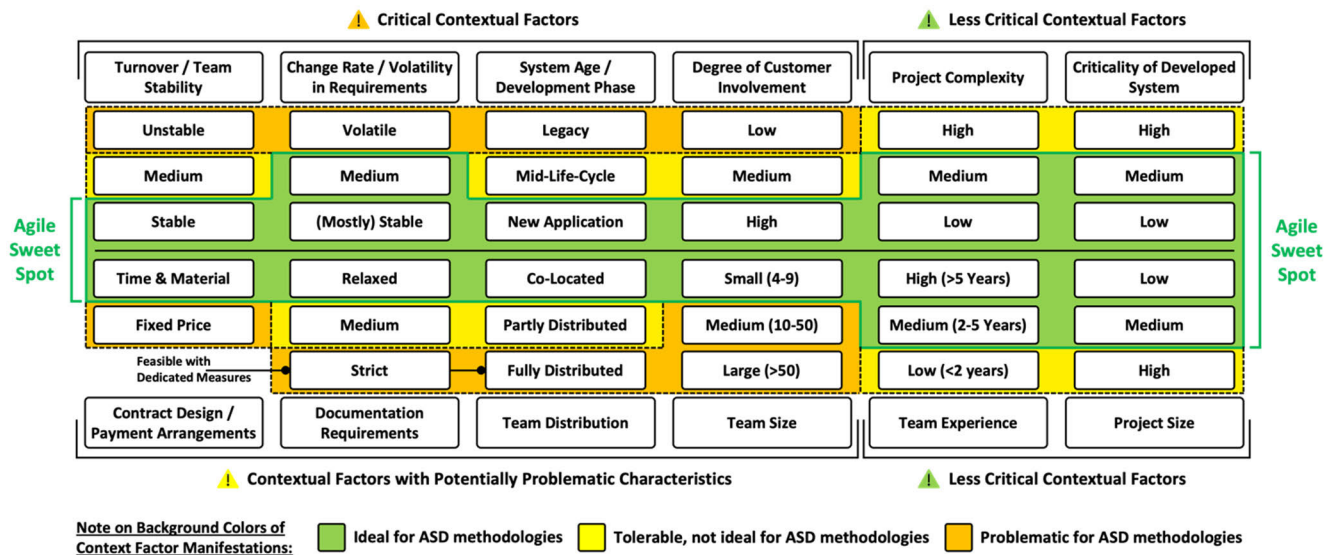


FIGURE 9. The agile sweet spot for contextual factors in ASD methodologies.

importantly, WC seems involved in the realization of almost all observed beneficial outcomes in some form, especially in interaction with other core concepts, but was barely found to provoke issues, and if so, only when developers had weak communication skills (D9 [121]). Based on the prominence of WC, we propose that this core concept represents an essential cornerstone for the realization of benefits for the social side of ASD, that is, the actors and their interactions, while its role for other benefits generally highlights the importance of WC for successful ASD.

P2: Joint interactions of communication/collaboration (WC) and inspection (IA) provide benefits for all four STS dimensions, suggesting communication and reflection on performed work as important benefit drivers in ASD.

In addition to the important role of WC in the realization of benefits for the actors, we find inspections of the current status (IA) conducted by the team in intensive discussions (WC) to be the most frequent interaction of core concepts that deliver beneficial outcomes. Our analysis reveals that continually adapting to changes collaboratively (IA x WC) can benefit various aspects of ASD projects, among others, especially the beneficial outcomes described in P1. Beyond, continuous improvement of the SD process especially benefits from IA x WC (B8 [164]), which can be realized in daily meetings or sprint retrospectives (B26 [56]). Retrospective meetings were frequently highlighted as an essential practice that facilitates process improvement and other benefits, e.g., (B30 [103]), (B62 [165]). While some issues may occur in retrospectives, as reported by (D27 [166]), the benefits that can be derived from collaborative retrospective meetings and other ceremonies suggest that IA x WC is a key stimulant behind a broad spectrum of beneficial implications. Consequently, ASD practitioners should regularly conduct retrospectives and daily meetings, however, with an

adequate balance to avoid issues, as described in the next proposition.

P3: Frequent inspections (IA) and iterative development (ID2) are necessary to achieve task/technology-related benefits, but an inadequate realization of these two core concepts can imply both immediate and long-term issues.

ASD's core concepts contribute to various benefits, which can, however, be accompanied by simultaneous or long-term issues. Especially IA and ID2 can be beneficial, yet concurrent issues suggest that these two core concepts represent a double-edged sword. As such, IA and ID2 foster transparency via daily and review meetings (B29 [109]), (B40 [160]), improve code quality through refactoring (B10 [76]), or accelerate the delivery of features via incremental SD (B38 [133]). Still, the issues that can accompany these benefits should not be neglected. Short sprints (ID2) put pressure on the developers (D21 [94]) and stress them (D5 [154]). Pressurized by the need to deliver, also technical debt occurs (D26 [150]), which may not be fixable in the long term with refactoring, especially if it has turned into legacy code (D37 [115]). To add, IA cycles, such as daily meetings, often cause interruptions and overhead (D45 [48]), thereby reducing productivity (D28 [97]). Considering the concurrent positive and negative implications of IA and ID2, we propose that an excessively high cadence of iterations and meetings may cause issues that overshadow the actual benefits that were intended to be achieved by these core concepts. We thereby also conclude that the execution of certain core concepts needs to be carefully balanced to uphold the principle of the Agile Manifesto for sustainability and constant pace [30]. Balancing the execution of the core concepts thus appears generally necessary, yet IA and ID2, which define the high-paced Modus Operandi of

ASD, can be especially adverse if they are not adequately balanced.

P4: Adequate customer involvement (CCI) is required to realize benefits for the task/structure dimensions, while insufficient CCI implies issues in all four STS dimensions.

Like a balanced execution of ASD core concepts, especially **IA** and **ID2**, establishing a minimum level of realization of core concepts also appears critical to enable successful ASD. We find that, in addition to **WC**, **CCI** needs to be ensured to avoid negative consequences for ASD teams and enable the successful development of a product that fulfills customer requirements (B3 [146]). In this regard, ASD teams especially rely on valuable customer feedback in the implementation (B2 [44]), which also helps to release a correct product in a shorter time frame (B14 [167]), (B20 [67]). In contrast, when **CCI** is lacking, product delivery can be affected, as without the feedback of the customer, delivery delays may occur due to unclarity in the clients' demands (D35 [101]). Consequently, ASD teams often involuntarily need to make assumptions about requirements, which may result in additional rework (D42 [100]). Overall, as is apparent in Fig. 5, Fig. 6, and Fig. 8, inadequate levels of **CCI** are often one or even the primary reason for identified issues, as teams are highly dependent on the involvement of the customer (D35 [101]). Therefore, **CCI** requires dedicated attention to enable ASD teams to operate properly and to ensure the swift delivery of a valuable software product for the customer.

P5: Benefits are primarily obtained by several core concepts in interaction, while issues usually stem from the inadequate realization of one specific core concept.

Lastly, we found that ASD core concepts primarily seem to create benefits in interaction, while issues can mostly be traced back to an inadequate realization of one specific core concept. As shown in Fig. 5-8, the interactions of **IA** x **WC**, **IA** x **ID2**, **IA** x **CCI**, and **IA** x **CCI** x **ID2** account for a large proportion of relationships between the ASD core concepts and beneficial consequences. In contrast, most issues seem related to one specific core concept that was not adequately executed. Examples include delivery delays, which relate to inadequate **CCI**, insufficient documentation, and technical debt that are provoked by an excessive pace relatable to **ID2**, or meeting overhead and workflow interruptions that stem from too many meetings embedded in **IA**. Based on these insights, we argue that attaining ASD's value to its full extent depicts a complex endeavor that requires the adequate execution of several core concepts. Identifying the reasons for the encountered issues and acting accordingly appears more straightforward, though, as these issues mostly stem from the inadequate execution of one distinct core concept. We believe our findings help to point out aspects that require specific attention to maximize the benefits of ASD. Still, adequately executing and balancing these core concepts to avoid issues remains a challenging task.

B. KEY TAKEAWAYS ON THE ROLE OF THE CONTEXTUAL FACTORS: RECONCEPTUALIZING THE SWEET SPOT FOR ASD METHODOLOGIES

Our findings in section IV-B suggest that some contextual characteristics are more favorable for ASD, as they appear to be more associated with the realization of benefits, while some manifestation forms of contextual factors can imply serious issues. This indicates that certain contextual characteristics form a particularly ideal setting, i.e., a sweet spot for ASD. As illustrated in the theoretical background section, this 'agile sweet spot' [20] remained somewhat vague in previous works.

To clarify what an 'agile sweet spot' [20] entails, we provide a reconceptualized version shown in Fig. 9 that employs the findings from section IV.B. In so doing, we segment the 12 contextual factors into three groups based on their potential criticality for ASD projects. The first group comprises factors with manifestation forms that appeared especially critical in section IV.B and should be avoided to prevent a potential failure of ASD projects. In the second group, we include contextual factors with certain manifestation forms that ASD methodologies can tolerate but require dedicated management attention to ensure success. In the third group, we include less critical contextual factors, which are important aspects to consider, but were not found in section IV-B to make ASD work outside of its optimal operating window. To emphasize how critical the different manifestation forms of the contextual factors appear to be for ASD, we employ a color scheme that segments the contextual factor manifestation forms into ideal (green), potentially tolerable but outside of the ideal setting (yellow), and especially problematic (orange). This color scheme was inspired by the color shading in Table 2 in [20] and further refined during the analysis of the contextual factors. As an illustrative example, several studies, e.g., (D19 [34]), (D25 [158]), (D42 [100]), cited low customer involvement as a source of problems, suggesting it as a context factor manifestation form that can be very problematic due to its negative influence. Therefore, low customer involvement is shaded with an orange background. Meanwhile, highly involved customers appeared essential to attain benefits with ASD (B31 [9]), (B57 [156]), (B63 [88]), (B64 [45]), (B74 [43]), so that high customer involvement is colored in green. Similarly, studies in which legacy systems were developed reported a range of issues, e.g., (D5 [154]), (D13 [118]), (D16 [107]), (D17 [157]), while studies that illustrated benefits of ASD mostly developed new applications, e.g., (B2 [44]), (B34 [131]), (B68 [144]). Hence, legacy systems are shaded with orange, while new applications are colored with a green background. As for a yellow background color, ASD can tolerate medium turnover (B46 [108]), but ideally, the team forms a cohesive unit without members leaving to prevent undesirable outcomes such as loss of domain knowledge (D11 [12]). Lastly, for context factors where multiple manifestation forms appeared to have a similar influence on outcomes, e.g., low and medium project

sizes, both share the same background color. Based on these findings, Fig. 9 highlights the characteristics of an agile sweet spot, where ASD methodologies, from the perspective of the contextual setting, can operate best. In contrast, the further away the manifestation forms appear from the green-shaded sweet spot, the more likely an ASD project is to fail due to a potential incompatibility of ASD with the contextual setting. In the following, we describe the three groups of contextual factors and associated manifestation forms, followed by the characterization of an ideal sweet spot for ASD projects.

In the **first** group, we include low customer involvement, high requirement volatility, high staff turnover, and legacy systems. Low customer involvement appears to be particularly problematic, as it entails negative outcomes such as delays and productivity losses (D19 [34]), requirements management issues (D42 [100]), and more rework (D12 [148]). Meanwhile, excessively volatile requirements can impede progress due to sprint cancellations, provoke difficulties in effort estimation (D20 [138]), and result in frustration for the team (D30 [152]). High requirement volatility can also lead to outdated documentation that is difficult to maintain (D11 [12]). In addition, even project settings with low staff turnover often seem to be associated with reduced productivity (B46 [108]) and a loss of valuable domain knowledge (D11 [12]). Loss of knowledge can especially affect ASD projects, as it is often not well documented (B1 [139]). Finally, concerning system age, large legacy systems can impede ASD projects, as they require ASD methodologies to be employed outside of their ideal operating window (D33 [116]), which hampers a correct application of ASD practices (D25 [158]). Thus, contextual settings with the characteristics described above should be avoided with ASD, as they can imply various problems that can contribute to a high likelihood of failure.

In the **second** group, we discuss distributed development, fixed-price budgets, strict documentation requirements, and large SD teams. We found that distributed ASD can work well in some cases (B9 [125]), (B60 [161]), but it required dedicated measures such as staff rotation between sites to compensate for the lack of collocation (B11 [84]). Studies on issues cited lacking collocation as a key reason for various problems (D10 [136]), (D33 [116]), (D39 [11]), (D40 [99]). Thus, while ASD can be employed in distributed projects, co-location is recommended to ensure success. Furthermore, fixed-price models and ASD are “challenging to combine” (D43 [117], p. 10). Cases with a fixed cost budget experienced issues in absorbing change due to budget constraints (D19 [34]), (D25 [158]). Settings where the customer “pays for resources spent” (B23 [129], p. 29) are therefore advisable to ensure sufficient capacity for changes. Similarly, strict documentation requirements affect teams in their work (D14 [6]), (D42 [100]), which contrasts ASD’s emphasis on limited documentation [30]. Generally, minimal documentation is recommended, while in cases where strict documentation is required, a dedicated documentation person (B17 [49]), (B19 [81]) can be assigned to limit additional overhead. Finally, it appears important to adhere to the recommended team

size of ten or fewer members [31]. We only identified a few slight deviations from this recommended number. Instead, large scenarios that exceeded the capacity of one team were handled with multiple small teams in scaled ASD approaches (B24 [107]). Therefore, small teams with a maximum of ten members are highly recommended, or a scaled approach with multiple teams should be selected [31] when exceeding this recommendation for team size. To conclude, while some manifestation forms of these contextual factors appear less favorable for ASD projects, they can still seem tolerable with dedicated management attention. Failing to manage these context factors adequately, however, can be problematic.

The **third** group entails team experience, project size, project complexity, and the criticality of the developed system. Regarding team experience, our findings suggest that ASD teams with varying degrees of experience have been involved in successful ASD projects. Issues in ASD projects were rarely attributed to team experience but relate to other contextual aspects. As such, even teams with less experience successfully conducted large ASD projects, as reported in (B9 [125]), (B57 [156]). Similarly, concerning project size, complexity, and criticality of the developed software, all project characteristics seem to be generally feasible. ASD was even found to support large projects with high criticality (D17 [157]), (B57 [156]), however, these cases rather represent an exception. Still, ASD should rather be applied in small, less complex, and less critical projects with experienced teams, as these contexts resemble the more optimal setting that ASD methodologies were conceived for [20]. Larger and more complex settings can also be feasible, but will require more dedicated management attention to ensure success.

Considering our findings, we propose that an ideal sweet spot for ASD projects, as shown in Fig. 9, is characterized by low to medium-sized projects with low to medium criticality and complexity, conducted by a small, stable, co-located, and reasonably experienced SD team. ASD projects also ideally develop a new application without any legacy, where certain requirements are known, while change can occur regularly, but without erratic volatility in customer demands. An optimal setting would also encompass a highly involved customer who provides resources on a time-and-material basis and only imposes relaxed documentation requirements. On the other hand, unstable teams, excessively volatile customer demands, legacy systems, fixed-price contracts, and lacking customer involvement should be avoided to prevent a range of problematic issues that could potentially lead to the failure of ASD projects. Lastly, projects in distributed settings can also be conducted reasonably well with ASD methodologies, but require additional management attention, which also holds true for project settings with strict documentation needs.

C. IMPLICATIONS FOR RESEARCH ON THE OUTCOMES OF ASD METHODOLOGIES

Our work provides several implications for scholars who investigate the outcomes of ASD methodologies:

First, our work addresses the call by [2] to examine “which core concepts might yield the greatest impacts on [different] desired outcomes” (p. 119). We identified **WC** as a cornerstone for ASD, often in combination with **IA** for various benefits, especially for the actors and the structure among them. Meanwhile, **ID2** and **CCI** particularly imply benefits for the task and technology dimension. Going beyond this call, our work also reveals that these core concepts not only foster desirable outcomes, but, depending on the execution of the core concepts, also various negative implications can result. In this line of thought, we propose that the relationship between the execution of certain core concepts and the resulting value could resemble an inverted u-shape. In this vein, we suggest that **IA** and **ID2** seem to deliver beneficial outcomes up to a certain point before negative implications begin to set in. Regarding **IA**, meetings that implement this concept can be beneficial for communication and other outcomes, however, if practiced too intensively, negative feelings and reduced development progress result (D32 [58]). Similarly, for **ID2**, (D21 [94]) finds that the iteration pressure created through **ID2** is, to a certain degree, necessary to motivate SD teams to deliver, yet if this pressure is too intense, it can be harmful to the team. Research can address this observation and further examine how the relationships between concept execution and outcome realization are defined. In addition, our findings provide a detailed characterization of the theoretical core concepts of ASD along the propositions P1-P5 and how they contribute to the different outcomes. With these propositions, we enable research to further assess how ASD methodologies contribute to the broad spectrum of different outcomes.

Second, this study provides a comprehensive framework that reveals how contextual factors differ in their influence on ASD projects and their outcomes. Researchers can adopt this redefined agile sweet spot to ensure a more thorough reporting on the contextual factors in their studies, as we found a compelling variance in the level of detail of the descriptions for the context factors, which can be inferred from the online appendix. This observation is in line with [2], who criticized frequently employed reductionist strategies in ASD research that neglect the important role of contextual factors. As such, several studies, e.g., (B25 [68]), (B43 [106]), (D8 [10]), (D37 [115]), barely touch upon the contextual characteristics of the project settings, which can affect the validity and credibility of these studies. In addition, studies that employed a multiple case study approach often only reported fragmented contextual factor information for the included studies and did not provide the same insights into all potentially relevant contextual characteristics, e.g., (B12 [87]), (D13 [118]), (D40 [99]), making it difficult to compare them. Meanwhile, our study emphasizes the need to consider contextual factors in future studies on ASD in more depth, as the observed benefits and issues seem to depend strongly on the respective context settings. In this regard, Table 12 and the defined manifestation forms for 12 selected contextual factors that are of substantial relevance to ASD research can

help researchers provide a more comprehensive account of the contextual settings that influence the observed outcomes in future studies.

As a **third** implication, we contribute a validation of the proposed theoretical core for ASD [2], as the framework had not been applied before. Our study serves as an assessment of the proposed theoretical core and enhances it with the inclusion of negative outcomes that these core concepts can imply, as this aspect was somewhat neglected in [2]. We also propose that the ASD core concepts are more interlinked than initially suggested. While **ID2** and **IA** are conceptually related and provide benefits in interaction, **IA** and **WC** particularly account for a large part of the benefits in interaction. Similarly, the benefits attainable through **IA**, **ID2**, and **CCI** in interaction show that these concepts appear strongly interrelated. As our analysis demonstrates that the four theoretical core concepts jointly constitute a well-defined framework that adequately captures the key characteristics of agility in ASD, we thus encourage research to employ this lens in future examinations.

Fourth, our study sheds light on the socio-technical nature of ASD's outcomes. Beyond identifying mostly similar benefits and issues compared to related secondary studies, e.g., being in line with those outcomes observed in [3], [5], [13], and [15], this study goes further by explicitly illustrating their socio-technical characteristics and delineating how they seem linked to ASD agility. In this vein, by studying how the four core concepts seem to differ in how they relate to the outcomes in each of the four STS-dimensions, we provide a foundation for future research to apply socio-technical grounded theory [50]. As such, classifying the outcomes along the dimensions of the STS and examining the relationships with the core concepts can enable a better understanding of how ASD's socio-technical outcomes are created. Equipped with these insights, scholars can thus conduct further studies on the “coupling between its social and technical aspects” [50, p. 7], and advance the understanding of the underlying mechanisms of ASD from a socio-technical perspective.

In sum, this study advances the theoretical understanding of how ASD shapes the realization of its different outcomes, enhanced with insights into the relevance of contextual factors for the benefits and issues that ASD methodologies can imply.

D. AVENUES FOR FUTURE RESEARCH ON THE OUTCOMES OF ASD METHODOLOGIES

In this section, we derive five avenues for future research as part of a research agenda, as suggested by [23], see Table 13 on the following page.

First, to understand how the ASD core concepts contribute to the realization of benefits or issues, future research should investigate apparent inverted u-shaped relationships between core concept execution and the resulting value of outcomes. While perspectives on inverted u-shaped relationships in ASD are rare, for instance, suggested in [168], we argue that

TABLE 13. Agenda for future research avenues on the outcomes of ASD methodologies.

Future Research Avenue	Explanation of Research Avenue	Exemplary Research Questions	Contributions
01. Inverted U-shaped Relationship Between ASD Core Concept Execution and Resulting Benefits or Issues	Research should understand the duality of outcomes resulting from the ASD core concepts, as certain core concepts to deliver benefits to a certain point before negative outcomes arise.	<ul style="list-style-type: none"> - Up to which point can the ASD core concepts deliver beneficial outcomes before issues occur? - How can the tipping point be moderated to maximize benefit realization? - What are efficient measures to balance the apparent inverted curvilinear relationships between ASD core concept realization and benefit / issue creation? 	<ul style="list-style-type: none"> - [168] - (D21 [94]) - (D32 [58])
02. Configurational Analysis (fsQCA) of ASD Core Concepts in Benefit or Issue Realization	Research should examine how ASD core concepts create benefits in interaction / on their own, thereby identifying necessary conditions that need to be fulfilled to achieve a certain set of beneficial outcomes, while also determining how the absence of certain core conditions / concepts creates issues.	<ul style="list-style-type: none"> - Which ASD core concepts represent necessary conditions for the realization of benefits? - Which configurations of core concepts are essential for different attainable benefits of ASD? - Which core concepts, if absent, contribute to issues? - Can core concepts compensate for a less adequate execution of certain other core concepts? 	<ul style="list-style-type: none"> - [51]
03. Further Operationalization of the ASD Core Concepts for Validation of our Findings and the Theoretical Framework	Research should apply the theoretical core concept framework for ASD in confirmatory and empirical approaches to validate our findings and the framework itself, thereby advancing the debate on the theoretical underpinnings of ASD methodologies.	<ul style="list-style-type: none"> - How are the ASD core concepts operationalized by practitioners in the practical application of ASD methodologies? - How can the degree of realization of ASD core concepts be adequately measured? 	<ul style="list-style-type: none"> - [2] - [17]
04. Role of Contextual Factors in Benefit or Issue Realization and Validation of the Agile Sweet Spot	Research should validate the redefined agile sweet spot and engage in more in-depth examinations of the role of contextual factors for ASD's outcomes, as the different contextual conditions are often not emphasized enough in extant literature.	<ul style="list-style-type: none"> - Is the proposed agile sweet spot representative of the reality in contemporary ASD projects? - Can the agile sweet spot be applied in all industries? - Which measures can allow ASD projects outside of the agile sweet spot to be performed successfully? 	<ul style="list-style-type: none"> - [19] - [20] - [21]
05. Advanced Socio-Technical Inquiries into the Nature of ASD and Associated Outcomes	Research should advance the efforts in understanding the socio-technical nature of SE / ASD methodologies, thereby focusing on the distinct outcomes that do not only include typical performance improvements along time, cost, quality, and scope.	<ul style="list-style-type: none"> - Do practitioners perceive the outcomes of ASD methodology-based projects to be socio-technical or are these perceptions solely focused on performance? - How do specific ASD practices implement social / technical characteristics of ASD and do these practices only benefit the associated socio-technical subsystem? 	<ul style="list-style-type: none"> - [50] - [51] - (B20 [67]) - (B25 [68])

research on the realization of outcomes based on the ASD core concepts could benefit from adopting this novel perspective. This appears especially promising when considering the double-sided nature of outcomes resulting from **IA** and **ID2**, which seem to depend on the execution of these core concepts.

Second, we observed that benefits are primarily realized by several interacting core concepts, while issues mostly stem from the inadequate realization of one core concept, for example, **ID2**, or the absence of a core concept such as **CCI**. Based on this observation, investigating outcome realization in ASD with a configurational approach (fsQCA) appears worthwhile. Following [51], future research could assess which ASD core concepts represent necessary conditions for benefits in each socio-technical outcome dimension, thereby also learning how an absence of certain core concepts may imply issues. A configurational approach could also advance knowledge on how the proposed theoretical core operates in the realization of outcomes and strengthen the framework to understand the theoretical foundations for outcome creation, while also confirming the relationships identified in this study.

Third, more validations of the theoretical core concepts framework are required, as it has not been applied in empirical settings yet [17]. Also, proving our findings with empirical or confirmatory approaches is needed. The two research avenues described before can serve as approaches

to operationalize this framework, while other strategies, such as multiple case studies in the SD industry, would similarly contribute to its validation. While our work cannot prove causality due to the selected literature-based research approach, as described in the limitations section, it offers guidance for these future efforts to operationalize the proposed theoretical core of ASD [2] and to confirm the relationships suggested in this study.

Fourth, in line with further operationalizations of the ASD core concept framework in empirical case studies, validating the redefined agile sweet spot represents a promising avenue for future research. While this sweet spot has been defined based on a large sample of studies, further validations of the conceptualization are required. The sweet spot can also be applied in case studies to address the call to “[understand] ASD’s project context and rigorously [examine] if, how, why and when ASD impacts outcomes” [2, p. 107]. Furthermore, by using the agile sweet spot, scholars could also examine different measures to enable ASD to work in less ideal environments.

Fifth, theorizing ASD methodologies and their outcomes as socio-technical is in line with suggested efforts to assess the socio-technical aspects of ASD [50], e.g., by applying socio-technical grounded theory. Considering that four dimensions of the STS were found to be affected by the characteristics of ASD and that STS-oriented research on ASD methodologies remains scarce in related literature,

advancing research on the socio-technical aspects of ASD, as suggested by [50], is a promising path for future research. In this regard, our work can provide the necessary foundations for these future research efforts “to strengthen our theoretical understanding of ASD” [2, p. 107], particularly from a socio-technical perspective.

E. IMPLICATIONS FOR THE PRACTICAL APPLICATION OF ASD METHODOLOGIES

For practice, we **first** show that **WC** is key for effective ASD, as these methodologies only seem to function under intense communication in the team and in collaboration with all involved actors/stakeholders. Similarly, (B30 [103]) found that communication is a key success factor for ASD, with social / PM practices being essential to enable communication (B31 [9]), (B57 [156]). Considering the benefits that **WC** delivers, ASD teams are advised to implement reliable communication mechanisms. To add, its interaction with **IA**, particularly in retrospectives, needs to be emphasized. As **IA** x **WC** seems to be a driver of various benefits, it is surprising that retrospectives are often abandoned in practice [169], [170]. In light of the benefits of **IA** x **WC**, we encourage practitioners to conduct retrospectives meetings regularly.

Second, our analysis identified **CCI** as a central aspect that practitioners need to ensure for successful ASD, as issues in the task and structure dimension seem especially related to inadequate **CCI**. Considering the work of (D19 [34]) on the negative consequences of inadequate **CCI** for ASD teams and issues associated with insufficient **CCI** identified in our study, continuously involving the customer seems essential. To add, upholding the promises of the Agile Manifesto [30] for short-term delivery, responsiveness to change, and increased customer satisfaction through working software only appears feasible with adequate **CCI**. Our work can be a reminder to ensure client involvement, e.g., via on-site customers [171].

Third, our work highlights the need for a sustainable pace, given the simultaneous benefits and issues of **IA** x **ID2**. As described, **IA** is important to improve the SD process (B35 [162]), (B69 [172]), deliver a high-quality product that meets requirements (B45 [173]), and foster team cohesion (B48 [58]). Similarly, **ID2** with frequent inspections (**IA**) jointly increases product quality (B54 [79]). However, **IA** and **ID2** can also provide issues that primarily stem from the high-paced cadence implied by these two core concepts. These may include interruptions (D45 [48]), stress and pressure for the team (D15 [155]), (D24 [174]), technical debt (D17 [157]), or the negligence of refactoring needed to fix technical debt (D26 [150]). Thus, besides the benefits the pace embedded in **IA** x **ID2** can deliver, we also shed light on the issues that may accompany it and emphasize the need for a sustainable pace.

Fourth, regarding the contextual factor analysis and the ‘agile sweet spot’ [20] for ASD projects, our work can remind practitioners about contextual factors in their project setting that require dedicated attention to avoid issues. In analogy

to the second implication, customer involvement is a critical context factor that needs to be ensured. Beyond, settings with high requirement volatility and staff fluctuation, as well as grown legacy systems, should be carefully managed, as these contextual characteristics are outside of the agile sweet spot and were frequently reported as problematic. The clarification of the sweet spot can also act as a guide for practitioners who set up SD projects and help them determine whether ASD methodologies are generally suitable in their respective cases.

In sum, practitioners need to foster **WC** as a cornerstone of ASD, conduct retrospectives to attain benefits of **IA** x **WC**, ensure adequate **CCI** to avoid a range of progress-impeding issues, and enable a sustainable pace that can be affected by excessive **IA** x **ID2**, despite its key role in realizing various beneficial implications. Lastly, based on the findings on contextual settings, practitioners need to be aware of the need to manage critical contextual factors such as team stability, requirement volatility, customer involvement, and system age. The agile sweet spot can help them to act accordingly.

F. LIMITATIONS

Our findings have potential limitations that are described along the threats to validity categories proposed by Petersen & Gencel [175]. Regarding credibility and reliability concerns, we acknowledge a certain probability of bias, which is present in any SLR [176]. To limit these concerns, we involved two authors during the selection and evaluation of the articles and the analysis procedure. The substantial inter-rater agreement scores and the supervision of the other authors further limited the remaining probability of bias, especially in cases of disagreement during the selection of studies. An additional forward-backward search also ensured the reliability of our work, as it prevented an unintended exclusion of potentially relevant articles. We also acknowledge that the interpretation of the literature may be subjective, and other researchers may have drawn different conclusions based on their interpretation. Having involved several authors in the analysis and by performing iterative analyses with joint discussions in cases of disagreement, however, we argue that the findings exhibit reliability. For internal and construct validity concerns, we acknowledge an inherent limitation of our literature-based research approach, which ultimately cannot prove apparent causal relationships between ASD core concepts and outcomes. Despite interpreting a large set of statements from the literature to identify associations among ASD core concepts and benefits or issues, proving these apparent relationships requires a confirmatory approach. As suggested in the research agenda, employing such an approach in future efforts appears fruitful, for which our findings can provide valuable guidance. With the iterative analysis of the statements extracted from the literature sample, we argue that our work provides valid claims regarding the relationships between ASD's core concepts and outcomes, e.g., due to the involvement of multiple authors. Future research efforts can further investigate the proposed

relationships and confirm them, for instance, in multiple case studies or by using confirmatory approaches, as suggested in the future research agenda. Lastly, we discuss generalizability issues, which relate to contextual factors. We conducted an in-depth analysis of the contextual factors that shape the outcomes of ASD, however, the varying depth in the descriptions of the factors in the selected studies can limit generalizability. As stated in section V-C, the studies varied considerably in their context descriptions, with some case studies even showing a substantial difference in the richness of details described between the included cases. To mitigate this limitation, we analyzed a large sample of studies (n=122) and identified 148 individual cases. Based on this extensive coverage of different context settings enabled by the large sample, we argue that our findings rest on a strong foundation that allows for generalizable insights. This also holds true for the agile sweet spot, which was defined based on 661 individual context factor observations in the literature. Thus, we argue that the agile sweet spot can serve as a useful guidance for scholars and practitioners who aim to understand how the outcomes of ASD projects depend on the respective contextual settings. Despite these limitations, by examining the relationships between ASD core concepts and outcomes, as well as focusing on the role of contextual factors, our work provides an important step towards a better understanding of the spectrum of outcomes resulting from ASD methodologies.

VI. CONCLUSION

The two-sided nature of outcomes of ASD methodologies, the role of ASD’s core concepts, and the contextual settings

that shape the benefits and issues of ASD have been mostly neglected in prior research. This study addresses these shortcomings by analyzing the spectrum of outcomes of ASD and relating them to the specific core characteristic(s) of agility that appear to contribute to their realization. Our findings equip scholars with a better understanding of the factors behind the outcomes of ASD, as we contribute a novel angle toward explaining the relationships between agility in ASD and resulting outcomes. To add, our work also serves as a test of the theoretical framework by Baham and Hirschheim [2], which captures the essence of what characterizes agility in ASD methodologies and shapes the realization of outcomes. Furthermore, the study advances the debate on context factors with a reconceptualization of the ‘agile sweet spot’ [20]. With the redefined sweet spot, we help to clarify which contextual factors require dedicated attention, as some factors embed potentially problematic manifestation forms that can provoke issues in ASD projects. Together with the findings on the ASD core concepts, our work thus also informs practitioners about essential aspects they need to ensure to apply ASD methodologies successfully, while moreover pointing out those contextual settings that should be avoided for ASD projects. Taken together, this study contributes towards a more nuanced understanding of *how* and *when* ASD methodologies realize different outcomes, while also fostering an improved use of the methodologies in daily SD practice.

APPENDIX A: LITERATURE SEARCH, INCLUSION / EXCLUSION CRITERIA, AND QUALITY ASSESSMENT CRITERIA

See Tables 14–17.

TABLE 14. Literature search on benefits.

Database	Initial Results	Results after Hard Inclusion Criteria	Results after Title / Abstract Screening	Results after Full-Text Relevance Analysis	Results after Quality Assessment and Snowballing
AISEL	208	199	37	15	13
IEEE	1688	1278	71	16	11
Science Direct	413	384	42	9	9
EBSCO	655	422	46	11	6
Taylor and Francis	38	32	10	3	3
Web of Science	554	502	57	16	10
Springer Link	855	622	60	18	15
ACM	384	299	18	13	10
WILEY	26	19	9	0	0
Σ	4821	3757	350	101	77

TABLE 15. Literature search on issues.

Database	Initial Results	Results after Hard Inclusion Criteria	Results after Title / Abstract Screening	Results after Full-Text Relevance Analysis	Results after Quality Assessment and Snowballing
AISEL	143	141	40	9	9
IEEE	1421	1114	23	7	4
Science Direct	385	285	55	17	17
EBSCO	391	280	45	8	4
Taylor and Francis	6	5	2	1	1
Web of Science	223	184	12	7	2
Springer Link	452	386	30	5	3
ACM	280	221	8	4	2
WILEY	18	15	5	3	3
Σ	3319	2631	220	61	45

TABLE 16. Inclusion and exclusion criteria.

Criteria	Description of Inclusion and Exclusion Criteria
IC1	Only publications written in English language were included.
IC2	Only publications by official conferences or scientific journals were included.
IC3	Only publications that were published between 2006 and 2023 were included.
EC1	Publications that are no full research papers, i.e., research in progress articles, opinion papers, presentations or posters, were excluded.
EC2	Publications that do not explicitly focus on ASD methodologies, their characteristics and either benefits or downsides were excluded.
EC3	Publications that assess agility in a different context than the application ASD methodologies were excluded.
Note: Inclusion Criteria = IC, Exclusion Criteria = EC	

TABLE 17. Quality assessment criteria.

Criterion ID	Quality Criterion	Reference for Quality Criterion
Q1	Theoretical Foundations and Backgrounds	Kitchenham & Charters (2007) [69]
Q2	Data Collection, Analysis and Reporting	Dybå, & Dingsøyr (2008) [61]
Q3	Reflexivity / Limitations / Threats to Validity	Dybå, & Dingsøyr (2008) [61], Usman et al. (2014) [177]
Q4	Use of References	Rohunen et al. (2010) [178]
Q5	Objectives of Research stated	Dybå, & Dingsøyr (2008) [61]
Q6	Credibility of presented Findings	Dybå, & Dingsøyr (2008) [61]
Q7	Coherent Thread in Article	Kitchenham & Charters (2007) [69]
Q8	Contribution to existing Knowledge	Kitchenham & Charters (2007) [69]

APPENDIX B: STUDY SAMPLE ON ASD BENEFITS

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APPENDIX C: STUDY SAMPLE ON ASD ISSUES

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