

Guest Editorial: Agile beyond software - In search of flexibility in a wide range of innovation projects and industries

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1. Agile Beyond Software

Since 2001, when its Manifesto was published, Agile has introduced radical changes in the way new software is developed. Today, it is possibly one of the most popular, researched and practiced management framework in the business world [1].

One main reason for its extensive use is that Agile supports developers with coping with the growing uncertainty and turbulence in technological and market environments [2]. Feedback and change are at the core of Agile for a dynamic, evolving, and organic, rather than static, predefined, and mechanistic development process advocated by Waterfall management [3]. To create timely, high-quality, cost-efficient and innovative solutions, Agile developers organized in small, co-located, autonomous teams, build and test software in rapid iterative cycles, actively involving users to gather feedback, updating the project scope and plan “on-the-fly”, using face-to-face communication as opposed to documentation [4].

Information Systems (IS), project management and innovation research have provided sufficient evidence of major quality and productivity gains brought by the application of Agile principles and tools in software development projects [5], [6]. Naturally, there are some relevant studies pointing to limitations of the Agile approach vis-à-vis other frameworks, for instance limited attention to architecture [7] and indicating a set of contextual conditions where the use of Agile is not optimal nor conducive to performance improvements (e.g. [8]).

Yet, recent works document a growing trend of practicing Agile outside its “home ground”, also to contexts loosely related or unrelated to software development [9]. Mangalaraj et al. [10] suggest that developers increasingly perceive Agile as a viable approach across all innovation projects. Contributing to this expansion are pervasive, systemic trends like digitalization, industry 4.0, and the emergence of platform-based business models, which blur the distinction between hardware and software, between product and service. SAAB, 3M, Bosch and ING Direct are examples of established corporations that have undertaken an organization-wide Agile transformation [1].

The growing application of Agile in practice has been documented and studied by researchers only to a limited extent so far. Most empirical studies have focused on the IT industry, offering little to no insights on the application of Agile in non-software contexts [11], [12]. This is a missed opportunity from a theoretical and practical standpoint.

The idea of this Special Issue stems from the belief that, as the world faces unseen levels of uncertainty and turbulence, Agile holds the potential for a wider and stronger impact than the one documented so far. As Andrew Hunt, one of 17 authors of the Agile manifesto, puts it: *“At its heart, an agile approach has little to do with software; it’s all about recognizing and applying feedback.”* The aim of this Special Issue is thus to spur and develop high-quality research-based knowledge of the application of Agile in contexts that are not exclusively concerned with the development of new software code. This new research should contribute to the emergence of a literature stream on organization-wide Agile management.

We view the expression “beyond software” in a broad and malleable way. Under this label, we include, e.g., the development of innovative systems that consist of, also, hardware, service and human components; organizational forms that transcend development teams, such as functions, communities, networks; work units beyond projects, such as portfolios, programs, strategies; functions that are not concerned with research and development, e.g., marketing, customer service or finance; any other industry besides IT, where computing technologies are just one of many relevant components; mature companies, including SMEs; developing economies.

Clearly, the expansion to these many contexts increases the diversity of the conditions in which Agile is to be applied and thus the complexity of its application. Scaling Agile by transferring its principles and practices from the narrow home ground of software development to a larger context of use is not a trivial endeavor due to significant changes in several aspects, e.g.: the nature of the outputs being created and the resources being used to do so; the goals, the performance requirements and how they are prioritized; the process design and execution; the relevance of “soft” organizational elements (e.g., culture, reputation and leadership) vis-à-vis “hard” ones (e.g., performance measures and work routines).

For instance, compared to purely digital products, physical ones can be complex systems with many interacting components belonging to several technical domains. Unlike software, their development is more difficult to break into small chunks due to strong interdependencies; it requires cross-functional teams that connect to departments that work very differently, are often geographically dispersed, and are harder to synchronize [13].

Hardware can be safety critical, implying that reliability and predictability have higher relevance than agility. Tangible products have longer development cycles and cost more to

prototype. The typical duration of Agile sprints is too fast for hardware developers to make meaningful progress and deliver a working prototype for user testing [9]

Another example is functions that are not concerned with developing new offerings. Differently from R&D or innovation units, they tend to be geared towards consistency, control, conformance to specifications, compliance with plans and budgets. Hierarchy, standard procedures and adherence to established routines play a more significant role, leading to manager-centric environments (vs. developer centric) [14].

2. The Special Issue

The nine articles presented in this Special Issue contribute to the state-of-the-art of Agile research by offering a rich, up-to-date account of the dynamics occurring when expanding Agile into “not-just-software” contexts, of the key challenges and perils related to the scaling and of the possible solutions to them.

From the publication of the call for papers for this Special Issue, we received 44 extended abstracts that have been reviewed and selected by us guest editors. From this pool, we invited the authors of 13 highly promising abstracts to draft and submit full papers. Nine of these completed a rigorous double-blind peer-review process involved a minimum of three reviewers per manuscript and are now part of this Special Issue. The authors of these articles are active researchers in different disciplines, from project management to innovation and new product development, from information systems to computer science, to software engineering and design, human resource management and supply chain management.

The individual articles of the Special Issue are briefly summarized below.

Meier and Kock [15] develop and validate a multidimensional scale to measure the organization of Agile R&D units. The scale includes six dimensions (a culture of agile values, customer integration, autonomy, an iterative work method, cross-functional capabilities, and flat hierarchies), reflecting the dynamic capabilities perspective adopted in this article. The comprehensiveness of the scale, the conceptualization of agility as a capability, and the focus on organizational units are original contributions of this study to Agile research and practice. Using answers from more than 150 R&D managers, the authors also find evidence of a correlation between an Agile organization of R&D units and front-end project success.

Van Wessel, Kroon and de Vries [16] focus on the issues that can occur at the enterprise level when implementing emergent architecture design, namely lack of coherence and poor integration across services. In Agile, architecture is expected to evolve incrementally rather than being dictated by enterprise architects. This has benefits in terms of flexibility but can come at the cost of consistency. Based on evidence from three longitudinal case studies, the authors argue that companies undertaking large-scale Agile transformations, should embrace Enterprise Architecture (EA) principles and practices. Because these diverge from Agile ones, the effective adoption of both Agile and EA depends on clear redefinition of roles and processes, on the balancing between autonomy and top-down guidance and on the combination of waterfall and agile elements.

Patrucco, Canterino e Minelgaite [17] address a possible gap between the sub-culture in Agile teams and the overall culture of the organization, and on how the former is associated to the use of Scrum practices. Drawing on the competing values framework and on seven case studies from multiple manufacturing and service industries, the authors find that the dominant

subcultures in Agile teams are either oriented towards collaboration or toward customer satisfaction and market competitiveness; and that the emergence of these subcultures is favored by the nature of the certain pillars and practices of Scrum.

Bechtel, Kaufmann and Kock [18] examine the relationship between Agile practices and the quality of teamwork in development projects and how this relationship is moderated by project portfolio management practices. One original contribution of this survey-based study is to investigate the interplay between practices at different organizational levels, such as portfolio and project. The findings of this study show that traditional portfolio management practices such as the existence of a business case and strategic clarity, reduce the positive impact of Agile on teamwork quality. One interpretation of this result is that conventional portfolio management, which is consistent with Stage-Gate principles, might restrict the flexibility that is required in Agile projects. The study also identifies a positive influence of Agile on project success, both direct and mediated by teamwork quality.

Sanasi, Manotti and Ghezzi [19] investigate the challenges arising from early testing of prototypes with customers when firms fear negative consequences on their reputation. While exploratory experimentation in Agile provides valuable feedback that enhances the quality of subsequent design decisions, it can pose major threats to the reputation of the innovating company. Based on the analysis of three case studies, the authors find that high-reputation firms control risks by relying on previously validated assumptions for the core elements of their business models, while more boldly experimenting with less critical elements. Drawing on the patterns identified in the cases, the authors develop a six-stage process model for running exploratory experiments while controlling reputational risks.

Sharma, Singh, Jones, Kraus and Dwivedi [20] examine the drivers influencing adoption of Agile by small and medium enterprises (SMEs). Results from a sample of 276 SMEs located in Fiji suggest that the intention to adopt Agile is positively associated with external factors such as mimetic isomorphism and normative isomorphism, and with internal ones, such as top management championship, adhocracy culture, clan culture, and organizational readiness.

Bianchi, Conforto, Rebentisch, Amaral, Rezende and de Padua [21] develop a recommendation system that support managers in choosing appropriate Agile practices depending on the particular project type and environmental conditions. This study contributes particularly to the process of customizing hybrid, Agile and Stage-Gate, models. Data mining techniques applied to a sample of 856 projects are used by the authors to design the recommendation system, which, compared to analogous methods proposed in the literature, has the advantage of adapting dynamically as the nature and conditions of the projects being executed change.

Ågren, Heldal, Knauss and Pelliccione [14] investigate the drivers and the consequences of scaling Agile beyond teams and beyond software. Specifically, the authors examine the reasons, the strategies and the implications of transforming the organization responsible for the development of complex safety-critical automotive systems, into Agile. The study identifies the main reasons to scale up Agile, among which the need to decrease lead time is the most important; seven strategies to scale up Agile to non-Agile surroundings, including e.g., a different allocation of responsibility; and the consequences of Agile adoption for the wider organization, e.g., the emergence of fewer and broader roles.

Strode, Sharp, Barroca, Gregory and Taylor [22] document the tensions that arise when transforming entire organizations into Agile. Compared to the typical focus on processes and organizational aspects in Agile literature, this study highlights changes to strategy, culture and operations as part of an organization-wide transformation. Based on three case studies and through the lens of paradox theory, the authors identify 13 tensions related to learning, organizing and performing. To help leaders address them both at the beginning and during the transformation, the authors formulate specific questions that spotlight key areas for decision making.

3. Scaling up Agile beyond its “home ground”

Taken together, the articles in this Special Issue shed light on the complex endeavor of scaling up Agile. In this section, we transversally review their insights on this phenomenon. As a support to our discussion, we use a model by Modig and Åhlström [23] which conceptualizes management approaches as trees of concepts at multiple levels of abstraction. This model has been previously adopted to investigate and inform the application of Lean to nonmanufacturing contexts [23] and of Design Thinking to advanced research settings [24]. We believe it can be a useful conceptual lens to understand the phenomenon of expanding the application of Agile too.

The tree model by Modig and Åhlström [23] make a distinction between the values, principles, methods and tools of a management approach. On top, i.e., at high levels of abstraction, values and principles define how an organization should think and behave, the state towards which the organization should continually stride. This state defined by framework-specific values and principles guide managers in their decision making and in what to prioritize, whatever the context and situation they face. Conversely, methods and tools are context-specific, i.e., they are placed at a lower level in the tree model: they define how to perform certain tasks with the aim of realizing the above values and principles in a particular set of (similar) use contexts. The nature and design of methods and tools are contingent on the characteristics of the environment in which are implemented.

As regards Agile, the key values and principles are formulated in its 2001 Manifesto. They include, among the other, adaptation to change, early customer involvement, iteration, experimentation, dynamic specification of outcomes, team autonomy. Differently from the above, Scrum is a project management method that implements Agile principles specifically in a software development context. Retrospectives, burndown charts, product backlogs, sprints, user stories and the like are Scrum tools. While these latter support software engineers in their design, coding and testing efforts, they might not be appropriate tools for sales reps, or mechanical engineers, or scientists or leaders of global divisions who all likely face different contextual conditions in their quest for higher agility.

In the view of Modig and Åhlström [23], when scaling up a management approach from its original “home ground” to a wider range of environments, organizations should not “literally” replicate its methods and tools. Instead, they should develop new methods and tools, or substantially adapt existing ones, that accomplish the foundational principles and values of the approach (which remain universally valid tenets) while accounting for the peculiar characteristics of the target application context.

Using the tree model to interpret the insights from the articles in the Special issue on scaling up Agile, we could distinguish a set of articles that, in line with the recommendations from Modig and Åhlström [23], focus on the adaptation or creation of methods and tools, while keeping Agile values and principles unchanged, from another set of articles, which instead implicate the co-existence of Agile tenets at the values and principles level with those from other approaches, such as Stage-Gate and Enterprise Architecture. Overall, as Agile scales up, the first set implies that its “heart” remains the same whereas the second set indicates that it might evolve into something different, also at its core, due to the incorporation of alternative values and principles. Hybrid models, such as Agile Stage-Gate, build on this latter notion.

With regards the first set of articles, Ågren et al. [14] describe a set of adapted Agile practices which are appropriate for the development of mechatronic systems in automotive organizations. Some of these diverge from standard methods and tools for the development of purely digital products, e.g., in relation to the integration of increments. The companies investigated in this study also appear not to use hybrid development approaches, due to likely conflicts between the principles of each original framework, in this case Agile and Stage-Gate. Findings by Bechtel et al. [18] provide some empirical support to these frictions as conventional portfolio management practices that implement Stage-Gate principles appear to reduce the effectiveness of Agile practices on performance. Based on these results, the authors propose that also portfolio management practices should transform according to “pure” Agile principles, rather than being the expression of a delicate balance between Agile and Stage-Gate principles. In their words, *“agile practices’ core principles are transferable to non-software project management and show similar benefits for performance in that setting”*.

Sanasi et al. [19] document that it is possible to modify experimentation’s methods and tools to test business model components, and not just software increments, while minimizing reputational risks. Patrucco et al. [17] reflect that the existence of culture clashes between agile teams and nonagile (or not yet agile) parts of the organization might be best addressed with the creation of specific procedures and rules for the integration of work; this is a departure from the loose and informal procedures used in Agile software development contexts.

The study by Strode et al. [22] offers evidence of different approaches to organization-wide Agile transformation. While each centered on a different area as the focus for the transformation (culture, strategy and operations, respectively), to reflect the different business and organizational context of the institution, they all shared the goal of enhancing flexibility in light of environmental shifts. An interesting insight from this study is that not only the nature of the Agile practices being adopted might differ across and within organizations, but also the timing and speed of their adoption.

All in all, these articles seem to imply that Agile is based on a specific, holistic way of thinking [25], that can be realized through the application of different and mutable practices and tools that suit their contexts of use [26].

In the second set, we include two articles in the Special Issue, Bianchi et al. [21] and van Wessel et al. [16], suggesting that “one size does not fit all” is true also for the foundational tenets of Agile, such as values and principles. Because they have limitations too, Agile principles should evolve and transform to be effective across different types of projects, outputs, organizations and industries. This evolution is driven by their integration with principles from

alternative approaches, such as Stage-Gate and Enterprise Architecture, eventually leading to hybrid models [13].

Bianchi et al. [21] build on the notion that “*hybrid models of project management can achieve better results than pure adoption of agile or traditional practices in certain cases*” by combining the advantages and correcting the deficiencies of the original approaches. Their study shows that projects driven by Agile, waterfall and hybrid principles can co-exist within the same organization. Eventual inconsistencies can be dealt with, by adopting the best combination of project management practices for a given project environment.

Van Wessel et al. [16] advocate the combination of two seemingly conflicting, approaches, Agile and Enterprise Architecture (EA), to address the lack of architecture coherence resulting from many Agile projects. While Agile is a bottom-up, decentralized approach, EA offers centralized, top-down guidance. One principle in the Agile Manifesto states that “the best architectures, requirements, and designs emerge from self-organizing teams” whereas EA pre-defines the architecture structure. According to the authors, it is still possible to achieve both flexibility and consistency by complementing the Agile approach with traditional waterfall-oriented characteristics of EA. The incorporation of principles at odds with its pillars would likely modify the very nature of Agile as a paradigm.

4. Conclusion

Together, the research presented in this Special Issue offers valuable insights into the complex challenge of scaling up Agile. More research is needed on how to best address the inconsistencies and tensions that might arise when expanding Agile into non-agile surroundings. What is Agile when it drives the decisions and actions of the entire organization?

Agile is a powerful and intriguing management approach because of its seemingly paradoxical nature. “Less” planning leads to better plans. An orientation towards reaction to change leads to less changes to be implemented in the process. Delayed design decisions lead to faster time to market. Experimenting with a larger number of concepts and prototypes leads to cheaper projects [3], [27], [28]. We hope that this Special Issue will invite more researchers to devote the time and energy to untangle the characteristics, drivers and effects of Agile in heterogenous environments.

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