A Complexity Framework for Project Management Strategies

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Published in:
Project Management Journal

DOI:
10.1177/87569728221142229

Article

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Project Management Journal
2023, Vol. 54(3) 253–267

DOI: 10.1177/87569728221142229
journals.sagepub.com/home/pmx

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Abstract

We examine how project complexity influences the choice of a project management strategy and present a framework that facilitates managers in selecting a suitable project management strategy. We distinguish the complexity of project domains from two dimensions, the degree of structural complexity and the degree of dynamic complexity, resulting in four generic project types. Four generic project management strategies are identified that match these project types. This complexity framework for project management allows key players to determine a better project management strategy and related practices given its content, the internal context, and the external environment.

Keywords

project diagnosis, complexity, project types, project management strategy, project practices, contingency theory

Introduction

Project management strategies are generic approaches to manage projects and reach project goals (Pich et al., 2002; Anderson & Merna, 2003). A project management strategy can be realized by adopting a coherent set of project practices. Although there is extensive literature on project management strategies (Fernandez & Fernandez, 2016; Pellerin & Perrier, 2019; Pich et al., 2002) project managers often lack an overview of these strategies and the theoretical insights behind them. As a result, they are often uncertain about which project management strategy to choose. Some organizations have adopted standard project management approaches and some experienced project managers intuitively know what to do, but problems due to unsuitable project management strategies are still common (Doloi, 2013; Pich et al., 2002). Problems of adopting unsuitable project management strategies include project abandonment, poor uptake of the project's outcomes, cost and time overruns, difficulties with spread and scaling up, and dissatisfied stakeholders (Van Camp & Braet, 2016).

The various project management strategies and their associated practices have emerged from different traditions (Pich et al., 2002). These traditions include the classical tradition with its hard and planned strategies (Matland, 1995); the political tradition where stakeholder management is a key strategy (Boonstra et al., 2017); and the participative tradition, including iterative, experimental, agile, and scrum strategies (Fernandez & Fernandez, 2016). Sometimes project management strategies can be complementary (e.g., milestone planning combined with participation). In contrast, others might be contradictory such as the need to perform scheduled tasks versus the need to learn and experiment or to try multiple solutions simultaneously (Pich et al., 2002). Having an overview of project management strategies in combination with an in-depth understanding of the project's degree of complexity is essential for adopting a strategy that suits a specific project. In this article, we assume that there is not one superior project management strategy but rather that a project management strategy should be contingent on the project's structural and dynamic complexity.

The research question that we address in this article is: How does project complexity influence the suitability of a project management strategy and associated project practices? To address this question, we draw on contingency theory to develop a coherent and theory-informed project complexity framework that facilitates adopting an appropriate project management strategy. The focus of the framework is on two dimensions of project complexity: structural complexity and dynamic complexity (Brady & Davies, 2014). Structural complexity relates to the degree, number, heterogeneity, and interrelatedness of project elements (Kermanschachi & Safapour, 2019), and dynamic complexity relates to the degree of available and reliable information on the future state (Maylor & Turner, 2017; Pich et al., 2002; Shenhar & Holzmann, 2017).

The project complexity framework relates four basic project types—uniform, pluriform, unfolding, and ambiguous—to four matching project management strategies—instructionism,

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stakeholder management, learning and experimenting, and symbolic dialogues on divergent future states. These four strategies can be appropriate for particular degrees of structural and dynamic complexity and can be combined, depending on the characteristics of a specific project.

This article makes four contributions. First, drawing on project complexity literature (Geraldi et al., 2011; Maylor & Turner, 2017; Morcov et al., 2020; Padalkar, & Gopinath, 2016; Brady & Davies, 2014) we operationalize different dimensions of complexity into interacting project domains, namely content, internal context, and external environment. A second contribution is that, although the framework identifies four generic project types, it also recognizes that most projects will be combinations of different types, depending on the complexity of the content, the internal context, and the external environment of the project at hand. Therefore, this complexity framework for project management adds to the literature on project categorizations (Matland, 1995; Payne & Turner, 1999; Pich et al., 2002; Shenhar, 2001; Snowden & Boone, 2007; Stacey, 1996; Brady & Davies, 2014) by demonstrating how project types, their associated project management strategies and practices can be hybrid. A third contribution is that, unlike most literature on project management typologies, the proposed framework relates project types to project management strategies and associated practices. The final contribution is that the framework is established as an analytical tool that enables those seeking to design a project management strategy to address the key challenges of their project. This tool can be used throughout the project and allows key players to conduct a fine-grained multidimensional diagnosis of various aspects of the three different project domains and to develop tailored project management strategies and practices that match with the project characteristics. The framework can also facilitate dialogue among key stakeholders regarding the project's characteristics and choose a project management strategy that aligns with the content, internal context, and external environment. Risk managers can use the framework to identify and mitigate various types of project risks.

In the next section, we provide an overview of project management strategies and underlying theories and address project diagnosis. We then present the proposed framework and the related diagnostic instrument. Finally, we discuss the theoretical and practical value of the framework, assess its limitations, and propose avenues for future research.

Theoretical Background of the Complexity Framework for Project Management

The complexity framework for project management that we develop in this article draws on contingency theory (Hanisch & Wald, 2012; Howell et al., 2010; Sauser et al., 2009; Burnes, 2017). For many decades, the project management literature largely ignored the importance of project contingencies, assuming that projects shared a common set of characteristics. The discipline was dominated by variants of the classical approach, also referred to as linear rationality, waterfall, hard project management, or theory E (Crawford & Pollack, 2004). This classical approach, originating in Operations Research, views projects as a consecutive series of directed and planned activities that lead to predetermined results (Boonstra et al., 2017) and assumes that participants harmoniously contribute to the project goals. This classical approach was the dominant approach of managing projects. In line with this one-size-fits-all thinking, project diagnosis amounted to a project health check that was based on comparing the actual management of the project with this one best way.

Since the mid-1990s, especially in fast-changing fields, such as new product development and software development, this classical approach was no longer meeting the needs of practitioners. A variety of new approaches to project management emerged, which were characterized as agile, soft, or modern, stressing iteration, experimentation, learning, participation, and recognizing diversity in beliefs and interests. Consequently, project management researchers recognized that, in projects, one size does not fit all, pretty much in line with contingency theorists, such as Lawrence and Lorsch (1967), Woodward (1958), Burns and Stalker (1961), and Thompson (1967), who asserted that there is no single best way of managing and organizing.

Classical contingency theory assumes that different constellations of situational variables require other organizational characteristics and that the effectiveness of an organization is contingent upon the fit between structural and situational variables (Shenhar, 2001). During the development of alternative project management approaches, the fundamental question arose as to how different types of projects and different situations could and should be managed in different ways. This led the Project Management Institute (PMI) to recognize the need for different principles for different project types (PMI, 2016). The question fueled the exploration of contingency factors of projects (Hanisch & Wald, 2012; Sauser et al., 2009; Shenhar, 2001). In a project management context, contingency theory implies that different situational conditions imply different project types and different project management strategies. Since then, contingency has become an essential perspective in the literature on project management. Söderlund (2011) distinguishes contingency as one of the seven schools of thought in the development of project management research and identifies technical uncertainty, complexity, and embeddedness as factors whose role for project management and project organization has particularly been researched. Project management contingency theory has the potential to provide insights for understanding project success and failure, but the question is what the most essential contingency factors are.

Various authors have proposed organization, implementation and decision-making typologies based on contingency factors. Stacey (1996), in his seminal study *Complexity and Creativity in Organizations*, proposed, drawing on complexity theory, that organizations and thus projects, are often too complex to plan, predict, and steer in a top-down style. He posited that two

contingencies—the degree of certainty and the degree of agreement—should determine an organization's management style. In the same vein, Matland (1995) proposed, in the context of policy implementation, four implementation paradigms derived from two contingencies: the degree of conflict and the degree of ambiguity. His paradigms are: administrative implementation, where there are low conflict and low ambiguity; political implementation, where there are high conflict and low ambiguity; experimental implementation where there are low conflict and high ambiguity; and symbolic implementation, where there are high conflict and high ambiguity. However, Matland did not develop these paradigms further into concrete project management strategies and associated practices. Pich et al. (2002) used the ideas of Stacey (1996) and Matland (1995) to apply them to project management. They argued that the choice from different project management strategies should depend on the uncertainty, ambiguity, and complexity of the project and its context. They propose, depending on these contingencies, using one of the following three fundamental project management strategies: instructionism, learning, and selectionism. In relation to decision-making in organizations, Snowden and Boone (2007) argue that executives should tailor their approach to match the complexity of the circumstances they face. They developed their well-known Cynefin Framework to demonstrate how managers should adjust their decision-making style to match the management context. They distinguish the following four contexts: simple, complicated, complex, and chaotic. Greenhalgh et al. (2017) drew on these insights to develop a project diagnosis framework that aims to predict and evaluate projects in the context of technology-based health services based on the simplicity, complicatedness, or complexity of 19 project characteristics from seven domains.

Given contingency thinking in a project management context, project diagnosis received a wider meaning. Instead of being only a health check that could lead to adjustments within the one-best-way approach, it became more relevant to examine how project contingencies can lead to tailored project management strategies. In short, this contingency thinking resulted in various contingency factors, leading to different project types and different project management strategies.

As set out in the next section, the complexity project management framework draws on contingency thinking as explained above. These authors recognize that the effectiveness of management actions—be it decision-making, implementation, strategy formulation, or project management—depends on contingency factors, especially the degree of complexity. In our framework, we have translated the dimension degree of agreement, which Matland and Stacey use, into structural complexity. This is a broader concept that includes the degree of agreement. Other facets of structural complexity, such as technical complexity, can also be included in this category. We use the concepts simple, complicated, and complex as Snowden and Boone (2007) and Greenhalgh (2017) use to identify projects. However, we indicate here terms that are more in line with the project management literature. Furthermore, our framework adds to this literature by demonstrating how project management strategies can be hybrid, depending on the content, the internal context, and the external environment of the project at hand. Another addition is that our project management framework relates project types to project management strategies and associated practices. This is unlike most literature on project management contingencies that recognize different project types but fail to relate these to project management strategies and associated practices.

Complexity Framework for Project Management

Method

This research adopts contingency theory as an encompassing theoretical lens to address the research question. From that lens, we synthesized the literature on project complexity (Aaltonen & Kujala, 2016; Bakhshi et al., 2016; Bosch-Rekveldt et al., 2011; Brady & Davies, 2014; Daniel & Daniel, 2018; Floricel et al., 2016; Geraldi et al., 2011; Hertogh & Westerveld, 2010; Kermanshachi & Safapour, 2019; Maylor et al., 2013; Maylor & Turner 2017; Morcov et al., 2020; Qazi et al., 2016) with the aim to develop a new theory-informed framework that relates a project's structural and dynamic complexity with project types resulting in implications for project management strategies and practices. We draw on Pettigrew and Whipp (1991), Greenhalgh et al. (2017), and Damschroder et al. (2009) to categorize complexity factors in (1) content-related, (2) internal-context related, and (3) external-environment related factors. Depending on a project's complexity profile, we draw on the project typology literature (Matland, 1995; Payne & Turner, 1999; Shenhar, 2001; Stacey, 1996; Pich et al., 2002; Snowden & Boone, 2007; Brady & Davies, 2014) to relate project types to complexity factors, resulting in uniform, pluriform, unfolding, and ambiguous projects or a combination thereof. Literature on project management strategies and practices informed us when relating project types with generic project management strategies and associated practices. Figure 1 presents our research approach graphically. By adopting this approach, this study connects literature on project complexity, project typologies, and project management strategies.

Framework Development

Complexity is probably the most extensively addressed contingency factor of projects (Geraldi et al., 2011). It is one of the central variables in the contingency school of thought in project management research (Söderlund, 2011), either addressed explicitly (Lindkvist et al., 1998) or somewhat hidden in concepts like task certainty and task interdependence (Dailey, 1978) and technological uncertainty and system scope (Shenhar, 1998). Also, more recently, complexity continues to be an essential topic within project management research (Maylor & Turner, 2017; Morcov et al., 2020) and it is

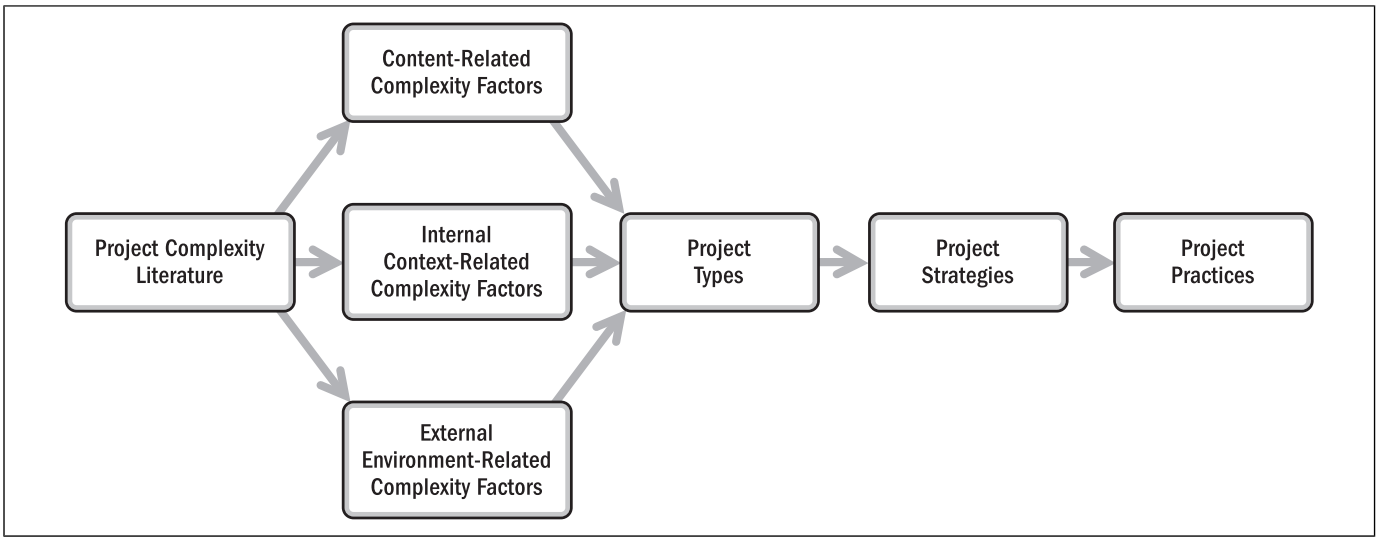

Figure 1. Research approach.

widely acknowledged that when it is not managed well, this might negatively affect the project's success (Floricel et al., 2016; Qazi et al., 2016). This subsection explains how we develop the complexity framework for project management by distinguishing three domains and two dimensions of project complexity. Based on these domains and dimensions, we present and refine the resulting framework.

The Three Domains of Project Complexity

Our level of analysis is the project with a focus on its complexity. Project complexity can vary within a project. For example, realizing a new software system can be simple, but the acceptance by influential internal stakeholders can be problematic. For this reason, we draw on Pettigrew and Whipp's classic model of strategic management of change (1991), which has been widely applied in many industries and organizational contexts. Greenhalgh et al. (2017) and Damschroder et al. (2009) build on this classical model by distinguishing between three generic interactive project domains—content, internal context, and external environment—that together represent change processes and define and shape any change. A leading assumption behind these frameworks is that project content, internal project context, and external project environment play a major role in designing a project management strategy and explaining project results. In our search for domains that determine project complexity, this broad categorization allows us to assign emerging factors to one of these three robust and well-defined project domains.

Content refers to the *what* of change—the goals and areas of change incorporated into the project—and can relate to combinations of new tasks, structures, technologies, and people. The internal context refers to the *where* of change, especially the characteristics of the organizations in which the project is situated. We assume that projects are situated within one or more organizations (Winch, 2014). These organizations are primarily responsible for the management and implementation of the project. The external environment consists of the characteristics of the project's environment outside the organization(s) that manage the project such as external project partners, other stakeholders, and wider environmental factors. The relevant external environment is influenced by the outcomes of the project, and external partners also influence the progress of the project. These three domains interact in complex ways (Damschroder et al., 2009). Our framework proposes that combinations of different types and degrees of complexity result in different project characteristics and require distinct project management strategies.

The Two Dimensions of Project Complexity

Based on a temporal analysis of the literature on the complexity of projects, Geraldi et al. (2011) argued in their systematic review that the complexity of projects had conceptually reached saturation and was sufficiently well understood. From the mid-1990s, research on project complexity distinguished the following five categories of complexity: structural complexity, uncertainty, dynamic, pace, and sociopolitical. Maylor et al. (2013) concluded that this categorization scores sufficiently on comprehensiveness but not on comprehensibility. Based on empirical work and conceptual consistency, they suggested a more lucid framework consisting of three dimensions: structural complexity, emergent complexity, and sociopolitical complexity (Maylor et al., 2013; Maylor & Turner, 2017). Their framework placed the original pace category under structural complexity and merged uncertainty and dynamic under emergent complexity. Brady and Davies (2014) identified sociopolitical complexity as a source of structural and dynamic complexity but not as a distinct dimension. This is in line with the extensive, recent literature review of Morcov et al.

Table 1. Low and High Structural Complexity in Project Content, Internal Context, and External Environment

	Structural Complexity	
	Low	High
Project Content	The project content is well-understood and there are few components and dependencies. There are clear and fixed goals and a convincing business case.	The project includes many project components and interdependencies plus ambiguous and unclear goals. The business case is multifaceted and subject to discussions.
Internal Context	Influential internal interest groups support the project goals and agree on the resources needed. The culture is homogeneous and cooperative.	Influential internal interest groups are unsupportive or disagree about the project goals as well as the resources needed. Internal experts from multiple disciplines are addressing a non-trivial problem.
External Environment	Experienced and established external partners support the project.	Influential external stakeholders are unsupportive or disagree about the project goals. The project is novel for the external partners.

(2020), which also found two dominant dimensions: structural complexity and dynamic complexity.

Drawing on Maylor et al. (2013), Brady and Davies (2014), Maylor and Turner (2017), and Morcov et al. (2020), the proposed complexity framework of project management differentiates between two dimensions of project complexity: structural and dynamic. Structural complexity increases with the number of elements, the degree of differentiation between those elements, the number of disciplines involved, the connectedness of elements and their characteristics, the variety of work being performed, and the project's scope. Dynamic complexity increases with the rate of changes in the content and context of the project, the novelty of the project, the lack of technical and commercial maturity, rising dominance of previously unidentified stakeholders, variability, and unpredictability. With increasing rates of (1) structural and (2) dynamic complexity, more information is needed to understand the project's system—the three domains of content, internal context, and external environment— (1) as it is and (2) as it evolves.

Structural complexity. In terms of project content, a low structural complexity relates to a straightforward problem that can be solved autonomously by a homogeneous group of experts. Depending on the project content, these could be, for example, IT, legal, or logistics experts. Often, there are only a few fixed project elements, and the project is based on a clear business case. There are relatively few internal and external stakeholders involved, and the agreement and support among stakeholders are high.

In a structurally complex project, experts from multiple disciplines combine their insights to address a non-trivial problem. A high technical, structural complexity involves many project components and interdependencies. Consequently, during the project, adaptations can be required, and the project's scope can change. The project will require cooperation among a network of multidisciplinary experts (Bakhshi et al., 2016; Bosch-Rekveldt et al., 2011). Conflicts among powerful internal and external interest groups are likely. Heterogeneity among these interest groups and the relationships between interest groups and the project team adds to this complexity (Aaltonen & Kujala, 2016; Ramasesh & Browning, 2014). Table 1 provides an overview of projects with low and high structural complexity in terms of content, internal context, and external environment.

Dynamic complexity. Like structural complexity, dynamic complexity also relates to the project's content, internal context, and external environment. Dynamic complexity refers to the extent to which a project can be executed without continuous adjustments. In projects with a low dynamic complexity there are agreed-on project objectives, the functional requirements are well understood, and the knowledge to conduct the project is available and familiar. In addition, the required project resources are straightforward, available, and sufficient. Projects with a low sociopolitical dynamic complexity have key stakeholders who are familiar with the project and their preferences are stable; stakeholder relations and power positions are also relatively immutable. Moreover, such projects have few unpredictable dependencies on other projects. In other words, there will be few surprises.

For projects of high dynamic complexity, the project goals are not fixed and may need to be adapted or developed over time. Dynamically complex projects are confronted with constantly changing interactions with the project's internal and external stakeholders (Brady & Davies, 2014; Daniel & Daniel, 2018; Maylor et al., 2008), due to changing attitudes and varying degrees of support. Another factor that contributes to dynamic complexity is unexpected challenges due to a lack of experience. This may be due to new insights from internal interest groups, shifting positions of power, or a changing environment and a lack of information. It will also be unclear what resources are needed to successfully execute the project and whether they will be available. Internal and external stakeholders may change attitudes during the project, for example, because they do not fully understand the project and its consequences at the outset (Brady & Davies, 2014). The project may also depend on the failures or successes of other projects taking place simultaneously. In general, surprises can be expected, and their nature is uncertain. Table 2 provides an overview of projects

Table 2. Low and High Dynamic Complexity of Project Content, Internal Context, and External Environment

	Dynamic Complexity	
	Low	High
Project Content	The problem is well understood. The project goals are clear and stable, the requirements are clear, and the resources available.	The problem is not fully understood. The project's goals and requirements change throughout the project. It is unclear what resources are needed and to what extent.
Internal Context	Influential internal interest groups understand the project and are consistent and stable in their support of the project.	Internal interest groups may change their attitudes and degree of support during the project.
External Environment	Influential external partners, such as technology vendors, suppliers, and customers, are experienced and consistent in supporting the project.	External partners, such as technology providers, suppliers, and customers, may change their attitudes and level of support during the project.

with low and high dynamic complexity in content, internal context, and external environment.

Complexity Framework for Project Management

Project management strategies and practices are often part of standard project management approaches, assuming that every project can be managed by adopting one generic approach. Common approaches include waterfall, Prince2, agile, and Scrum. We argue that this often leads to inappropriate project management strategies, cost overruns, dissatisfied stakeholders, and project abandonment. Therefore, our complexity framework fundamentally counters this by assuming that an appropriate project approach depends on the degree of structural and dynamic complexity. We argue that project management strategies and practices are not generic but should match the structural and the dynamic complexity of a particular project to achieve the best possible project outcomes. For this reason, our framework provides insight into appropriate strategies and practices.

Table 3 relates the four project types that result from these two contingencies to four project management strategies: uniform projects are related to instructionism, pluriform projects to stakeholder management, unfolding projects to learning and experimenting strategies, and ambiguous projects to symbolic dialogues on divergent future states.

Table 3. Complexity Framework with Four Generic Project Types and Related Project Management Strategies

		Structural Complexity	
		Low	High
Dynamic Complexity	Low	*[1] Uniform projects* → Instructionism	*[2] Pluriform projects* → Stakeholder management
	High	*[3] Unfolding projects* → Learning and experimenting	*[4] Ambiguous projects* → Symbolic dialogues on divergent future states

Related Project Management Strategies

The complexity framework for project management is predicated on the idea that particular project types are matched by particular project strategies (Boonstra & van Offenbeek, 2021). A project management strategy is a generic approach to managing a project and reaching project goals. A project management strategy can be realized by adopting a coherent set of project practices. Project practices are management actions that are intended to achieve the project goals. Following we describe four project management strategies, discuss why they match certain project types, and suggest associated project practices. These strategies are informed by the literature on implementation strategies (Waltz et al., 2015), change management interventions (Cameron & Green, 2019; Varsi et al., 2019), and risk responses (Moeini & Rivard, 2019).

Uniform Projects are Matched by Instructionist Strategies

Uniform projects are characterized by a low structural and low dynamic complexity. Uniformism and instructionism relate to the hard systems model of change, rooted in systems engineering, operational research, and classical project management (Pich et al., 2002). The model provides a deterministic way of thinking in terms of setting project objectives, determining resources, and developing a plan that identifies and organizes project activities. Such a plan may involve setting milestones and advanced planning techniques for project scheduling. The plan can relate to the project content as well as the involvement of the internal context and external environment.

Uniform, predictable, stable, and unquestioned projects combine with instructionist strategies to arrive at a proven best practice (Snowden & Boone, 2007). Content wise, this assumes a well-understood problem, agreed upon and clear goals, and clear functional requirements. The necessary project resources are agreed upon and specified in detail. From the perspective of the internal context, this strategy requires consistent support from top management as well as consensus among powerful internal stakeholders. The same is true for the external environment, where there are outside

linkages or projects that cover multiple organizations. A technically competent project team knows what is expected.

Typical instructionist practices include the development of a clear blueprint of the end state, the use of advanced planning techniques, a well-communicated definition of formal phases with milestones, decisions to take irreversible steps, go/no-go criteria at milestones, strong top-management support (Boonstra, 2013), a top-down management style, sufficient resources, and a technically competent project team. Management has to protect the project team from external interruptions. In such projects, interactive communication is unnecessary, but unambiguous communication to relevant stakeholders regarding the project's progress is still important (Snowden & Boone, 2007). In technological projects, training and on-the-job assistance have been recommended (Varsi et al., 2019).

Pluriform Projects are Matched by Stakeholder Management Strategies

Pluriform projects are characterized by a low dynamic complexity combined with high structural complexity. When the structural complexity has a technical nature, experts from different disciplines have to cooperate to address an unfamiliar problem. For example, dermatologists may work with computer scientists to develop an artificial intelligence (AI) system for clinical decision-making. The team of experts takes the lead, analyzes the problem in its context, and proposes a good practice instead of best practice (Snowden & Boone, 2007). Management relies on these experts and should provide good working conditions as well as clear constraints. Technically complex projects thus require expertise, the ability of experts to cooperate and bridge differences in multidisciplinary teams, creativity, as well as clear constraints (Snowden & Boone, 2007). Scope reduction can be a tactic to limit technical complexity (Pich et al., 2002).

When the structural complexity has a sociopolitical nature, powerful interest groups think differently about the project's goals and resources, and the relative power of these groups is an important determinant of the outcome. Findings from the stakeholder management literature (Matland, 1995) suggest that project managers should assess the power relationships, respond appropriately, and bridge different views. A politically savvy project leader is required, and early and extensive stakeholder involvement is recommended (Boonstra et al., 2008). Negotiations, adjustments (Waltz et al., 2015), strategic use of time (breathers), pilots, use of incentives, and the timely involvement of influential stakeholders are all appropriate strategies. Trade-offs are possible in structurally complex projects: one can decide not to fully map out a complex but predictable system but incorporate flexibility in the project management strategy. This results in more options as there may be some more negotiations linked to the acceptance of unpredictability. Other suggestions to manage predictable but structurally complex projects are to limit the scope of the project to reduce complexity, to formally and transparently coordinate the negotiation processes, and to create breathing spaces throughout the project (Doloi, 2013).

Unfolding Projects are Matched by Learning and Experimentation Strategies

Unfolding projects are characterized by a high dynamic and low structural complexity. In case of dynamically complex but straightforward contents or contexts, the scope is small but may need to be adjusted throughout the project. The project's requirements are not fixed at the outset and may change depending on the intermediate outcomes of the learning and experimentation process. The project's business case is somewhat open-ended, and the required resources are not entirely clear. Regarding the internal context, the top management supports the project and can also participate in the learning process. Those involved in the learning and experimenting agree on the global project goals and are able and willing to participate constructively in the team effort (Fernandez & Fernandez, 2016).

When the technology is new or changing rapidly, or when the demands of the internal context or external environment are subject to change but not necessarily conflicting (Eisenhardt & Tabrizi, 2005; Sobek et al., 1999), an iterative and experimental project management strategy matches the project characteristics (Chin, 2004; Highsmith, 2009). The learning and experimenting strategy is based on a broad and flexible shared vision instead of a specific end state.

Learning and experimenting generally relate to relatively small and evolving projects. In terms of the content, the problem is only globally understood, and therefore the project team must be familiar with agile strategies (Fernandez & Fernandez, 2016). In terms of the internal context, top management (Boonstra, 2013) and other powerful internal stakeholders should support the global vision. The same goes for the external environment where there are outside connections. Examples are technology suppliers, government agencies, or supply chain partners.

Typical practices include mutual consultations and stakeholder dialogues, in agile and Scrum-style sessions that are based on learning, experimentation, and self-organization (Fernandez & Fernandez, 2016) and lead to intermediate results. Incrementalism, short-term sprints, and longer-term flexible planning are also parts of the repertoire. Requirements and solutions evolve, and the leadership style promotes self-organizing rather than being directive and top-down. Continuous interactions among various actors, including technology experts and business partners, are necessary to keep them engaged.

Ambiguous Projects are Matched by Symbolic Dialogues on Divergent Future States

Ambiguous projects combine high structural and dynamic complexity. In such situations, it is impossible to predict the outcome since this depends on the changing views of powerful actors and environmental developments (Snowden & Boone, 2007). In other words, the internal context and external environment dominate the process and dictate the project. The garbage

can decision-making model (Cohen et al., 1972) is a fitting metaphor for such ambiguous settings. Streams of stakeholders, issues, options, and solutions arise. Because the setting is dominated by vague goals, uncertain technologies, and variable participation, choices are hard to make (Pich et al., 2002). Multiple solutions are pursued in parallel, choosing the best when it becomes observable (Sobek et al., 1999).

In such projects, it may help if future scenarios are being developed and the project is intensively debated. External and internal stakeholders, and top management, should be invited to participate in these debates. These strategies are based on ambidextrous organizational designs to pilot, experiment, and learn in uncertain environments. Due to the possible conflicts present in these projects, the suggestions mentioned under pluralism and stakeholder management are again applicable. Stakeholders are intensively involved, and disagreements are resolved through negotiations and coalition building. Patience and time for reflection are also recommended practices (Snowden & Boone, 2007).

Framework-Based Diagnostic Instrument

Table 4 demonstrates how the framework can be refined and applied to assess projects and develop a project profile in terms of its structural and dynamic complexity. The three domains (content, internal context, and external environment) are further detailed in terms of various aspects by drawing on previous work on project complexity (Bosch-Rekveldt et al., 2011; Greenhalgh et al., 2017; Jochemsen et al., 2016).

Table 5 (Boonstra & van Offenbeek., 2021) summarizes project practices that fit the four project management strategies in terms of the role of top management, the management approach, the role of the team, and how to approach the internal context and external environment. This table is based on the literature presented in the previous subsection.

Discussion

Theoretical Implications

This study aimed to utilize contingency theory to develop a coherent and theory-informed framework that facilitates project diagnosis, management, and evaluation. We drew on the studies of Bosch-Rekveldt et al. (2011), Geraldi et al. (2011), Bakhshi et al. (2016), Padalkar and Gopinath (2016), Maylor and Turner (2017), Brady and Davies (2014), and Morcov et al. (2020) to operationalize the concepts of dynamic and structural project complexity in the resulting framework. Pettigrew and Whipp's well-known dimensions of change framework (1991) and articles by those who draw on their work (e.g., Damschroder et al., 2009; Greenhalgh et al., 2017) facilitated us to recognize and operationalize the interacting domains of projects. The main contribution of this study is a more fine-grained multidimensional framework of the different project domains and even of various aspects within these domains. This new framework enables a new way of looking at projects' content, internal context, and external environment that closely draws on recent literature on project complexity. This framework may avoid potential mistakes at the outset, steepen the learning curve during projects, and deepen insights when projects are evaluated.

Theoretically, the complexity framework for project management to an extent builds on the contingency thinking of Stacey (1996), Matland (1995), Pich et al. (2002), and Snowden and Boone (2007) that aims to characterize management activities in the areas of decision-making, implementation, change, and projects. Their work highlights that contexts vary hugely and that one generic strategy cannot fit all projects. They propose that different situations require fundamentally different management approaches. This way of utilizing contingency thinking inspired us to develop a theory-informed framework that would be particularly suited to the varying complexities of projects. By doing so we re-examined the fit between project characteristics and project management strategies based on two dimensions of project complexity and demonstrate how project types, their associated project management strategies and project practices can be hybrid, depending on the complexity of the content, the internal context, and the external environment of the project at hand.

Another significant contribution of this study is that we relate project diagnosis to project management strategies and associated practices. Due to this link, the complexity framework allows users to map the wide range of existing project management strategies (e.g., Waltz et al., 2015; Cameron & Green, 2019; Moeini & Rivard, 2019) in the context of their suitability for varying degrees of dynamic and structural complexity. This may result in tailored project management strategies and practices. In doing so, we have developed a unifying, coherent, and theoretically grounded framework for project diagnosis, management, and evaluation. Based on this framework, we argue that recommending generic project management strategies (Waltz et al., 2015; Varsi et al., 2019) is over simplistic. We contribute by specifying the circumstances under which particular project management strategies and practices are most effective.

This study focuses on project management strategies and project practices. Morris and Jamieson (2005) explore the relationship between corporate strategy and project strategy by arguing that strategies are typically translated into programs and projects. Within the terminology of the framework proposed in this article, the top management, which is primarily responsible for realizing the corporate strategy, belongs to the internal context. If a project is critical to the realization of the strategy, top management support will be consistent, and strong and adequate resources will be made available. Also, top management will usually involve other influential stakeholders to establish sufficient support for the project. The organization will more readily understand a project content that aligns with the corporate strategy and therefore has a clearer scope and a more convincing business case.

Table 4. Domains and Aspects Within the Complexity Framework

Domain	Aspect	1 Uniform Projects	2 Pluriform Projects	3 Unfolding Projects	4 Ambiguous Projects
Content	*Problem* Greenhalgh et al., 2017; Jochemsen et al., 2016	Well characterized, well understood	Complex problem, not fully understood	Problem not fully understood	Poorly characterized, poorly understood, high risk
	Project goals Bosch-Rekveldt et al., 2011; Bahksi et al., 2016	Clear, agreed, and fixed goals	Disagreement among stakeholders on goals	Unclear goals, to be developed over time	Ambiguous and unclear goals, subject to disagreement
	Project scope Bosch-Rekveldt et al., 2011	Small and fixed scope	Wide but clear scope	Small but unclear scope	Wide and unclear scope
	Adaptability Bosch-Rekveldt et al., 2011; Boonstra, 2013	Standard project, no adaptations during the project	Adaptations are required but complex to realize	Continuous adaptations within limited scope	Continuous adaptations within a wide scope
	Functional requirements Bosch-Rekveldt et al., 2011	Easy and certain	Many complex requirements, conflict prone	Exploration of uncertain requirements	Exploration of many alternative directions
	Value proposition Greenhalgh et al., 2017	Clear business case	Business case is subject to discussions	Business case is not detailed and includes uncertainties	No business case, only generic directions with benefits and problems
	Timescale Bosch-Rekveldt et al., 2011	Short to medium	Medium	Short to medium	Ill-defined and long
Internal Context	*Resources* Bosch-Rekveldt et al., 2011; Boonstra, 2013	Clearly defined	Disagreement about the resources or diversity of resources	Uncertainty regarding the necessary resources	Uncertainty about the necessary resources due to the novelty and the scope of the project
	Top management Jochemsen et al., 2016; Boonstra, 2013	Consistent and strong top management support	Ambivalent or internally divided	Consistently supports the project but may want to adapt the project	Support is inconsistent, uncertain, and ambiguous.
	Organizational readiness Bosch-Rekveldt et al., 2011; Greenhalgh et al., 2017	Well-led organization and good relations	Little pressure for change, powerful opponents	Participants are used to change and willing to participate.	Organization is unprepared and insecure.
	Internal stakeholders Bosch-Rekveldt et al. 2010; Bakhshi et al. 2016	Shared perceptions of goals and resources among powerful stakeholders	Diverse perceptions of goals and resources among established stakeholders	Although project goals are fluid, disagreement among powerful established and emerging internal stakeholders is unlikely.	Diverging views about changing high-level project goals among established and emerging internal stakeholders are likely.
	Internal dependencies Greenhalgh et al., 2017; Bakhshi et al., 2016	Few interdependencies.	Many predetermined interdependencies.	Few but undetermined interdependencies.	Many undetermined interdependencies.
	Internal culture Bosch-Rekveldt et al. 2011	Homogeneous and cooperative	Relatively homo-geneous but conflict prone	Heterogeneous and diverse but cooperative	Heterogeneous, conflicts are likely.
External Environment	*External project partner* Bosch-Rekveldt et al., 2011; Greenhalgh et al., 2017	Experienced and established external partners	Project is complex for the external partner	Experienced external partner but unpredictable project	The project partner lacks experience in dealing with ambiguous and ill-defined projects.
	Other external stakeholders Greenhalgh et al., 2017	The project enjoys a stable and harmonious external environment.	Stable but controversial external environment, conflicts are likely	The project has a turbulent but harmonious and supportive external environment.	Turbulent and controversial environment; conflicts with existing and emerging external stakeholders are likely.

Table 5. Project Practices Associated With the Four General Project Management Strategies

1. Instructionist Practices	2. Stakeholder Management Practices
Role of top management	**Role of top management**
Provide support.	Support the project leader and the project team.
Provide adequate resources.	Provide adequate resources.
Approach	**Approach**
Develop a clear blueprint of the future state.	*With sociopolitical complexity:*
Apply advanced formal planning techniques.	Assess power relations.
Define formal phases with milestones.	Make adjustments and adapt the content to the context.
Make decisions to take irreversible steps.	Proactive stakeholder communications.
Formulate go/no-go criteria.	Use time strategically
Draw on best practices from other organizations.	Deploy pilots to demonstrate the project outcome.
Team	Use incentives to compensate those who lose.
Appoint a technically competent project leader and project team.	Incorporate flexibility in the project management approach, create options and sufficient room for decisions.
Protect the project team from external interruptions.	Limit the scope of the project to reduce sociopolitical complexity.
Internal context	*With technical complexity:*
Communicate unambiguously to relevant internal stakeholders about the project's progress.	Involve experienced experts from different disciplines who have to cooperate and bridge differences.
Understand that extensive interactive communication is unnecessary.	Limit scope to reduce technical complexity. Divide the project into manageable subcomponents.
Train and educate, provide interactive support.	**Team**
External environment	Appoint a politically savvy project leader.
Take an action-oriented approach with technology partners and other stakeholders.	Recruit team members who can ensure support from the organization.
Proactively inform external stakeholders throughout the project.	**Internal context**
	Engage internal powerful stakeholders in a timely manner.
	Align the negotiation processes formally and transparently and create breathing space throughout the project.
	External environment
	Negotiate contracts and exit strategies with partners.
	Involve external stakeholders at an early stage, assess their interests and power, and negotiate on competing positions. Try to reach agreement on critical issues at an early stage.

3. Learning and Experimentation Practices	4. Symbolic Dialogues Practices
Role of top management	**Role of top management**
Create an environment that allows experimenting, learning, and failing.	Participate actively in dialogues.
Ensure early interactions between different actors, including experts and business.	Encourage dissent and pluralism.
Stimulate self-organization.	Provide sufficient resources for the project.
Provide adequate resources.	**Approach**
Approach	Develop alternative paths of action.
Use agile, prototyping, and Scrum approaches.	Employ experiments to try out.
Implement step-by-step.	Use methods that can help generate ideas and encourage creative and innovative approaches.
Learning by trial and error.	Make use of ambidextrous organization designs.
Short-term sprints and longer-term flexible planning. Deal with temporal milestones and rapid mutual adjustments in response to unplanned events.	**Team**
Evolve requirements and solutions, keep options open.	Appoint a project leader who is experienced in complex environments and in dealing with uncertainty.
Team	Team members should feel comfortable with a high degree of uncertainty.
Appoint a project leader and team members who have experience with agile approaches. Work together in multi-functional teams.	**Internal context**
Communicate regularly with the project environment to adjust and adapt.	Discuss the project among knowledgeable internal stakeholders.
Internal context	Involve internal experts to stimulate discussion.
Frequent collaboration and communication with internal stakeholders.	**External environment**
Promote continuous interactive communication.	Involve outside experts and opinion leaders to drive discussion.
External environment	Develop an appealing vision of the future and make external partners a part of it.
Adopt an incremental and developmental relationship with technology partners, build mutual trust.	Organize dialogues with potential future partners to assess potential collaboration.
Keep external stakeholders well informed, involve them in crucial choices that affect their interests.	

Our study demonstrates that projects are often multifaceted and cannot simply be placed in one category. Project content, internal context, and external environment may be characterized differently. Certain domains can have a low structural or dynamic complexity, while other domains of the same project can have a high structural or dynamic complexity. For example, in the case of the implementation of a standard software system, the project content can be structurally straightforward (e.g., a standard software system), but the internal context can be structurally complex (e.g., many powerful and unsupportive stakeholders), while the external environment can be dynamic at the same time (e.g., an overreliance on the vendor or uncertainty about future customer reactions). This implies that a project diagnosis should differentiate among content, internal context, and external environment and also be sensitive to interactions among these domains. This also means that for different domains of the same project different strategies and associated practices will be suitable. Moreover, projects can also change throughout their duration. For example, requirements can be very vague at the outset but become clearer during the project's later phases. Moreover, conflict solving in the project's earlier stages and the learning curve during the project will make the project become more predictable and straightforward. This all implies that, for most projects, a combination of strategies and practices might be needed to manage the project effectively. However, combining strategies and practices could result in conflicting directions, especially when they address the same domain, and require "great will, skill, and wisdom" (Beer & Nohria, 2000, p. 138).

Practical Implications

In addition to its theoretical insights, the proposed complexity framework for project management is also directly relevant to project managers in practice. Through the development of the framework, we have demonstrated how a project's content, internal context, and external environment can be determined in terms of structural and dynamic complexity. Consequently, appropriate project management strategies can be selected that should cope with different project characteristics.

Our framework suggests that taking sufficient time to establish the various dimensions of a project before adopting a particular project management strategy is of considerable value. There is usually no identification of project complexities prior to the project initiation or conscious adaptation of project practices. When a structurally or dynamically complex project is managed with an instructionist strategy, it will probably fail. The reverse will also be the case: if a relatively simple and predictable project is managed with an emphasis on stakeholder management and symbolic dialogues, unnecessary budget and time will be spent. This means that project managers should consider carefully, and preferably with the project's key players, a project's type and degree of complexity.

The complexity framework can be applied in various ways, depending on the project phase, project type, and stakeholders. Upfront, the framework can be used to inform the identification of a project's complexities. Using this instrument in the form of an open dialogue with a project's primary stakeholders will result in a fine-grained mapping of the various project domains over time. Such a mapping activity creates a shared understanding of the characteristics of the project as perceived by the main stakeholders. Based on this project diagnosis, the project's management team can adapt and plan strategies and practices that suit the project, which can be informed by the practices summarized in Table 5. The model can also be used to identify project risks and to propose mitigating actions. During the project, the framework can be applied to provide insight into the causes of possible problems and suggest adjustments in terms of strategies and practices. When used in project evaluation, the framework can contribute to a learning process in relation to future projects.

This project management complexity framework is an intersubjective approach to assess a project from different perspectives and interests. Together, on the basis of a dialogue, these assessments lead to a supported project management strategy. The approach is subjective because those involved in the diagnosis must assess and weigh each project domain based on the characteristics discussed. To avoid a blind and uncritical application of the framework, we have explained the assumptions behind the different complexities. The framework also outlines measures to manage or reduce the different types of project complexity, but these are guidelines rather than mandatory regulations. When used in practice, the framework aims to promote dialogue to arrive at an appropriate, coherent, and accepted approach and to avoid conflicting project practices. The complexity framework for project management warns organizations against one company-wide approach of project management. Many organizations adopted standardized approaches, which may either have instructionist or experimental (agile) characteristics. Such common procedures are often expected to be utilized by all project managers. We suggest that organizations could use the framework to classify the characteristics of an individual project in its context. This classification may influence the choice of project leaders, team members, and project management practices. We have shown how this insight can be applied by using this complexity framework for project management, which could also serve as a basis to organize and develop knowledge regarding projects within and between organizations.

Limitations and Future Research

The complexity framework for project management aims to function as a general and broad framework that can be used to diagnose a wide variety of project types from many industries. However, we agree that there are certain limitations, and the framework may need to be modified to be helpful in some instances. Especially in the case of megaprojects (Shenhar & Holzmann, 2017) and large programs including a range of projects, the framework might be less useful for diagnosing the entire project and more useful for diagnosing parts of the project or the program. The entire megaproject or project

program can be too multifaceted and diverse to approach from one project management strategy. In such a case, a differentiated strategy may be appropriate.

We also acknowledge that other contingency factors could be relevant (Hanisch & Wald, 2012), including the urgency and size of the project (McDonough, 1993; Eisenhardt & Brown, 1998; Chin, 2004; Bosch Rekveldt et al., 2010). At the same time, we would like to comment that framework users can often translate these other factors into structural or dynamic complexity. To be manageable, it is also necessary to focus on the most significant contingency factors.

We also acknowledge that the two complexity dimensions in our framework are not fully independent. Nevertheless, we would argue that the distinction between these two contingencies results in a richer picture of the variety of projects. Another limitation is that the framework leans toward projects within one organization. We acknowledge that the framework can easily be extended or adapted to contexts where multiple organizations are responsible for joint projects.

The proposed framework can be validated and further extended both theoretically as well as practically. More research is needed to specify the project management strategies in terms of project practices and then to decide when to use which practice. In other words, the theory-based fit between a project profile and a suitable project management strategy should be empirically validated. This study also provides a starting point for myriad empirical studies operationalizing and validating the several fits we postulate, for example, low structural and dynamic complexity with uniform projects and instructionist practices. Further, this study still proposes relatively generic project management strategies. Research is needed to understand which specific practices are complementary or contradictory so that managers can decide how and when practices should be combined.

We have demonstrated that project types, their associated project management strategies, and project practices can be hybrid, depending on the complexity of the content, the internal context, and the external environment of the project at hand. Moreover, projects can also change throughout their duration. This implies that for most projects, a combination of strategies and associated practices might be needed to manage the project effectively in all its domains and throughout its entire trajectory. Combining strategies and practices could, however, result in conflicting directions. Research is needed to understand further the consequences of combining strategies simultaneously and sequentially and ways to manage them. We suggest connecting to change management research as a combination of strategies is one of the main topics in that field (Beer en Nohria, 2000; Burnes, 2004; Edwards et al., 2020).

Building on this work, we intend to develop a web-based toolbox that project managers can use to diagnose their projects, consider a combination of suitable strategies and practices, and identify other dimensions they deem sufficiently important to consider. The collected data and feedback will be used to enrich the framework further. Another direction for future work is to further tailor the framework to specific project types, such as engineering projects or IT projects, and for particular industries such as manufacturing, finance, or healthcare.

Conclusion

This article aimed to develop a coherent and theory-informed framework that will facilitate project diagnosis, management, and evaluation. Using contingency theory as an encompassing theoretical lens, we ground the framework on a synthesis of literature on project complexity, project typologies, and project management strategies. The resulting conceptual framework assesses three project domains—content, internal context, and external environment—from two contingencies, namely structural and dynamic complexity. This results in four generic project types and four matching project management strategies, but we acknowledge that hybrid projects exist, for example, technically simple projects combined with complicated internal contexts and turbulent external environments. Based on this framework, we argue that recommending generic project management strategies is often oversimplistic. We have established the framework as a descriptive tool for managers, which allows a project's key players to conduct a fine-grained, multidimensional diagnosis of various aspects of the three different project domains and develop tailored project management strategies and practices that match the project characteristics. Since the framework is primarily theory-informed, we acknowledge that it should be empirically validated. More research is needed on how project management strategies and tactics can be tailored to hybrid projects. As it stands, we hope that the framework will help project teams develop a deeper understanding of projects at an early stage and throughout and at its end. This will result in appropriately tailored project management strategies and associated practices.

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