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Project complexity and team-level absorptive capacity as drivers of project management performance

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Abstract

Many believe that project complexity reduces project management performance. However, so far research has failed to establish this causal relationship conclusively. We extend research on project complexity by introducing the concept of team-level absorptive capacity and by studying its role as mediator between project complexity and project management success. Applying structural equation modelling to a sample of 285 respondents, we find an unequivocal, direct and positive statistical association between project complexity and delays and overspending. Further, we show that team-level absorptive capacity is critical for successful project management, but also that absorptive capacity can only partially offset the harmful impact of project complexity. Beyond adding to project management theory, the paper contributes to the wider management literature. We establish complexity as an antecedent of absorptive capacity and demonstrate how each dimension of absorptive capacity has unique determinants and outcomes.

Keywords: Project management success; Project management performance; Project complexity; Absorptive capacity

1. Introduction

Berlin Brandenburg Airport in Germany was scheduled to open in 2011 at a price of 2 billion euro. Five years on, the facility had still not opened, and the final bill was estimated at 6 billion euro (The Economist, 2017). Every Olympic Game since 1960 has experienced cost overruns, at an average rate of 156%. The 2016 Summer Games in Rio saw a cost overrun of 51% and the 2014 Winter Games in Sochi an astounding 289% (Flyvbjerg et al., 2016). Delays and overspending are defining features of project management failure (Davis, 2014; Turner and Zolin, 2012). As the above examples illustrate, in particular complex projects are susceptible to delays and cost overruns (Hertogh and Westerveld, 2010; Lu et al., 2015). Whereas contextual factors may be beyond the control of the project team, a team's internal capacities can influence the outcome. However, research on complexity's effect on project management performance remains inconclusive. Scholars lack both theoretical knowledge and empirical validation of how complexity influences project success (Floricel et al., 2016). This is particularly disturbing as complexity is commonly regarded as a key characteristic of projects (Burke and Morley, 2016; Hanisch and Wald, 2014). Consequently, while projects have come to define the contemporary work place (Schoper et al., 2018), there are important gaps in our understanding of their defining features.

In this paper, we argue that project complexity is potentially an important determinant of project management performance, as measured by delivery on schedule and on budget. Complexity diminishes project management performance because complexity entails the presence of "a large number of parts that interact in a non-simple way" (Simon, 1962). As a

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result, coordination requirements in the project are exacerbated. Nevertheless, any project team possesses capabilities that help in keeping the project on track. Notably, the team's capacity to transfer knowledge effectively among its members is of critical consequence (Hanisch et al., 2009). In a highly influential paper, Cohen and Levinthal (1990) introduced the concept absorptive capacity, which refers to "the ability […] to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal, 1990, p. 128). In a much-cited extension of the model, Zahra and George (2002) identify four dimensions of absorptive capacity. *Acquisition capacity* involves identifying and acquiring new knowledge. *Assimilation capacity* allows the knowledge to be analysed, processed, interpreted and understood. *Transformation capacity* refers to the ability to combine existing and new knowledge. Finally, *exploitation capacity* entails the organisational routines and competence to leverage and utilise the new knowledge.

This paper focusses on the interplay between project complexity and the absorptive capacity of the project team. The authors argue that the relationship between these variables to a large extent determines project management performance. Based on the above, we set out to address the following two research questions: Does project complexity increase the risk of project management failure in terms of unscheduled delays and overspending? If so, does team-level absorptive capacity mitigate such risk?

2. Hypotheses and research model

2.1. Project management performance

The perspective of this study is project *management* performance as opposed to *project* performance (De Wit, 1988). Project management performance is typically measured in terms of time, cost and quality. Project performance is a far broader concept, involving the objectives of all stakeholders throughout the project life cycle. Cost and time are often closely correlated, whereas quality is known to compete with the two former performance indicators (Might and Fischer, 1985). Moreover, budget and schedule performance generally manifest themselves in the course of project implementation (Atkinson, 1999), whereas quality is a multi-faceted concept with a more fluid measurement horizon (De Wit, 1988; Shenhar and Levy, 1997). Notably, an assessment of quality typically requires multiple outsider perspectives (Turner and Zolin, 2012), whereas our unit of analysis is team members' perceptions of project management performance. For these reasons, and with a desire to maintain model parsimony, this study limits its scope to explore only the intra-organisational antecedents of delays and overspending.

2.2. Absorptive capacity

Absorptive capacity (Cohen and Levinthal, 1990; Zahra and George, 2002) remains a strong and growing area of research across the field of management and organisational studies (Apriliyanti and Alon, 2017; Lane et al., 2006; Volberda et al., 2010). An established stream of literature views projects as *temporary organisations* (Bakker et al., 2016; Burke and Morley, 2016; Lundin and Söderholm, 1995; Packendorff, 1995; Sydow, 2017). Nevertheless, despite the construct's popularity in the wider business literature, the project management literature has applied it only sparingly (Killen et al., 2012). However, as evidenced by several recent contributions, there is an emerging interest among project-management and team scholars to apply the construct (Backmann et al., 2015; Leal-Rodríguez et al., 2014; Oluwaseyi et al., 2017; Sandor et al., 2016). This paper contributes to this recent line of research.

Overall, outcome-focussed studies of absorptive capacity at the team level are rare. Recent such contributions include Zhang et al.' (2011) analysis of team performance, Gutiérrez et al.' (2012) discussion of organisational learning orientation, Leal-Rodríguez et al.' (2014) study on innovation outcomes, Popaitoon and Siengthai's (2014) assessment of projects' short- and long-run project performance and Curado et al.' (2017) exploration of teams' innovation. This literature is unanimous in identifying absorptive capacity as a driver of teams' performance and project management success. In the present paper, we contribute to this body of knowledge by assessing the effect of absorptive capacity on two dimensions of performance in project management: schedule performance (i.e. delays) and budget performance (i.e. overspending). Although Cohen and Levinthal (1990) originally defined absorptive capacity in the context of new and external knowledge, we argue that the project team is a highly relevant context in which to apply the construct. The professional and organisational diversity frequently encountered in project teams (DeFillippi and Arthur, 1998; Grabher, 2004; Zwikael and Unger-Aviram, 2010) represent a palette of original and novel perspectives that need to be assessed, assimilated and applied (Cohen and Levinthal, 1990) by the project team collectively. Indeed, this fusion of disparate experience and expertise is often the reason why project teams are assembled (Cicmil et al., 2009). The possibility that absorptive capacity may be built from internal sources is further acknowledged by Szulanski (1996), Lane et al. (2006) and Volberda et al. (2010).

Absorptive capacity is a multi-faceted construct (Cohen and Levinthal, 1990; Zahra and George, 2002). Nonetheless, only limited empirical research has been conducted on the outcomes of the individual dimensions of absorptive capacity (Volberda et al., 2010). In their study on the performance of international joint ventures, Lane et al. (2001) apply Cohen and Levinthal's (1990) original three-component model of absorptive capacity. They found that similarities between organisations, national cultural compatibility and previous learning from one and the same source contribute to the understanding of external knowledge. Further, knowledge assimilation is facilitated by training and by organisational flexibility and creativity. In contrast, with regard to knowledge exploitation Lane et al. (2001) fail to demonstrate a link between the understanding and assimilation of new knowledge, on the one hand, and performance in terms of market shares and financial results on the other. The authors conclude that absorptive capacity is a many-sided construct, whose individual dimensions may not display identical outcomes or share the same antecedents.

In the project literature highlighting outcomes of absorptive capacity, Popaitoon and Siengthai (2014) and, equally, Leal-Rodríguez et al. (2014) distinguish between potential and realised absorptive capacity (Zahra and George, 2002). Thus, different from our approach, these two contributions see absorptive capacity as a binary construct. Popaitoon and Siengthai (2014) demonstrate that transformation and exploitation capabilities (i.e. realised absorptive capacity) augment short-run project performance (including the meeting of time and budget goals), while acquisition and assimilation capabilities (i.e. potential absorptive capacity) enhance long-term project performance. The other study considers potential absorptive capacity as an antecedent of realised absorptive capacity. Assessing both construct's effect on project teams' innovation outcomes, Leal-Rodríguez et al. (2014) demonstrate that potential and realised absorptive capacities play different but complementary roles in contributing to competitive advantage. Comparable with Popaitoon and Siengthai's (2014) results, transformation and exploitation were found to influence project-team performance positively and directly, whereas acquisition and assimilation exhibit only an indirect effect.

Several studies have called for further investigation into the internal relationships among the individual dimensions of absorptive capacity (Jansen et al., 2005; Todorova and Durisin, 2007; Zahra and George, 2002). Thus, this paper attempts to do justice to the richness of the absorptive capacity construct and to address the present voids in the literature with respect to the outcomes of each dimension of the concept. We build on Jiménez-Barrionuevo et al. (2011) measurement of absorptive capacity and its four constituent parts (cf. Table 1). *Acquisition capacity* entails close personal interaction and mutual trust and respect between team members. These team features facilitate the effective and cost-efficient identification and acquisition of new and relevant knowledge. *Assimilation capacity* is characterized by the team's ability to work together across professional and structural divisions. Complementary skill sets and a common professional language aid the team in analysing and interpreting the new knowledge, thus ensuring timely and economical knowledge processing. The ability to combine old and new knowledge is reflected in the notion of *transformation capacity*. Delays and overspending are mitigated by effective knowledge sharing within the project team. Finally, the team's *exploitation capacity* is defined by the team's prowess in knowledge utilisation and, accordingly, by its ability to achieve its task while minimising delays and overspending.

Knowledge processes are essential in innovation and product development projects. Moreover, and less recognised, we argue that knowledge processes are as important in construction projects, where the highly knowledge-intensive engineering phase should be regarded as an integral part of the project life cycle. Equally, in the later stages of project implementation, effective communication and knowledge

Table 1
Questionnaire items, internal consistency reliability and convergent validity.

Variable (*Alpha; CR; AVE*)	Questionnaire items. "1" = Strongly disagree. "7" = Strongly agree.	Outer loadings[weights]	Sig. (*P* values)
Project complexity	The project had a high degree of complexity concerning content.	0.756	<0.001
(*0.759; 0.836; 0.632*)	To me, the project had a high degree of complexity concerning interdisciplinary participants.	0.707	<0.001
	The project was characterized by high risk and uncertainty.	0.907	<0.001
Absorptive capacity:	There was close personal interaction between project participants.	[0.028]	0.796
Acquisition	The relation between project participants was characterized by mutual respect.	[0.782]	<0.001
	The relationship between project participants was characterized by a high level of reciprocity and mutual support.	[0.269]	0.139
Absorptive capacity:	Project participants shared their own common professional language.	[0.233]	0.063
Assimilation	There was high complementarity between the resources and capabilities of project participants.	[0.225]	0.173
	The organisational cultures of the project participants were compatible.	[−0.275]	0.096
	The operating and management styles of project participants were compatible.	[0.918]	<0.001
Absorptive capacity:	The different project participants shared informative documents periodically.	[−0.147]	0.286
Transformation	The important knowledge was transmitted regularly to all project participants.	[0.390]	0.020
	When something important occurred, all project participants were informed within a short time.	[0.118]	0.423
	The project had the capabilities or abilities necessary to ensure that knowledge flowed within the project and was shared between the different project participants.	[0.696]	<0.001
Absorptive capacity: Exploitation	In the project, there was a clear division of functions and responsibilities regarding the use of information and knowledge shared by project participants.	[0.387]	0.004
	In the project, there were sufficient capabilities and abilities to exploit information and knowledge shared by project participants.	[0.689]	<0.001
Delays	The project experienced significant delays.	0.851	<0.001
(*0.796; 0.868; 0.622*)	All phases of the project were completed on time. (R)	0.730	<0.001
	Unexpected interruptions were common.	0.817	<0.001
	In the project, we often had to wait for others.	0.751	<0.001
Overspending	It was easy to maintain financial control over the project. (R)	0.555	<0.001
(*0.714; 0.827; 0.550*)	Project coordination was expensive.	0.736	<0.001
	Overspending was a problem.	0.825	<0.001
	Unexpected costs occurred frequently.	0.818	<0.001

(R) = Reversed score.

exchange between team members remain essential to keep the project on budget and schedule (Hanisch et al., 2009). Thus, throughout the project life cycle the team's capacity to absorb and utilise new knowledge is critical to project management performance. Hence, we hypothesise that:

Hypothesis 1a. Acquisition capacity reduces delays.

Hypothesis 1b. Acquisition capacity reduces overspending.

Hypothesis 2a. Assimilation capacity reduces delays.

Hypothesis 2b. Assimilation capacity reduces overspending.

Hypothesis 3a. Transformation capacity reduces delays.

Hypothesis 3b. Transformation capacity reduces overspending.

Hypothesis 4a. Exploitation capacity reduces delays.

Hypothesis 4b. Exploitation capacity reduces overspending.

2.3. Project complexity

Project complexity can be understood as the "number and heterogeneity of different elements that interrelate" (Burke and Morley, 2016, p. 1243). To capture the full richness of the construct, Bosch-Rekveldt et al. (2011) determine no less than three categories, fourteen subcategories and fifty distinct elements. Projects are regularly established with the explicit aim of solving complex tasks (Hobday, 2000). Interdisciplinary teams (Pauget and Wald, 2013), ambiguous goals and methods (Turner and Cochrane, 1993; Williams, 1999) and the uncertainty of unique and novel mandates (Geraldi, 2009) add complexity to temporary organisations (Geraldi et al., 2011). Hanisch and Wald (2014) emphasise the multiple and dominant effects of *structural* complexity on project-team performance. Encompassing the professional and demographic diversity of the project team and the numerous interfaces between the project team and project stakeholders, structural complexity raises the demand for information processing and coordination, impedes the establishment of common norms, weakens trust and heightens the risk of coordination failure.

Despite the fact that complexity is an inherent and defining feature of projects (Burke and Morley, 2016), the effect of complexity on project management performance is not extensively explored empirically. Bakhshi et al. (2016) even claim that complexity is one of the most controversial topics in project management. Tatikonda and Rosenthal (2000b) find that project complexity is associated with poor unit-cost outcomes. Sicotte and Bourgault (2008) report that project complexity has a weak negative impact on efficiency and a weakly positive effect on effectiveness. Hanisch and Wald (2014) conclude that structural complexity diminishes projects' efficiency and effectiveness, whereas task and temporal complexity leave no such impact. Floricel et al. (2016) identify a negative statistical association between technical complexity and schedule and budget performance in projects. As the number of interrelated elements to coordinate and process increases, the project team is exposed to greater risk of delays and overspending. Further, the presence of cross-disciplinary team members, diverse and changing project objectives and contradicting stakeholder interests additionally diminish the chances of project management success. In light of the above we propose:

Hypothesis 5a. Project complexity increases delays.

Hypothesis 5b. Project complexity increases overspending.

Until now, researchers have devoted only scant attention to the intra-organisational antecedents of absorptive capacity (Apriliyanti and Alon, 2017; Volberda et al., 2010). Notably, the association of intra-organisational antecedents with different dimensions of absorptive capacity has received little scholarly consideration (Volberda et al., 2010). Thus, by assessing the impact of complexity on the individual components of absorptive capacity, this paper addresses an enduring void in the absorptive capacity literature.

Absorptive capacities are path-dependent and develop cumulatively, facilitated by communication between individuals and subunits (Cohen and Levinthal, 1990). Thus, the development of absorptive capacity presupposes smooth knowledge exchange between individuals. In contrast, complexity is likely to manifest itself in communication challenges between interlocutors and, consequently, in dysfunctional collaborative relationships across professions, disciplines and cultures (Geraldi et al., 2011; Hanisch and Wald, 2014). Accordingly, by embodying uncertainty, diversity and heterogeneity, complexity impedes effective intra-team collaboration, giving rise to a gulf between available and required knowledge (Geraldi et al., 2011). For example, task uncertainty may hinder a team's ability to identify and acquire relevant new knowledge. Professional and cultural diversity can easily obstruct the team's assimilation of knowledge. Similarly, stakeholder heterogeneity and structural complexity are likely to retard the transformation of existing knowledge into new knowledge. Finally, if complexity impairs any of the preceding knowledge processes, then the final stage of knowledge exploitation is jeopardised. Thus, whereas complexity increases the demand for coordination and knowledge handling in the project (Hanisch and Wald, 2014), complexity at the same time wears down the very team-level capabilities that are needed to handle these processes. In short, high project complexity can overtax the team's absorptive capacity.

The literature offers limited guidance with respect to the effects of complexity on the unique dimensions of absorptive capacity. Cohen and Levinthal (1990) explicitly theorised about the possible benefits of professional diversity, one aspect of complexity, in the development of organisational absorptive capacity. Nonetheless, subsequent empirical research is inconclusive (Cheung et al., 2016). Measuring units' *cross-functional interfaces* (i.e. liaison personnel, temporary task forces, permanent teams for coordination), a measure that may serve as a proxy for team diversity, Jansen et al. (2005) found a positive correlation with knowledge acquisition, assimilation and transformation but not with knowledge exploitation. Dahlin et al. (2005) reported inverted curvilinear correlations between a team's educational diversity and the range and depth of information being applied by the group. In contrast, their study revealed a negative effect of educational diversity on knowledge integration. Similarly, within the literature on functional diversity in teams, Bunderson and Sutcliffe (2002) found that the dispersion of team members across functional areas has a negative impact on intra-team information sharing. Based on this discussion, we predict that:

Hypothesis 5c. Project complexity reduces acquisition capacity.

Hypothesis 5d. Project complexity reduces assimilation capacity.

Hypothesis 5e. Project complexity reduces transformation capacity.

Hypothesis 5f. Project complexity reduces exploitation capacity.

2.4. Mediating effects

One contribution of this study is the empirical measurement of team-level absorptive capacity. Thus, by comparing the mediating effect with the direct relationship between project complexity and project management performance, we are able to quantify the relevance of the construct. To our knowledge, this has not been done explicitly before.

We have hypothesised the detrimental effects of project complexity on both delays and overspending in the project. Further, we anticipate that project complexity has a negative impact on all dimensions of absorptive capacity. Although we believe that absorptive capacity will mitigate the negative effects on project management performance, the overriding effect of project complexity on the project's schedule and budget performance is expected to be negative. Accordingly, we expect *complementary mediation* throughout the model (Nitzl et al., 2016; Zhao et al., 2010), with respect to both the total indirect effects and the specific indirect effects (Hair Jr et al., 2017).

The reason why we believe that project complexity will override team capabilities is that complexity is an inherent feature of any project (Bakhshi et al., 2016; Burke and Morley, 2016), with a multitude of potential internal and external causes. In contrast, the project team's resources are limited. Similarly, although high team-level absorptive capacity does contribute to schedule and budget performance, a vast number of extrinsic factors, which cannot be controlled for, routinely cause projects to derail. Thus, in the words of De Wit (1988), p. 164, “good project management can contribute towards project success but is unlikely to be able to prevent failure”. Accordingly, we propose that:

Hypothesis 6a. Mediated by acquisition capacity, project complexity increases delays.

Hypothesis 6a. Mediated by assimilation capacity, project complexity increases delays.

Hypothesis 6c. Mediated by transformation capacity, project complexity increases delays.

Hypothesis 6d. Mediated by exploitation capacity, project complexity increases delays.

And further:

Hypothesis 7a. Mediated by acquisition capacity, project complexity increases overspending.

Hypothesis 7b. Mediated by assimilation capacity, project complexity increases overspending.

Hypothesis 7c. Mediated by transformation capacity, project complexity increases overspending.

Hypothesis 7d. Mediated by exploitation capacity, project complexity increases overspending (Fig. 1).

3. Method and data

3.1. Data collection

For the sample selection, the major challenges were to reach respondents with experience in working in projects of varying degrees of complexity and, further, to include a diverse range of industries and national contexts. As there are no dedicated project-team databases, we chose to collaborate with project-oriented industrial associations and government agencies. This approach is consistent with sampling procedures in recent project research (Hanisch and Wald, 2014; Lindner and Wald, 2011; Tyssen et al., 2014). The method ensured that replies were obtained from knowledgeable respondents, which enhances the sample's representativeness compared with a less targeted sampling strategy. The absence of a definable population does preclude statistical validation vis-à-vis the population but allows external generalisation and, hence, external validity to be established in relation to similar projects and similar environments (Schwab, 2005). Survey data were collected using the member lists of three Norwegian industrial associations and one Swedish and two Norwegian directories of government-supported international projects. Questionnaires were disseminated by e-mail to 3544 project teams. Respondents could choose between a Norwegian-language and an English-language version of the questionnaire. A bilingual research team ensured the compatibility of the two language versions. The respondents related their assessments to a completed project of their own choice. Consistent with the study's unit of analysis, respondents were requested to consider the project team as a whole. Valid responses were received from a total of 285 project teams, yielding a response rate of 8%. Eighty-eight of these teams were domestic, whereas the other 197 teams operated in two or more countries. In all, respondents were based in 45 countries and represented projects with operations in 72 countries in all continents except Australia. Among the respondents, 182 (64%) were project managers, 69 (24%) team members and 34 (12%) had other functions. Thus, the sample's geographical scope and functional and sectoral diversity diminish the likelihood of systematic

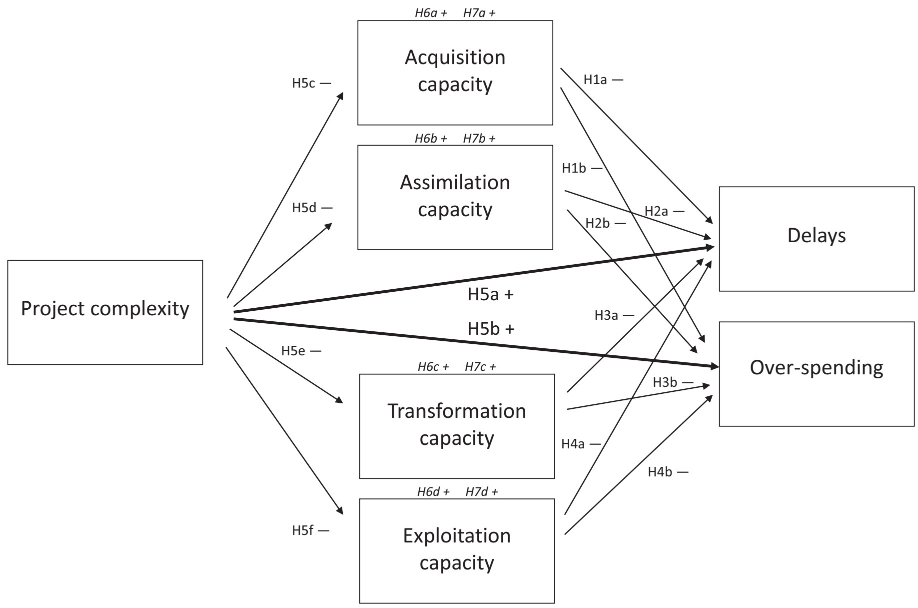

Fig. 1. Research model (hypothesised mediating effects in italics).

error due to respondent traits or project characteristics. Thirty-one project teams represented the non-governmental sector, 149 teams the public sector and 105 teams were in the private sector. The geographical and sectoral diversity of the sample augments the generalisability of the results.

Partial least squares (PLS) structural equation modelling (SEM), a nonparametric technique, was chosen to analyse the data, aided by the SmartPLS 3 software application (Ringle et al., 2015). This technique is complementary to covariance-based SEM techniques and suitable for, inter alia, path models including both formatively and reflectively measured constructs or having six or more latent variables (Sarstedt et al., 2017).

3.2. Measures

3.2.1. Main model variables

For all constructs in the main model, we employed perceptual measures. Perceptual measures have been found to produce reliable and valid results in management and organisational studies (Ketokivi and Schroeder, 2004). Table 1 gives the full questionnaire items. Each construct was measured using three- or four-item scales that were assessed on seven-point Likert scales (“1” = Strongly disagree, “7” = Strongly agree”). Only one construct, *knowledge exploitation*, was measured using only two items.

The reflective scales for the two dependent latent variables (i.e. delays and overspending) were developed specifically for this study. Indicators for these two measures were tested and refined in a pilot study involving twenty respondents representative of the main survey. For absorptive capacity and its components, we employed Jiménez-Barrionuevo et al.’ (2011) validated absorptive-capacity instrument. Their formative scales build on Zahra and George's (2002) taxonomy of the construct's constituent parts. This taxonomy consists of four elements and is, therefore, the most comprehensive conceptualisation of absorptive capacity available. Only limited editing was required to adapt the scale to the project context. In consequence, a total of thirteen indicators were available to assess distinct nuances of team-level absorptive capacity, rendering a rich representation of the construct. Whereas reflective absorptive-capacity scales exist (e.g. Jansen et al., 2005; Popaitoon and Siengthai, 2014), the bottom-up logic of a formative scale makes it suitable for mediating latent variables.

The reflective project complexity scale was drawn from Tyssen et al. (2014), who found the construct to have a reliability of 0.798, an adequate value. Their instrument builds on Geraldi et al.’ (2011) conceptual discussion of complexity in projects, incorporating complexity related to task, structure and uncertainty. A distinct advantage of this scale is that it is designed specifically to measure complexity in projects. Control variables serve to assess the influence of factors external to the exogenous variables under direct scrutiny. Accordingly, data were collected for objective variables such as economic sector, budget size, team size, the duration of the project and project configuration (i.e. the number of organisations engaged in the project). Conceivably, all these factors can affect a project team's absorptive capacity by augmenting or weakening the team's knowledge creation, sharing and utilisation capabilities (Cohen and Levinthal, 1990; Zahra and George, 2002).

3.3. Common-method bias

Common-method bias (Campbell and Fiske, 1959) is a systematic error “attributable to the measurement method rather than to the construct of interest” (Bagozzi et al., 1991, p. 421), threatening the validity of most empirical research (Spector, 2006). To limit any common-method bias, all endogenous constructs were in part assessed by a second team member identified by the respondent, similar to the research design followed by Tatikonda and Rosenthal (2000a). A total of 58 responses were obtained from these additional sources, representing 20% of the main sample. Based on the full set of indicators in the survey (N = 40), a paired-samples correlation test revealed that 43 of the 58 respondent pairs were strongly correlated ($r > 0.50$, $p < 0.05$) and another 9 pairs exhibited a medium association ($r > 0.3$, $p < 0.05$) (Cohen, 1988). Only 6 pairs failed to yield statistically significant correlation coefficients at the $p < 0.05$ level. Thus, 90% of the control group's assessments were either strongly or moderately correlated with those of the main group, indicating that common-method bias is not a major concern in the study.

As further, *ex ante,* procedural steps, survey participants were assured anonymity, and dependent and independent variable items were arranged separately in the questionnaire. Survey items were kept simple, specific and concise (Tourangeau et al., 2000). Respondents assessed features associated with the team as a whole, not with themselves. Key informants' rating at the group level is less likely to be influenced by personal and role characteristics than when individual characteristics are self-reported (Podsakoff et al., 2003). In addition, the 285 respondents represented a diversity of functional roles on the project, with 182 (64%) project managers, 69 (24%) team members and 34 (12%) other functions, thus reducing the possible bias arising from identical functional perspectives. Equally, the sample's geographical scope and sectoral diversity serves to minimise any systematic error associated with respondents' national and organisational cultures. Finally, with ten substantively uncorrelated independent variables and several mediating relationships, our research model is sufficiently extensive and complex so as to reduce the effect of common method bias (Chang et al., 2010; Siemsen et al., 2010). Below, we report convergent and discriminant validity for all reflective-indicator constructs and adequate collinearity levels for the formative measurement models. These results are further indicators of construct validity and, by implication, of the absence of serious common-method variance (Conway and Lance, 2010). Because the mediating variables applied in this study (i.e. the four dimensions of absorptive capacity) are formative-indicator constructs, post hoc statistical techniques to control for method variance are not suitable (Podsakoff et al., 2003).

4. Results

4.1. Evaluation of the measurement model

Assessing the indicators' Cronbach's alpha and composite reliability values, we tested the reflective measurement models for *internal consistency reliability* (Table 1). The traditional threshold of >0.70 was applied. Nevertheless, owing to the exploratory nature of the study and consistent with Hair Jr et al. (2017), one indicator with a Cronbach alpha value of 0.555 (on the variable *overspending*) was retained due to its contribution to the construct's content validity. Further, the data yielded average variance extracted (AVE) values of at least 0.50 for all reflective variables, indicating *convergent validity*. Finally, having performed bootstrapping (5000 sub-samples), the heterotrait-monotrait ratios of correlations (HTHM) statistic rendered values lower than the conservative upper threshold of 0.85, thus establishing *discriminant validity* for all reflective variables (Henseler et al., 2015).

A separate set of tests was conducted for the four *formative* measurement models that represent absorptive capacity (Henseler et al., 2009). No critical levels of collinearity (i.e. VIF > 5) were detected. Several formative indicators' outer weights did not meet statistical significance (Table 1). However, examining their absolute importance (i.e. their loadings), all the problematic indicators displayed significant ($p < .001$) outer loadings with values above 0.50, which allowed us to retain them (Hair Jr et al., 2017). Thus, the outer measurement model was deemed sufficiently robust to conduct structural equation modelling.

4.2. Evaluation of the structural model

4.2.1. Main effects

In PLS-SEM, goodness-of-model fit is assessed differently from the approach used in covariance-based SEM (Sarstedt et al., 2014). Specifically, a PLS-SEM structural model is evaluated on the basis of how well it predicts the endogenous constructs (Hair Jr et al., 2017). Hence, we evaluate the inner (structural) model by considering (i) collinearity, (ii) path coefficients, (iii) coefficients of determination (R^2) and effect size (f^2).

Testing each set of predictor variables in the model for possible *collinearity*, all variance inflation factor (VIF) values were found to be well below 3, suggesting a model free of collinearity. The evaluation of the *path coefficients* established that several structural model relationships were statistically significant at either the <0.050 or the <0.100 levels. The results are exhibited in Table 2.

As expected, with increasing project complexity, unscheduled delays (0.306, $p < 0.001$) and overspending (0.331, $p < 0.001$) rise. Further, project complexity reduces all dimensions of absorptive capacity. On the other hand, absorptive capacity serves to improve project management performance, albeit not exhaustively. A project team's acquisition capacity limits overspending (−0.137, $p = 0.056$) but has no statistically significant impact on unscheduled delays. In contrast, assimilation capacity forestalls delays (−0.126, $p = 0.051$) but does not prevent overspending. A project team's capacity to transform knowledge helps it avoid both delays (−0.158, $p = 0.042$) and cost overruns (−0.183, $p = 0.020$). Exploitation capacity markedly reduces delays but has little impact on overspending.

Both dependent variables exhibit pronounced coefficients of determination: the R^2 value is 0.407 ($p < 0.001$) for delays and 0.335 ($p < 0.001$) for overspending. The other four endogenous latent variables display substantially lower R^2 values: acquisition capacity (0.081, $p = 0.012$), assimilation capacity (0.059,

Table 2
Path coefficients.

Variables		Path coefficients (*p* value)		
Exogenous	Endogenous	Direct	Indirect	Total
Project complexity	Delays	0.178 (<0.001)	0.129 < (0.001)	0.306 (<0.001)
Project complexity	Overspending	0.229 (< 0.001)	0.102 (0.001)	0.331 (<0.001)
Project complexity	Acquisition capacity	−0.284 (<0.001)		−0.284 (<0.001)
Project complexity	Assimilation capacity	−0.242 (<0.001)		−0.242 (<0.001)
Project complexity	Transformation capacity	−0.157 (0.011)		−0.157 (0.011)
Project complexity	Exploitation capacity	−0.189 (0.001)		−0.189 (0.001)
Acquisition capacity	Delays	−0.085 (0.252)		−0.085 (0.252)
Acquisition capacity	Overspending	−0.137 (0.056)		−0.137 (0.056)
Assimilation capacity	Delays	−0.126 (0.051)		−0.126 (0.051)
Assimilation capacity	Overspending	−0.099 (0.204)		−0.099 (0.204)
Transformation capacity	Delays	−0.158 (0.042)		−0.158 (0.042)
Transformation capacity	Overspending	−0.183 (0.020)		−0.183 (0.020)
Exploitation capacity	Delays	−0.260 (0.001)		−0.260 (0.001)
Exploitation capacity	Overspending	−0.056 (0.453)		−0.056 (0.453)
Budget size	Delays	0.004 (0.910)		0.004 (0.910)
Budget size	Overspending	0.015 (0.789)		0.015 (0.789)
Duration	Delays	0.071 (0.178)		0.071 (0.178)
Duration	Overspending	0.084 (0.119)		0.084 (0.119)
Number of organisations	Delays	−0.091 (0.144)		−0.091 (0.144)
Number of organisations	Overspending	−0.023 (0.618)		−0.023 (0.618)
Number of team members	Delays	−0.115 (0.017)		−0.115 (0.017)
Number of team members	Overspending	0.101 (0.069)		0.101 (0.069)
Private sector	Delays	0.097 (0.051)		0.097 (0.051)
Private sector	Overspending	0.062 (0.256)		0.062 (0.256)

p = 0.036), transformation capacity (0.025, p = 0.244) and exploitation capacity (0.036, p = 0.128). The effect size f^2 statistic establishes how much the removal of an exogenous construct from the model would change the R^2 value of a specified endogenous construct. Statistically significant effect sizes f^2 were established for four relationships in the model: complexity on acquisition capacity (0.088, p = 0.025), complexity on assimilation capacity (0.062, p = 0.057), complexity on delays (0.041, p = 0.096) and complexity on overspending (0.061, p = 0.062). These are all low effects (Cohen, 1988). Thus, the effect sizes f^2 suggest, first, that none of the control variables have an effect on the model. Second, project complexity does exert an influence on both absorptive capacity and project management performance, even if it explains only a small part of the endogenous constructs' R^2 values.

4.2.2. Mediating effects

Instead of conducting a Sobel (1982) test, and consistent with the literature on PSL-SEM (e.g. Klarner et al., 2013; Sattler et al., 2010), we performed bootstrapping to assess the statistical significance of the *mediating* effects. As displayed in Table 2, two *total indirect effects* are established, both of which are statistically significant. Thus, the combined effect of all absorptive capacity dimensions partially and positively mediates the relationship between project complexity and delays (0.129, p < 0.001) and, similarly, the association between project complexity and overspending (0.102, p = 0.001). In both cases, we see complementary mediation (Nitzl et al., 2016; Zhao et al., 2010). These total indirect effects reflect the aggregated mediating relationships in the model. In addition, we are interested in the mediating effect of each dimension of absorptive capacity. Table 3 displays the specific indirect effects along with their effect sizes and accompanying *p* values. Only two of these are significant at the <0.100 level, namely the effects of assimilation capacity (0.031, p = 0.089) and exploitation capacity (0.049, p = 0.017) on the relationship between complexity and delays.

4.2.3. Control variables

Finally, most control variables do not exhibit any statistically significant association with the dependent variables in the model. This is true for *budget size*, *duration* as well as for the *number of organisations* in the project. However, *sector* matters insofar as private-sector projects see more unscheduled delays than do public-sector projects (0.097, p = 0.051). Moreover, the *size of the project team* has a dual impact: with a greater number of team members, delays are reduced (−0.115, p = 0.017) but overspending augmented (0.101, p = 0.069) (Fig. 2).

Table 3
Specific mediation effects.

The specific indirect effects making up the total indirect effects		P value
Specific indirect effect	Effect size	
Complexity → Acquisition capacity → Delays	0.024	0.263
Complexity → Acquisition capacity → Overspending	0.039	0.120
Complexity → Assimilation capacity → Delays	0.031	0.089
Complexity → Assimilation capacity → Overspending	0.024	0.227
Complexity → Transformation capacity → Delays	0.025	0.131
Complexity → Transformation capacity → Overspending	0.029	0.126
Complexity → Exploitation capacity → Delays	0.049	0.017
Complexity → Exploitation capacity → Overspending	0.011	0.469

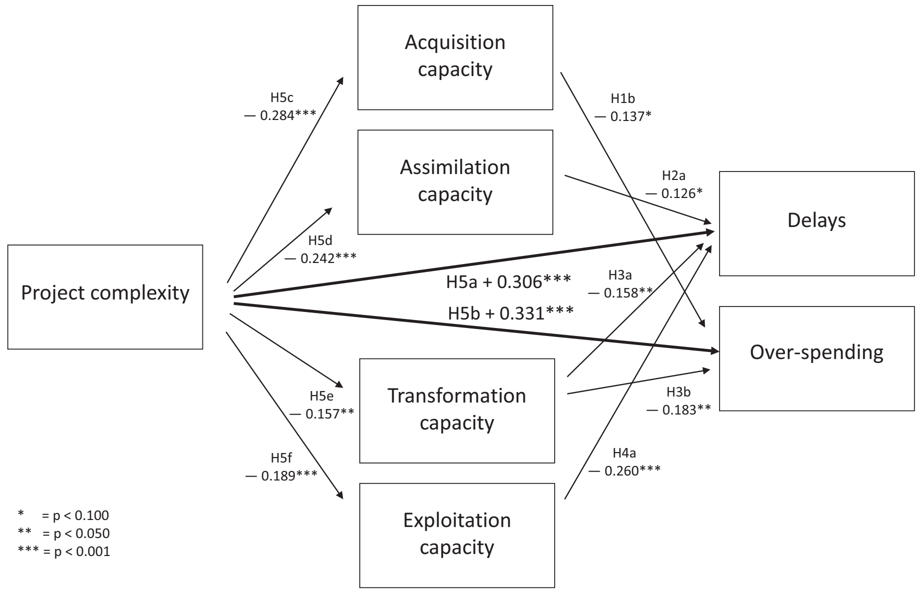

Fig. 2. Empirical model. Statistically significant total effects.

5. Discussion

5.1. Hypotheses testing

5.1.1. Effects of complexity

As expected, project complexity augments unscheduled delays and overspending (hypotheses 5a-b supported). This finding contrasts with several other studies that establish mostly weak and sometimes bidirectional associations between project complexity and project management performance (Floricel et al., 2016; Hanisch and Wald, 2014; Sicotte and Bourgault, 2008; Tatikonda and Rosenthal, 2000b). The direct effect on overspending is relatively stronger, suggesting that budget management is more sensitive to complexity than is time management. This answers research question number one.

Equally, project complexity weakens all dimensions of absorptive capacity, as expected (hypothesis 5c–hypothesis 5f supported). It is, however, noteworthy that complexity reduces acquisition capacity and assimilation capacity comparatively more than the two other dimensions of absorptive capacity. The immediate interpretation is that complexity in the form of cross-disciplinarity, task uncertainty and goal ambiguity have a particularly strong impact on the inter-personal relationships among team members (acquisition capacity) and, further, on the sense of compatibility and complementarity of team members' skills and work styles (assimilation capacity). Whereas also affected, transformation and exploitation capacity come out more robust to the effects of project complexity. The discovery that each dimension of absorptive capacity has unique intra-organisational antecedents fills a gap in the scholarly literature on absorptive capacity (Volberda et al., 2010; Zahra and George, 2002).

5.1.2. Effects of absorptive capacity

The effects of absorptive capacity on project management performance are more ambiguous. Whereas acquisition capacity diminishes overspending in the project (hypothesis 1b supported), it does not prevent unscheduled delays (hypothesis 1a rejected). The implication is that a project team's acquisition capacity substantially determines project management performance, specifically in meeting budget targets. In contrast, the team's capacity to assimilate knowledge proves instrumental in deterring unscheduled delays (hypothesis 2a supported) but has little effect on costs (hypothesis 2b rejected). The contradictory outcomes of the team's knowledge-acquisition and knowledge-assimilation capacities are unexpected and give reason for speculation. One possibility is that in the early, exploratory stage of knowledge acquisition, a well-prepared team can control expenses, but given the open-ended nature of knowledge acquisition, the team is unable to influence how long the process takes. On the other hand, in the more defined context of knowledge assimilation, the team is in a position to determine the duration of the process but not the expenses incurred. However, further enquiries are necessary to determine the exact causes of these effects. With strong transformation capacity, the project team is able to ward off delays and, in particular, overspending (hypothesis 3a–hypothesis 3b supported). Overall, it is during the transformation stage that the team has the greatest opportunity to manage costs. This requires, however, that the team build and maintain adequate capacity to transform knowledge effectively. Finally, the project team's capacity for knowledge exploitation does not influence overspending (hypothesis 4b rejected) but it does mitigate delays (hypothesis 4a supported). Indeed, with a path coefficient of −0.260 ($p = 0.001$), exploitation capacity represents the strongest constraining effect on unscheduled delays in the model.

Thus, it is primarily knowledge transformation capacity and knowledge exploitation capacity that reduce delays and overspending. Consequently, it appears that the two aspects of absorptive capacity that emphasise intra-team routines and knowledge-handling procedures (cf. Table 1) are the ones that contribute most to project management performance. In contrast, the two aspects of absorptive capacity emphasising people characteristics (i.e. acquisition and assimilation capacity) yield a comparably weaker impact. These results lend empirical support and add theoretical clarity to Popaitoon and Siengthai's (2014) and Leal-Rodríguez et al.' (2014) findings that realised absorptive capacity (i.e. transformation and exploitation capabilities) affects project-team performance more directly and more strongly than does potential absorptive capacity (i.e. acquisition and assimilation capabilities).

In summary, the analysis suggests that just as the distinct dimensions of absorptive capacity have unique antecedents, they have dissimilar outcomes. This finding justifies a far more nuanced treatment of the individual components of absorptive capacity than has been the practice in the past (Lane et al., 2006; Volberda et al., 2010; Zahra and George, 2002). Linking our results to the project literature, we draw attention to the conceptual commonalities of the funnel view of absorptive capacity (Lane et al., 2006) and the traditional taxonomy of phases in the project life cycle. As stated by Geraldi (2009, pp. 149–150): "Projects tend to emerge, in the sense of formless or disordered […] with a unique idea, undefined scope, unclear division of authority and responsibilities, etc. The following phases clearly demand higher levels of order." Accordingly, our research suggests that the conceptualisation, planning, execution and termination stages of a project (Pinto and Prescott, 1988) can productively be analysed in the context of knowledge acquisition, assimilation, transformation and exploitation and their accompanying organisational capacities and capabilities. This insight opens promising avenues for future research, in which projects are studied in the context of their knowledge creation and exploitation processes.

5.1.3. Mediating effects

As displayed in Table 2, the total indirect effect between complexity and delays is 0.129 ($p < 0.001$), and between complexity and overspending 0.102 ($p = 0.001$). Thus, the combined net mediating effect for all dimensions of absorptive capacity is positive. Accordingly, research question number two is answered. Arithmetically, these results mirror the positive product of two negative mediation path coefficients. Conceptually, we determine that team-level absorptive capacity cannot fully eliminate the many challenges inherent in a complex project. This finding further underscores the relevance of recent research on complexity in projects and in other business settings (Hanisch and Wald, 2014).

Assessing the size of the total indirect effects, a team's absorptive capacity reduces delays 0.129 ($p < 0.001$) more effectively than it reduces overspending 0.102 ($p = 0.001$). More importantly, these two mediating effect sizes represent the importance of absorptive capacity for teams' management performance in complex projects. Adding the two mediating effects on delays and overspending, we arrive at a total combined indirect effect of absorptive capacity of 0.231. This value is non-trivial, and the result establishes empirically that absorptive capacity does have an impact on teams' project management performance. The contribution to theory is the following: where complexity is high, or when teams have only limited absorptive capacity, we may expect high levels of delays and overspending. Conversely, where projects are simple, and teams possess high levels of absorptive capacity, delays and overspending will be less prominent. Whereas the project team cannot always influence project complexity, the team can often enhance its routines and capacities regarding the acquisition, assimilation, transformation and exploitation of new knowledge. Thus, the lesson for practice lies primarily in the imperative of ensuring sufficient absorptive capacity in the project team, with heightened capacities imperative in complex projects.

Regarding the individual dimensions of absorptive capacity, Table 3 affirms that two of the specific indirect effects are statistically significant at the <0.10 level: assimilation capacity on the association between complexity and delays (0.031, $p = 0.089$) and exploitation capacity on the association between complexity and delays (0.049, $p = 0.017$).

5.1.4. Effects of control variables

With respect to the control variables, a couple of remarks are in place as they point out directions for future research. First, private-sector projects experience more delays than do public-sector projects. The observation is noteworthy but can depend on a range of exogenous moderating variables. Hence, a conclusive explanation must await further research. Second, team size matters. Big project teams see more overspending but less delays. The reason may be that with more people to assist, the project is kept on schedule. The downside is that unplanned increases of staff incur unforeseen operational costs.

5.2. Implications for practice

The results reported above have several implications for practice. First, project complexity contributes appreciably to project management failure or success. If project complexity cannot be reduced, the project team must be furnished with adequate and relevant resources. In terms of practical team leadership, our results show that transformation and exploitation capacity produce the stronger tempering effects upon both delays and overspending. Accordingly, in complex settings the project team must get its information flows right and make sure it is equipped to utilise the information that is shared within the team. This is achieved by, inter alia, implementing project-wide meetings, ensuring regular and extensive document sharing, insisting on timely notifications and establishing well-defined divisions of responsibility among team members.

6. Concluding remarks

6.1. Summary

Our research has established empirically the relationships between project complexity and project management performance in terms of unscheduled delays and overspending. Importantly, the mediating effect of team-level absorptive capacity was determined, confirming the relevance of this construct to project teams' performance. We found, first, that the adverse effect of complexity overrides the alleviating influence of absorptive capacity on project management success. Second, absorptive capacity does, nevertheless, play a critical mediating role, and its relevance was quantified at 23.1%. We propose that this effect is a generalisable, albeit approximate, estimation of absorptive capacity's importance in comparable settings. Finally, the individual dimensions of absorptive capacity were found to display unique antecedents and outcomes. For theory, this means that absorptive capacity should predominantly be maintained as a multi-dimensional construct, as originally posited by Cohen and Levinthal (1990). In consequence, our results unveil an extensive research agenda where the unique dimensions of absorptive capacity take centre stage. Both the drivers and the outcomes of the individual dimensions merit scholarly attention, with Volberda et al.' (2010) integrative framework and identified research gaps offering a useful starting point. More specifically, the complementarity of Lane et al.' (2006) funnel perspective on absorptive capacity, Nonaka and Von Krogh's (2009) knowledge conversion model and the traditional project life-cycle literature look set to offer rich insights into how team-level knowledge processes determine project management performance. With regard to complexity's effect on team outcomes, the concept of *complexity resistance* (Hanisch and Wald, 2014) and the possibility of curvilinear relationships deserve further exploration. Moreover, insights from the field of cognitive psychology are likely to improve our understanding of the micro-organisational antecedents of team-level absorptive capacity (cf. Cohen and Levinthal, 1990).

6.2. Limitations

Inevitably, there are limitations to this study. First, we have considered only intra-organisational, team-level drivers of delays and overspending. Additionally, contextual factors can have a considerable, and even greater, effect on these variables. Second, project complexity is a multi-faceted construct (Geraldi et al., 2011; Hanisch and Wald, 2014), and we do not capture all its dimensions. Third, as pointed out by Turner and Zolin (2012), project performance embodies a far wider range of success criteria than those assessed here. Specifically, future industry-specific or project purpose-specific studies may shed light on the intra-organisational drivers of project quality in distinct types of projects. Fourth, we used Jiménez-Barrionuevo et al.' (2011) validated scale for absorptive capacity. Other scales are available, and our findings should be tested against these. Finally, although our data were collected across industrial sectors and drew on respondents in 45 countries, a Scandinavian bias persists. Further research in other geographical regions and societal contexts is required to substantiate our results. Nevertheless, this study does indicate that absorptive capacity is a highly relevant construct in project management research. Furthermore, the findings and arguments presented above have implications for the wider management literature as well as for practice.

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Additional information - classification

- People
- Implementation
- Structural equation modelling (PLS-SEM)

Declarations of interest

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References

Apriliyanti, I.D., Alon, I., 2017. Bibliometric analysis of absorptive capacity. Int. Bus. Rev. 26, 896–907.

Atkinson, R., 1999. Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. Int. J. Proj. Manag. 17, 337–342.

Backmann, J., Hoegl, M., Cordery, J.L., 2015. Soaking it up: absorptive capacity in Interorganizational new product development teams. J. Prod. Innov. Manag. 32, 861–877.

Bagozzi, R.P., Yi, Y., Phillips, L.W., 1991. Assessing construct validity in organizational research. Adm. Sci. Q. 36, 421–458.

Bakhshi, J., Ireland, V., Gorod, A., 2016. Clarifying the project complexity construct: past, present and future. Int. J. Proj. Manag. 34, 1199–1213.

Bakker, R.M., DeFillippi, R.J., Schwab, A., Sydow, J., 2016. Temporary organizing: promises, processes, problems. Organ. Stud. 37, 1703–1719.

Bosch-Rekveldt, M., Jongkind, Y., Mooi, H., Bakker, H., Verbraeck, A., 2011. Grasping project complexity in large engineering projects: the TOE (technical, organizational and environmental) framework. Int. J. Proj. Manag. 29, 728–739.

Bunderson, J.S., Sutcliffe, K.M., 2002. Comparing alternative conceptualizations of functional diversity in management teams: process and performance effects. Acad. Manag. J. 45, 875–893.

Burke, C.M., Morley, M.J., 2016. On temporary organizations: a review, synthesis and research agenda. Hum. Relat. 69, 1235–1258.

Campbell, D.T., Fiske, D.W., 1959. Convergent and discriminant validation by the multitrait-multimethod matrix. Psychol. Bull. 56, 81–105.

Chang, S.-J., van Witteloostuijn, A., Eden, L., 2010. From the editors: common method variance in international business research. J. Int. Bus. Stud. 41, 178–184.

Cheung, S.Y., Gong, Y., Wang, M., Zhou, L., Shi, J., 2016. When and how does functional diversity influence team innovation? The mediating role of knowledge sharing and the moderation role of affect-based trust in a team. Hum. Relat. 69, 1507–1531.

Cicmil, S., Hodgson, D., Lindgren, M., Packendorff, J., 2009. Project Management Behind the Façade. Ephemera: Theory and Politics in Organization. vol. 9 pp. 78–92.

Cohen, J., 1988. Statistical Power Analysis for the Behavioral Sciences. Lawrence Earlbaum Associates, Philadelphia, PA.

Cohen, W.M., Levinthal, D.A., 1990. Absorptive capacity: a new perspective on learning and innovation. Adm. Sci. Q. 35, 128–152.

Conway, J.M., Lance, C.E., 2010. What reviewers should expect from authors regarding common method Bias in organizational research. J. Bus. Psychol. 25, 325–334.

Curado, C., Oliveira, M., Maçada, A.C.G., Nodari, F., 2017. Teams' innovation: getting there through knowledge sharing and absorptive capacity. Knowl. Manag. Res. Pract. 15, 45–53.

Dahlin, K.B., Weingart, L.R., Hinds, P.J., 2005. Team diversity and information use. Acad. Manag. J. 48, 1107–1123.

Davis, K., 2014. Different stakeholder groups and their perceptions of project success. Int. J. Proj. Manag. 32, 189–201.

De Wit, A., 1988. Measurement of project success. Int. J. Proj. Manag. 6, 164–170.

DeFillippi, R.J., Arthur, M.B., 1998. Paradox in project-based enterprise: the case of film making. Calif. Manag. Rev. 40, 125–139.

Floricel, S., Michela, J.L., Piperca, S., 2016. Complexity, uncertainty-reduction strategies, and project performance. Int. J. Proj. Manag. 34, 1360–1383.

Flyvbjerg, B., Stewart, A., Budzier, A., 2016. The Oxford Olympics study 2016: cost and cost overrun at the games. Saïd Business School Research Papers, pp. 1–27.

Geraldi, J.G., 2009. Reconciling order and chaos in multi-project firms. Int. J. Manag. Proj. Bus. 2, 149–158.

Geraldi, J., Maylor, H., Williams, T., 2011. Now, let's make it really complex (complicated) a systematic review of the complexities of projects. Int. J. Oper. Prod. Manag. 31, 966–990.

Grabher, G., 2004. Temporary architectures of learning: knowledge governance in project ecologies. Organ. Stud. 25, 1491–1514.

Gutiérrez, L.J.G., Bustinza, O.F., Molina, V.B., 2012. Six sigma, absorptive capacity and organisational learning orientation. Int. J. Prod. Res. 50, 661–675.

Hair Jr., J.F., Hult, G.T.M., Ringle, C., Sarstedt, M., 2017. A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). 2nd ed. Sage Publications.

Hanisch, B., Wald, A., 2014. Effects of complexity on the success of temporary organizations: relationship quality and transparency as substitutes for formal coordination mechanisms. Scand. J. Manag. 30, 197–213.

Hanisch, B., Lindner, F., Mueller, A., Wald, A., 2009. Knowledge management in project environments. J. Knowl. Manag. 13, 148–160.

Henseler, J., Ringle, C.M., Sinkovics, R.R., 2009. The Use of Partial Least Squares Path Modeling in International Marketing, New Challenges to International Marketing. Emerald Group Publishing Limited, pp. 277–319.

Henseler, J., Ringle, C.M., Sarstedt, M., 2015. A new criterion for assessing discriminant validity in variance-based structural equation modeling. J. Acad. Mark. Sci. 43, 115–135.

Hertogh, M., Westerveld, E., 2010. Playing with Complexity. Management and Organisation of Large Infrastructure Projects. Erasmus Universiteit Rotterdam, p. 377.

Hobday, M., 2000. The project-based organisation: an ideal form for managing complex products and systems? Res. Policy 29, 871–893.

Jansen, J.J., Van Den Bosch, F.A., Volberda, H.W., 2005. Managing potential and realized absorptive capacity: how do organizational antecedents matter? Acad. Manag. J. 48, 999–1015.

Jiménez-Barrionuevo, M.M., García-Morales, V.J., Molina, L.M., 2011. Validation of an instrument to measure absorptive capacity. Technovation 31, 190–202.

Ketokivi, M.A., Schroeder, R.G., 2004. Perceptual measures of performance: fact or fiction? J. Oper. Manag. 22, 247–264.

Killen, C.P., Jugdev, K., Drouin, N., Petit, Y., 2012. Advancing project and portfolio management research: applying strategic management theories. Int. J. Proj. Manag. 30, 525–538.

Klarner, P., Sarstedt, M., Hoeck, M., Ringle, C.M., 2013. Disentangling the effects of team competences, team adaptability, and client communication on the performance of management consulting teams. Long Range Plan. 46, 258–286.

Lane, P.J., Salk, J.E., Lyles, M.A., 2001. Absorptive capacity, learning, and performance in international joint ventures. Strateg. Manag. J. 22, 1139–1161.

Lane, P.J., Koka, B.R., Pathak, S., 2006. The reification of absorptive capacity: a critical review and rejuvenation of the construct. Acad. Manag. Rev. 31, 833–863.

Leal-Rodríguez, A.L., Roldán, J.L., Ariza-Montes, J.A., Leal-Millán, A., 2014. From potential absorptive capacity to innovation outcomes in project teams: the conditional mediating role of the realized absorptive capacity in a relational learning context. Int. J. Proj. Manag. 32, 894–907.

Lindner, F., Wald, A., 2011. Success factors of knowledge management in temporary organizations. Int. J. Proj. Manag. 29, 877–888.

Lu, Y., Luo, L., Wang, H., Le, Y., Shi, Q., 2015. Measurement model of project complexity for large-scale projects from task and organization perspective. Int. J. Proj. Manag. 33, 610–622.

Lundin, R.A., Söderholm, A., 1995. A theory of the temporary organization. Scand. J. Manag. 11, 437–455.

Might, R.J., Fischer, W.A., 1985. The role of structural factors in determining project management success. IEEE Trans. Eng. Manag. EM-32, 71–77.

Nitzl, C., Roldan, J.L., Cepeda, G., 2016. Mediation analysis in partial least squares path modeling: helping researchers discuss more sophisticated models. Ind. Manag. Data Syst. 116, 1849–1864.

Nonaka, I., Von Krogh, G., 2009. Perspective—tacit knowledge and knowledge conversion: controversy and advancement in organizational knowledge creation theory. Organ. Sci. 20, 635–652.

Oluwaseyi, O.A., Murali, R., Wei, C.C., 2017. Microlevel antecedents of absorptive capacity in joint project engineering teams. Manag. Res. Rev. 40, 990–1006.

Packendorff, J., 1995. Inquiring into the temporary organization: new directions for project management research. Scand. J. Manag. 11, 319–333.

Pauget, B., Wald, A., 2013. Relational competence in complex temporary organizations: the case of a French hospital construction project network. Int. J. Proj. Manag. 31, 200–211.

Pinto, J.K., Prescott, J.E., 1988. Variations in critical success factors over the stages in the project life cycle. J. Manag. 14, 5–18.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.-Y., Podsakoff, N.P., 2003. Common method biases in behavioral research: a critical review of the literature and recommended remedies. J. Appl. Psychol. 88, 879–903.

Popaitoon, S., Siengthai, S., 2014. The moderating effect of human resource management practices on the relationship between knowledge absorptive capacity and project performance in project-oriented companies. Int. J. Proj. Manag. 32, 908–920.

Ringle, C.M., Wende, S., Becker, J.-M., 2015. SmartPLS 3. SmartPLS GmbH, Boenningstedt.

Sandor, L., Jeroen, K., Aard, G., 2016. The team absorptive capacity triad: a configurational study of individual, enabling, and motivating factors. J. Knowl. Manag. 20, 1083–1103.

Sarstedt, M., Ringle, C.M., Henseler, J., Hair, J.F., 2014. On the emancipation of PLS-SEM: a commentary on Rigdon (2012). Long Range Plan. 47, 154–160.

Sarstedt, M., Ringle, C.M., Hair, J.F., 2017. Partial least squares structural equation modeling. In: Homburg, C. (Ed.), Handbook of Market Research. Springer International Publishing AG, pp. 1–40.

Sattler, H., Völckner, F., Riediger, C., Ringle, C.M., 2010. The impact of brand extension success drivers on brand extension price premiums. Int. J. Res. Mark. 27, 319–328.

Schoper, Y.-G., Wald, A., Ingason, H.T., Fridgeirsson, T.V., 2018. Projectification in Western Economies: a comparative study of Germany, Norway and Iceland. Int. J. Proj. Manag. 36, 71–82.

Schwab, D.P., 2005. Research Methods for Organizational Studies. 2nd ed. Lawrence Erlbaum Associates, New Jersey.

Shenhar, A.J., Levy, O., 1997. Mapping the dimensions of project success. Proj. Manag. J. 28, 5–13.

Sicotte, H., Bourgault, M., 2008. Dimensions of uncertainty and their moderating effect on new product development project performance. R&D Manag. 38, 468–479.

Siemsen, E., Roth, A., Oliveira, P., 2010. Common method bias in regression models with linear, quadratic, and interaction effects. Organ. Res. Methods 13, 456–476.

Simon, H.A., 1962. The architecture of complexity. Proc. Am. Philos. Soc. 106, 467–482.

Sobel, M.E., 1982. Asymptotic confidence intervals for indirect effects in structural equation models. Sociol. Methodol. 13, 290–312.

Spector, P.E., 2006. Method variance in organizational research. Organ. Res. Methods 9, 221–232.

Sydow, J., 2017. Temporary organizing –the end of organizations as we know them? Rutgers Bus. Rev. 2, 199–204.

Szulanski, G., 1996. Exploring internal stickiness: impediments to the transfer of best practice within the firm. Strateg. Manag. J. 17, 27–43.

Tatikonda, M.V., Rosenthal, S.R., 2000a. Successful execution of product development projects: balancing firmness and flexibility in the innovation process. J. Oper. Manag. 18, 401–425.

Tatikonda, M.V., Rosenthal, S.R., 2000b. Technology novelty, project complexity, and product development project execution success: a deeper look at task uncertainty in product innovation. IEEE Trans. Eng. Manag. 47, 74–87.

The Economist, 2017. Why Berlin's new airport keeps missing its opening date [Online]. The Economist. Available: https://www.economist.com/blogs/economist-explains/2017/01/economist-explains-18, Accessed date: 20 November 2017.

Todorova, G., Durisin, B., 2007. Absorptive capacity: valuing a reconceptualization. Acad. Manag. Rev. 32, 774–786.

Tourangeau, R., Rips, L.J., Rasinski, K., 2000. The Psychology of Survey Response. Cambridge University Press.

Turner, J.R., Cochrane, R.A., 1993. Goals-and-methods matrix: coping with projects with ill defined goals and/or methods of achieving them. Int. J. Proj. Manag. 11, 93–102.

Turner, R., Zolin, R., 2012. Forecasting success on large projects: developing reliable scales to predict multiple perspectives by multiple stakeholders over multiple time frames. Proj. Manag. J. 43, 87–99.

Tyssen, A.K., Wald, A., Spieth, P., 2014. The challenge of transactional and transformational leadership in projects. Int. J. Proj. Manag. 32, 365–375.

Volberda, H.W., Foss, N.J., Lyles, M.A., 2010. Perspective: absorbing the concept of absorptive capacity: how to realize its potential in the organization field. Organ. Sci. 21, 931–951.

Williams, T.M., 1999. The need for new paradigms for complex projects. Int. J. Proj. Manag. 17, 269–273.

Zahra, S.A., George, G., 2002. Absorptive capacity: a review, reconceptualization, and extension. Acad. Manag. Rev. 27, 185–203.

Zhang, X., Venkatesh, V., Brown, S.A., 2011. Designing collaborative systems to enhance team performance. J. Assoc. Inf. Syst. 12, 556.

Zhao, X., Lynch Jr., J.G., Chen, Q., 2010. Reconsidering Baron and Kenny: myths and truths about mediation analysis. J. Consum. Res. 37, 197–206.

Zwikael, O., Unger-Aviram, E., 2010. HRM in project groups: the effect of project duration on team development effectiveness. Int. J. Proj. Manag. 28, 413–421.