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## Innovation at the project-level: the role of organisational innovation capabilities

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**Abstract:** Strategic management research shows that firm innovation capabilities enable innovation at the *firm-level*. Extending and enhancing this research, we theorise and hypothesise that firms' innovation capabilities manifest as project-level innovation capabilities and enable the creation of innovation at the *project-level*. Drawing on a repeated cross-section of innovation projects and regression analysis, we find that internal and external innovation capabilities have a positive influence on technological and non-technological innovation at the project-level. A key theoretical implication is that innovation capabilities enable organisations to manage the uncertainties and complexities of the innovation journey as it manifests at the project-level. This is another testimony to the importance of innovation capabilities for organisations searching for innovation.

**Keywords:** internal and external project innovation capabilities; internal and external search; technological innovation output; non-technological innovation output.

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## 1 Introduction

Firms need to be prepared to introduce a steady stream of innovations to survive and prosper (Lee and Trimi, 2018; Cheng and Van de Ven, 1996). Research has shown that firms with the capability to (re)combine internal and external resources are more likely to succeed with innovation (Molden and Clausen, 2020; Wang et al., 2013). This is one of the key reasons why scholars have directed attention to firms' innovation capability (Molden and Clausen, 2020), that is the organisational capacity to create new products, services, solutions, processes, and administrative systems (Lawson and Samson, 2001). Reviews of the literature conclude that firm innovation capability is a key driving force behind firms' innovation performance (Lawson and Samson, 2001; Whittaker et al., 2016; Iddris, 2016, 2019; Birchall and Tovstiga, 2005). This research has typically focused on innovation at the firm-level (Im et al., 2013; Iddris, 2016). However, firms typically organise the search for innovation in projects (Salge et al., 2013).

Therefore, firms with a capacity for innovation should have an advantage in creating innovation output at the project-level (Markovic et al., 2021). However, this is a line of theoretical reasoning that has not been in focus in the extant literature, arguably because most extant research has focused on innovation output at the firm-level (Forsman, 2011; Menguc et al., 2014; Agyapong et al., 2016; Iddris, 2016; Saunila, 2016, 2017, 2020; Strønen et al., 2017; Vakulenko, 2020; Hwang et al., 2020). While interesting, extant research on innovation at the firm-level can only to a limited extent reveal insight into the innovation processes as they pan out at the project-level. Typically, firm-level research on innovation conflates and averages out innovation heterogeneity as it unfolds at the project-level. Research on the firm-level innovation capabilities has tended to overlook that firms' innovation capabilities manifest and pan out at the project-level. This has resulted in a gap in our knowledge of innovation projects and their interplay with organisational capabilities (Vanhaverbeke et al., 2014), generating a need to reveal additional insights about the influence of firm innovation capabilities on output at other levels of analysis, such as the project-level (Cassiman et al., 2010; Im et al., 2013; Iddris, 2016). While firms with a capacity for innovation should have an advantage in creating innovation output at the project-level (Bagherzadeh et al., 2022), this is a notion that has not been in focus in the extant literature. Further, one may wonder to what extent existing firm-level results are applicable to the project-level. Reflecting this, we argue that it is of considerable theoretical and practitioner interest to examine the relationship between innovation capabilities and innovation output at the project-level.

To remedy these gaps, we build on extant research (Cassiman et al., 2010; Pesch et al., 2021) and establish that project innovation capabilities manifest themselves in the form of firm innovation capabilities (Davies and Brady, 2016). From there, we argue that projects are a particularly interesting setting for examining the relationship between project innovation capabilities and innovation output. Reflecting this gap in the literature, we ask the following research question:

- What is the role of innovation capabilities in innovation at the project-level?

We argue that capabilities measured at the project-level reflect capabilities at the firm-level as projects stem from firms (Brady and Davies, 2004). By building a theoretical link between firm-level and project-level analysis, and how this relates to project innovation output, we operationalise our research question into testable hypotheses. Next, we test hypotheses by drawing on a panel dataset where a survey has

been administered to leaders of 1814 Norwegian innovation projects with a time lag of three years. Empirical results from regression analyses show that internal and external innovation capabilities have a positive and important influence on technological and non-technological innovation output at the project-level. Moreover, when added simultaneously, we find that external innovation capabilities influence mainly technological innovation output at the project-level, while internal innovation capabilities influence mainly non-technological innovation output. We discuss all these results and add policy and managerial implications at the end.

Our paper contributes to the literature in three ways. First, we contribute by examining the role of innovation capabilities in the search for innovation at the project-level, and thereby expand the domain of research on innovation capability to new units and levels of analysis, as called for in the literature (e.g., from Im et al., 2013). Second, we do not only examine technological innovation as a relevant output, which has been a key tendency in the literature (Geldes et al., 2017), but also add non-technological innovation (marketing/organisational innovation) as another important type of innovation output at the project-level. Last, we make a methodological contribution in introducing a time-lag between project innovation capabilities and innovation output. Much of the existing research is either qualitative (Marullo et al., 2020; Bagherzadeh et al., 2022) or cross-sectional (Schwartz et al., 2012; Kostopoulos et al., 2019) where we apply a time-lagged dataset at two points in time, enabling us to draw a wider set of conclusions compared to cross-sectional analysis. Such a time lag between the key explanatory variable of interest (i.e., innovation capabilities) and the performance outcome of interest ensures a more robust estimation of the actual influence of project innovation capabilities on innovation outputs.

This paper is organised as follows; first, the theoretical discussion outlines the relevance of project innovation capabilities for the introduction of innovation outputs at the project-level. Here, we address the link between capabilities at the firm- and project-level. Second, we propose the way in which internal and external innovation capabilities affect technological and non-technological innovation outputs at the project-level. Next, we present the methodology and data applied in this research, after which we introduce and discuss our empirical results. Finally, we provide conclusions, discuss our study limitations, and suggest ideas for further research.

## **2 Theoretical framework and hypothesis development**

To shed theoretical light on the proposed research question we need to establish several concepts and their linkages with each other. The key concepts of this paper are innovation output, firm innovation capabilities, and project innovation capabilities, as well as the link between the latter two.

Innovation output can be defined as the result of an innovation process (such as activities in an innovation project). Innovation itself is defined as value creation introducing new features in products, processes, marketing, or services (to name but a few). It is also widely understood as “a means of, either as a response to changes in the external environment or as a pre-emptive action to influence the environment” [Damanpour, (1996), p.694]. Innovation is in this literature an outcome of a search process (Laursen and Salter, 2006; Katila and Ahuja, 2002; Dahlander et al., 2016) where

firms recombine new and existing resources (Savino et al., 2017; Schilke et al., 2018) and is a central part in firm's competitiveness (Lee and Trimi, 2018).

Firm innovation capability can be defined as the "ability to continuously transform knowledge and ideas into new products, processes, and systems for the benefit of the firm and its stakeholders" [Lawson and Samson, (2001), p.384]. Theoretically speaking, innovation capability can be understood as a "set of specific and identifiable *processes*" [Eisenhardt and Martin, (2000), p.1105, emphasis added], and as "a subset of the competencies and capabilities allowing firms [to create] new products and processes" [Breznik and Hisrich, (2014), p.378, emphasis added]. As such, firm innovation capabilities are defined at the firm-level (Molden and Clausen, 2020; Lawson and Samson, 2001; Breznik and Hisrich, 2014), but they also manifest themselves at the sub-firm-level such as a project (Morris, 2013; Davies and Brady, 2016; Bagherzadeh et al., 2022). Thus, we can apply the definition above on the project-level as well.

It is a central theoretical notion in the field of strategic management that firms have a capacity for innovation (Breznik and Hisrich, 2014). Drawing on evolutionary and resource-based theories of the firm (Nelson and Winter, 2002; Barney, 1991; Wernerfelt, 1984; Schilke et al., 2018), scholars have pointed to the role of resources and capabilities in how firms create innovation (Katila and Ahuja, 2002). Extant research has therefore highlighted that firms create innovation through a learning and problem-solving process where innovation capability occupies a central role (Katila and Ahuja, 2002; Laursen and Salter, 2006).

The literature on firm innovation capability is consistent with an organisation-centric view of innovation (Lawson and Samson, 2001). Such a view highlights that the firm is a lot more than an empty shell converting innovation inputs to innovation outputs. Instead, it emphasises that the capacity and agency of the organisation occupy a central role in the innovation process as it manifests at the firm-level (Clausen et al., 2020). Moreover, and less discussed in extant literature, innovation capabilities also manifest themselves at the project-level (Morris, 2013; Bagherzadeh et al., 2022; Gullmark and Clausen, 2023), and they interact with firm-level capabilities in a mutually reinforced way (Davies and Brady, 2016; Chen et al., 2022). Thus, we argue that capabilities at the project-level manifest themselves from capabilities at the firm-level effectually tying the concepts together across levels of analysis (*ibid*).

While firms introducing a higher number of innovations may have a better-developed innovation capability, this does not necessarily have to be the case. Scholars have, against this backdrop, highlighted that it is very important to separate clearly between the capacity to innovate and actual innovation (Kahn, 2018). While innovation is typically defined as the introduction of new products, processes, services, etc (*ibid*) innovation capability captures the capacity of the organisation to recombine and reconfigure internal and external resources with the purpose of creating innovation (Iddris, 2016). Reflecting this, extant literature highlights that an important nature of innovation capability is its "potential to generate new ideas, identify new market opportunities and implement marketable innovations by leveraging existing resources and capabilities" [Hii and Neely, (2000), p.5]. This applies to both firm- and project-level capabilities. Nuancing this understanding, Molden and Clausen (2020) argue that there is an internal and external dimension to the organisational capacity to innovate. While internal project innovation capabilities are oriented toward internal resources and search within the firm project, such as idea recognition and resource orchestration (Duran et al., 2016; Withers et al., 2011; Vakulenko, 2020; Zhou and Minshall, 2014), external project innovation

capabilities involve the search and sourcing of resources outside the boundaries of the firm and the project, such as from collaboration partners, users, and universities (Ma et al., 2013).

Extant literature has documented a positive relationship between firm innovation capabilities and firm innovation output (see Iddris, 2016) for a review of this literature). For example, Martínez-Román et al. (2011) confirmed a positive effect of innovative capability on the innovative outcomes of SMEs, while Molden and Clausen (2020) showed that both internal and external firm innovation capabilities have a positive influence on innovation output at the firm-level. However, as noted earlier, most empirical research on the performance implication of firm innovation capabilities has been conducted at the firm-level. This has limited our understanding of the role of project innovation capabilities (Prajogo and Ahmed, 2006; Iddris, 2016) at lower levels of analysis, such as the project-level (Im et al., 2013; Tranekjer and Søndergaard, 2013; Kim et al., 2015). The project-level is here particularly interesting, because the search for innovation is typically organised in projects (Nelson and Winter, 1977; Cassiman et al., 2010) and that aggregation of innovation capabilities at the firm-level may average out and thus mask variations stemming from the project-level (Vanhaverbeke et al., 2014). Thus, we need a better understanding of the project as the level of analysis (Tranekjer and Søndergaard, 2013).

### *2.1 The role of innovation capabilities at the project-level*

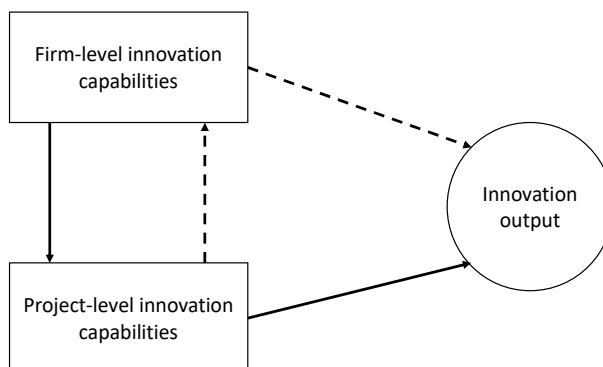
We define a *project* as a temporary entity, meaning it has a start and an end, with a clear objective designed to yield a unique output such as a product, process, or service (among others). Projects are most often nested within an organisation such as a firm. Consequently, we can define the project-level as a sub-organisational unit of analysis capturing the project-specific resources and objectives such as project managers and subject matter experts. Given that innovation activities within the firm are organised as projects (Tranekjer and Søndergaard, 2013), and the projects draw on capabilities at the firm-level (i.e., innovation capabilities) (Kostopoulos et al., 2019; Evald et al., 2021), the study of project-level traits of a firm's innovation process is warranted. Projects matter for firms and firms matter for projects in a reciprocal way (Davies and Brady, 2016). Extant literature has studied the impact of project-level variables through studies of various industries such as the service industry (i.e., hotels) (Santos-Vijande et al., 2021), construction (Ozorhon, 2012), and manufacturing (Kobarg et al., 2018).

Moreover, project-level analysis has also been conducted to support open innovation (Kim et al., 2015; Kostopoulos et al., 2019; Evald et al., 2021), new product development (Tranekjer and Søndergaard, 2013) and digital product innovation (Pesch et al., 2021). Building on these contributions we argue that project-level analysis is important to understand innovation within firms, and how firm-level traits play into the project-level within the firm (Vanhaverbeke et al., 2014). Although several recent contributions have focused on different aspects of project-level analysis (Cassiman et al., 2010; Kim et al., 2015; Pesch et al., 2021) and their relation to firm-level characteristics (Madhok, 2002), they also call for more nuanced findings at lower level of analysis (Jones et al., 2020; Du et al., 2014; Brunswicker and Chesbrough, 2018). In particular, most current studies are cross-sectional and thus cannot account for the effect of time (Kobarg et al., 2018). Thus, more studies observing effects over time is also needed.

Firm-level characteristics play into the project-level in several ways (Davies and Brady, 2016; Morris, 2013). First, firm innovation experience plays into innovation projects by setting the standard for how projects are conducted (Kostopoulos et al., 2019). Second, firm capabilities often influence projects within the firm as multi-level interactions (Vanhaverbeke et al., 2014; Barbic et al., 2021; Davies and Brady, 2016) being a determinant of project success and failure (Brunswick and Chesbrough, 2018). Third, firms with an innovation culture are more likely to produce good innovation projects (Santos-Vijande et al., 2021). Again, we argue that innovative culture and structures at the firm-level are part of a set of capabilities working to front innovation at the project-level.

The mechanism through which firm-level capabilities matter to projects is that projects are a product of the know-how and know-what of the firm and how these interact in a multi-faceted and multi-level way for identifying contingency factors induced by the different levels of analysis (West and Bogers, 2017, 2014; Davies and Brady, 2016). Moreover, innovation capabilities are resources accessible to the firm and of pivotal importance for long-term sustainable competitive advantage (Barney, 1991). Projects could be seen as a diversification where risks, inherently a part of innovation, are spread out on several projects rather than at the firm-level (Belderbos et al., 2004). Moreover, innovation capabilities impact projects for two reasons. First, innovation capabilities at the firm-level inform the selection of project managers and project staff who, in turn, affects projects (Calantone et al., 2010; Kostopoulos et al., 2019). Thus, firm-level capabilities will be reflected in the resources and capabilities at the project-level (Morris, 2013). Second, the project taps into firm resources to be able to go through with the project (Salge et al., 2013). These resources and capabilities are themselves subject to change over time (Schilke et al., 2018). Thus, a multilevel approach has been found to play a role in establishing and running projects (Salge et al., 2013). Typically, project leaders are seen as pivotal in establishing and running projects and this person taps into resources both at the project- and firm-level (Haas, 2010). These project leaders draw on resources and capabilities at the firm-level while leading processes at the project-level. This also applies to firm structures and organisational capabilities. However, learning and experiences accumulated at the project-level is a source of changes at the firm-level (Cohen and Levinthal, 1990). Extant research on this interplay holds that firms manage knowledge flows both into and out of projects (Brunswick and Chesbrough, 2018). Figure 1 sums up the focal theoretical relationships between firms and projects.

**Figure 1** Conceptual figure on the focal relationships



Innovation studies have shown that the introduction of innovations is messy, complex, and uncertain (Malik and Yun, 2017). Therefore, innovation search may lead the project into uncharted territories, new resources may be needed, and new collaboration partners (open communication) may be required (Kenny, 2003; West and Bogers, 2014). Firms, through projects, may find new solutions to problems, and/or innovation projects may generate benefits (Greco et al., 2019). However, it is precisely in such circumstances that firms with a better developed innovation capability should have a clear advantage. First, through sensing and seizing, project innovation capabilities will influence the scope and quality of innovation ideas that a focal firm has access to (Teece, 2007) and thus play into how the firm organises its innovation activities. In other words, organisations with better-developed innovation capabilities are expected to sense a higher number of ideas, with a higher quality, and possess the capacity to seize the best ideas/opportunities and implement them in the form of innovation projects (Martin, 2011). Thus, we argue that firm-level capabilities and resources matter for projects. Second, through reconfiguration, project innovation capabilities will match external and internal resources (Molden and Clausen, 2020) to develop innovation projects into actual innovation. Based on the discussion above we propose two hypotheses:

- H1 (a) Internal project innovation capabilities and (b) external project innovation capabilities are predictors of technological innovation output at the project-level.
- H2 (a) Internal project innovation capabilities and (b) external project innovation capabilities are predictors of non-technological innovation output at the project-level.

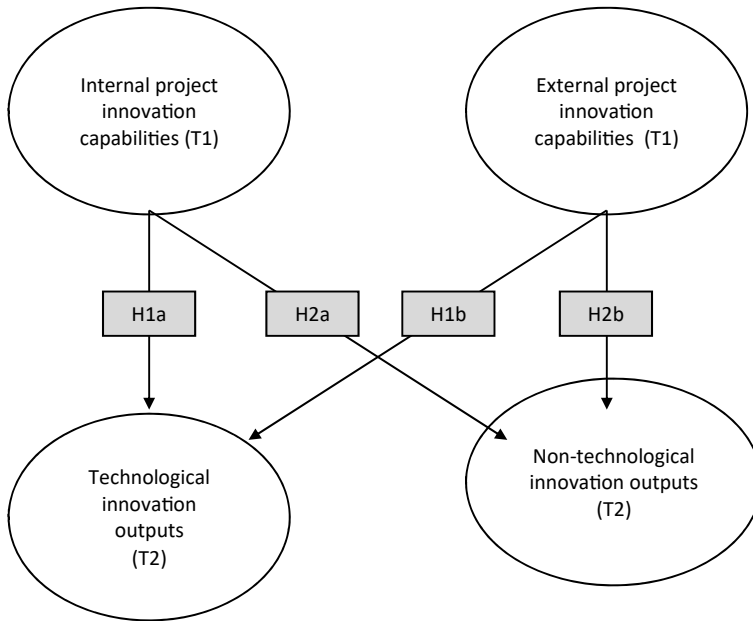
### **3 Data and methods**

#### *3.1 Sample and data*

The data source for our empirical analysis is the User Survey 2010 designed to capture innovations in projects that was conducted for Innovation Norway<sup>1</sup> by Oxford Research AS. The data were gathered among Norwegian companies that received services from Innovation Norway, a national entity supporting innovation in firms and public agencies through grants and loans. The survey was conducted in two waves – one in 2011 and another in 2014 (T1 and T2) – to determine the effects and impact of innovation projects in the respondent companies. The company that collected the data reported a 64% response rate to the web survey, yielding a total sample of 1914 projects. The survey contained a set of questions suitable for constructing empirical representations of all the concepts in our research. Moreover, information available at the firm and industry levels allowed us to control for important industry and firm-level variables.

#### *3.2 Research design*

The overall research model with a summary of the different hypotheses is presented in Figure 2. We test the different relationships separately, examining the effect of project innovation capabilities on innovation at the project-level using multiple regression analysis.

**Figure 2** Research model with a summary of different hypotheses

### 3.3 Variables and measures

The variables are presented below and described in Table 1. There are two dependent variables: *technological innovation outputs (TEC)* and *non-technological innovation outputs (NTEC)*. Further, there are two key explanatory variables: *internal project innovation capabilities (IC)* and *external project innovation capabilities (EC)*. The dependent variables (technological and non-technological innovation outputs) and the key explanatory variables (internal and external project innovation capabilities) are measured by the same principle. Applying five-point Likert scales to the respondents' responses about certain statements (1 = no degree/no contribution and 5 = to a very large degree/very large contribution), we composed four latent variables constructed as additive indexes, each with its indicators (see Table 1). To test the hypotheses, we constructed a composite measure of the dependent and independent variables by computing the mean of the items' set for each dependent and independent variable. To measure the reliability of the scales used in this study, we checked the internal consistency and reported Cronbach alpha (Ch.a) coefficients in Table 1. Additionally, we employed internationalisation and various project objectives at T1 as control variables at the project-level. As firm-level controls, we used firm size and firm age, which may have a significant impact on innovation outputs (Duran et al., 2016; Withers et al., 2011). Finally, we controlled for industry fixed effects using two-digit NACE codes. More details on the selection of control variables are included under a separate section.

### 3.3.1 *Dependent variables*

Based on the definition given by the *OECD Oslo Manual* (OECD, 2005), *technological innovation outputs* consist of new and/or significant technological improvements in products and processes. We measured technological innovation outputs using the items presented in Table 1. Specifically, we use items where respondents have been asked to answer about the *outcome (TEC)* of the project. These are all captured at T2 and reflect what was achieved by the project. Sample items include questions regarding ‘to what extent the project has led to’ outcomes such as ‘improved design, properties, and quality of existing products’, ‘development of new product’, ‘development of new service’ and ‘development of new production process’. These are captured three years after the project was initiated. Similarly, *non-technological innovation outputs (NTEC)* refer to any new marketing or project innovation (Parrilli and Heras, 2016). Specifically, we use to ‘what extent the project has led to’ outcomes such as ‘use of new sales channels or marketing methods’, ‘new business practice of work, procedures and quality assurance’, ‘new methods for organising work responsibilities and decisions within the company’ and ‘new methods for organising external relationships with other companies or public institutions’. In common for these items is that they are proxies for non-technological innovation. Table 1 sums up the items used in the analysis.

### 3.3.2 *Independent variables*

The independent variables are captured at the beginning (T1) of the project and measured against the actual outcome at T2. These variables capture capabilities at the project-level at T1 and are thus expected to affect outcomes at T2. The items are reported at the beginning of the project capturing the respondent. It is a proxy for capabilities at the start of the period. This approach is to remedy the shortcomings of cross-sectional analysis by accounting for time in a repeated cross-section.

We use three items to measure internal project innovation capabilities. Our items reflect past research highlighting that internal project innovation capabilities emphasise the importance of development and innovation (Eisenhardt and Martin, 2000), utilisation of knowledge (Zollo and Winter, 2002; Eisenhardt and Martin, 2000) and competence development among employees (Teece, 2007; Eisenhardt and Martin, 2000). We constructed a latent variable to capture these three indicators of internal project innovation capabilities, as described in Table 1. We measured external project innovation capabilities using the approach offered by Molden and Clausen (2020), who suggested that external project innovation capabilities reflect firms’ search for new opportunities, resources, and competencies outside their organisational boundaries. Hence, we constructed a latent variable capturing three indicators of external project innovation capabilities, as presented in Table 1.

### 3.3.3 *Control variables*

We have five control variables at the project-level, as called for in the literature (Cassiman et al., 2010), two at the firm-level, and sector fixed effects. Of the controls at the project-level, four variables control for project objectives while one is related to internationalisation. These are added to reduce the probability of omitted variable bias (Hair et al., 2018). The first four variables ask if the project has or will lead to the development and improvement of products, processes, marketing, or organisational

development. First, the product objective control variable answers a question: does or will the project lead to the development and improvement of products/goods and/or services? Second, the process objective control variable answers a question: does or will the project lead to the development and improvement of production processes? Third, the marketing objective control variable answers a question: has or will the project/activity lead to market development and/or changed marketing? Finally, the organisational development objective control variable answers a question: does or will the project/activity lead to organisational development? These variables control for the influence of initial project goals (T1) on the technological and non-technological innovation outputs (T2). The rationale for these controls is that the initial objectives of the project may influence the outcome of the project at a later stage (Howell et al., 1993). Extant literature holds that the inherent uncertainty of project objectives impacts project realisation (ibid). Thus, we control for project objectives. These metrics are measured using a Likert scale from 1 through 5. We control for internationalisation, since companies operating internationally face the more complex and varied needs of their customers, which may affect their need for innovation (Molden and Clausen, 2020).

**Table 1** Empirical constructs and reliability measures

| <i>Construct</i>                          | <i>Ch.a</i> | <i>Items</i>                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Technological innovation outputs (T2)     | 0.776       | To what extent has the project/activity led to: <ol style="list-style-type: none"> <li>1 Improving the design, properties, and qualities of existing products?</li> <li>2 The development of a new product?</li> <li>3 The development of a new service?</li> <li>4 The development of a new production process?</li> </ol>                                                                                                                           |
| Non-technological innovation outputs (T2) | 0.752       | To what extent has the project/activity led to: <ol style="list-style-type: none"> <li>1 The use of new sales channels or marketing methods?</li> <li>2 The introduction of products/goods and/or services to new customer groups?</li> <li>3 New methods for organising work responsibilities and decisions within the company?</li> <li>4 New methods for organising external relationships with other companies or public institutions?</li> </ol> |
| Internal innovation capabilities (T1)     | 0.755       | To what extent does the project/activity contribute to the following innovation behaviour: <ol style="list-style-type: none"> <li>1 Increased focus on development and innovation?</li> <li>2 Better utilisation of knowledge?</li> <li>3 Competence development in myself/employees?</li> </ol>                                                                                                                                                      |
| External innovation capabilities (T1)     | 0.761       | To what extent does the project/activity contribute to the following innovative behaviour: <ol style="list-style-type: none"> <li>1 Hiring new employees?</li> <li>2 Seeing new opportunities in international cooperation?</li> <li>3 The development of collaboration/networks?</li> </ol>                                                                                                                                                          |

We control for firm size and age at the firm-level, since large/small and new/established firms differ in their resources and capabilities that they can devote to projects (Withers et al., 2011; Tranekjer and Søndergaard, 2013; Kobarg et al., 2018). Firm and age are proxies for the liability of *smallness* (Ulvenblad and Barth, 2021; Aldrich and Auster, 1986) and *newness* (Stinchcombe, 1965; Yang and Aldrich, 2017) where small and young firm have a distinct disadvantage compared with older and larger firms. More precisely, smaller firms may have limited access to capabilities than their larger rivals (Aldrich and Auster, 1986), while younger companies may differ in their capabilities to innovate (Withers et al., 2011). The firm-level control variable – firm age – was measured as an ordinal variable, with 1 representing companies five years and younger, 2 representing companies between five and ten years, and 3 representing established companies older than ten years. Firm size is measured as a continuous variable where firms report their turnover. Finally, the sector control variable was measured as each firm’s economic activities (NACE code), and dummies for each sector were added to capture sector-specific fixed effects as innovation outputs may be influenced by the sector within which the focal firm is (Tranekjer and Søndergaard, 2013; Kobarg et al., 2018).

### 3.4 Analysis

We conducted our analysis using R studio. We started by analysing the summary statistics and making the correlation matrix (see Table 3). Then, we performed analyses to test for normality, linearity, multicollinearity, and homoscedasticity issues, but we did not find any problems affecting the results. We examined common method bias by employing the Harman’s single factor test. The result showed that a single factor accounted for 32.9%, which is far less than the 50% threshold suggested in extant research (Hair et al., 2018). Further, the data is also collected at two points in time, which is also known to alleviate common method bias issues. Thus, common method bias should not be an important source of bias in our research.

**Table 2** Descriptive statistics

| <i>Variable</i>             | <i>Mean</i> | <i>Median</i> | <i>St. dev.</i> |
|-----------------------------|-------------|---------------|-----------------|
| 1 Tech innovation           | 3.007       | 3.007         | 0.674           |
| 2 Non-tech innovation       | 3.096       | 3.066         | 0.702           |
| 3 Internal capabilities     | 3.717       | 3.717         | 0.763           |
| 4 External capabilities     | 3.209       | 3.209         | 0.936           |
| 5 Firm size                 | 0.907       | 1.000         | 0.252           |
| 6 Firm age                  | 1.967       | 2.000         | 0.961           |
| 7 Product objective         | 3.646       | 4.000         | 1.458           |
| 8 Process objective         | 3.776       | 4.000         | 1.308           |
| 9 Marketing objective       | 3.732       | 4.000         | 1.361           |
| 10 Organisational objective | 3.368       | 3.000         | 1.433           |
| 11 Internationalisation     | 0.261       | 0.261         | 0.173           |

**Table 3** Correlation matrix

| <i>Variable</i>             | <i>1</i> | <i>2</i> | <i>3</i> | <i>4</i> | <i>5</i> | <i>6</i> | <i>7</i> | <i>8</i> | <i>9</i> | <i>10</i> | <i>11</i> |
|-----------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|
| 1 Tech innovation           | 1        |          |          |          |          |          |          |          |          |           |           |
| 2 Non-tech innovation       | 0.473    | 1        |          |          |          |          |          |          |          |           |           |
| 3 Internal capabilities     | 0.254    | 0.31     | 1        |          |          |          |          |          |          |           |           |
| 4 External capabilities     | 0.307    | 0.282    | 0.586    | 1        |          |          |          |          |          |           |           |
| 5 Firm size                 | -0.054   | -0.053   | -0.053   | -0.11    | 1        |          |          |          |          |           |           |
| 6 Firm age                  | 0.073    | 0.047    | 0.072    | 0.246    | -0.243   | 1        |          |          |          |           |           |
| 7 Product objective         | 0.173    | 0.134    | 0.344    | 0.34     | -0.059   | 0.013    | 1        |          |          |           |           |
| 8 Process objective         | 0.214    | 0.176    | 0.387    | 0.379    | -0.069   | 0.12     | 0.576    | 1        |          |           |           |
| 9 Marketing objective       | 0.14     | 0.088    | 0.315    | 0.367    | -0.054   | 0.046    | 0.54     | 0.615    | 1        |           |           |
| 10 Organisational objective | 0.083    | 0.129    | 0.346    | 0.344    | -0.116   | 0.067    | 0.453    | 0.418    | 0.502    | 1         |           |
| 11 Internationalisation     | 0.063    | 0.033    | -0.01    | 0.03     | -0.037   | -0.018   | -0.018   | -0.052   | -0.02    | -0.042    | 1         |

To check for the validity and reliability of the measurement factors, we conducted an exploratory factor analysis on the scale items. All factor loadings are well above the 0.5 level and the correlation matrix reveals that almost all coefficients are above about 0.3 level (Pallant, 2013). The Kaiser-Meyer-Olkin value exceeded the recommended value of 0.6 for all constructs and Bartlett's Test of Sphericity justified the factorability of the correlation matrix, reporting statistical significance. To provide the reliability analyses for each construct, we estimated Cronbach's alpha, and found that all values are greater than the 0.7 level (ibid). The analysis described above did not uncover any apparent issues of concern and we can conclude that all the constructs showed adequate reliability and convergent validity.

**Table 4** OLS results – standard errors in parentheses

|                               | <i>Dependent variable</i>            |                     |                     |                                          |                     |                     |
|-------------------------------|--------------------------------------|---------------------|---------------------|------------------------------------------|---------------------|---------------------|
|                               | <i>Technological innovation (T2)</i> |                     |                     | <i>Non-technological innovation (T2)</i> |                     |                     |
|                               | <i>1</i>                             | <i>2</i>            | <i>3</i>            | <i>4</i>                                 | <i>5</i>            | <i>6</i>            |
| Internal capability (T1)      | 0.112***<br>(0.022)                  |                     | 0.022<br>(0.025)    | 0.277***<br>(0.051)                      |                     | 0.242***<br>(0.058) |
| External capability (T1)      |                                      | 0.164***<br>(0.019) | 0.154***<br>(0.022) |                                          | 0.152***<br>(0.042) | 0.059<br>(0.047)    |
| Firm size (T1)                | −0.033<br>(0.061)                    | 0.004<br>(0.061)    | 0.004<br>(0.061)    | −0.013<br>(0.122)                        | −0.014<br>(0.124)   | −0.014<br>(0.122)   |
| Firm age (T1)                 | 0.029*<br>(0.016)                    | 0.019<br>(0.016)    | 0.020<br>(0.016)    | −0.036<br>(0.037)                        | −0.056<br>(0.038)   | −0.044<br>(0.037)   |
| Product objective (T1)        | −0.012<br>(0.016)                    | −0.013<br>(0.015)   | −0.014<br>(0.015)   | 0.006<br>(0.031)                         | 0.013<br>(0.032)    | 0.004<br>(0.031)    |
| Process objective (T1)        | 0.063***<br>(0.017)                  | 0.063***<br>(0.017) | 0.060***<br>(0.017) | 0.048<br>(0.036)                         | 0.070*<br>(0.037)   | 0.048<br>(0.036)    |
| Marketing objective (T1)      | 0.025<br>(0.017)                     | 0.004<br>(0.017)    | 0.004<br>(0.017)    | −0.066*<br>(0.038)                       | −0.079**<br>(0.038) | −0.071*<br>(0.038)  |
| Organisational objective (T1) | −0.015<br>(0.014)                    | −0.02<br>(0.014)    | −0.02<br>(0.014)    | 0.036<br>(0.032)                         | 0.045<br>(0.033)    | 0.031<br>(0.032)    |
| Internationalisation (T1)     | 0.101<br>(0.088)                     | 0.048<br>(0.087)    | 0.052<br>(0.087)    | 0.176<br>(0.158)                         | 0.146<br>(0.161)    | 0.160<br>(0.158)    |
| Incubator fixed effects       | Yes                                  | Yes                 | Yes                 | Yes                                      | Yes                 | Yes                 |
| R <sup>2</sup>                | 0.116                                | 0.138               | 0.139               | 0.179                                    | 0.153               | 0.182               |
| Adjusted R <sup>2</sup>       | 0.104                                | 0.126               | 0.126               | 0.137                                    | 0.110               | 0.138               |

Note: \* $p < 0.1$ ;  $p < 0.05$ ; \*\*\* $p < 0.01$ .

## **4 Results**

The main results of our analysis are depicted in the regression table (see Table 4). The results show that both internal and external project innovation capabilities have positive significant effects on technological and non-technological innovation outputs at the project-level. These results support H1 (a and b) and H2 (a and b). We find notable effects from both internal and external innovation capabilities on two types of innovation output (TEC and NTEC). However, when included simultaneously the pattern changes. We see a differing result between TEC and NTEC. The former is only impacted by external capabilities whereas the latter is impacted by internal capabilities. This finding is a bit puzzling and warrants further investigation in our discussion.

Moreover, the effect of external project innovation capabilities on both technological innovation outputs and non-technological innovation outputs is stronger. Particularly, the results demonstrate that there is a significant positive relationship between the internal project innovation capabilities and TEC (0.11) and between the external project innovation capabilities and TEC (0.28). This supports our hypotheses H1a and H1b. We find similar results on the relationship between the internal project innovation capabilities and TEC (0.16) and between the external project innovation capabilities and NTEC (0.15). All these results are positive and significant.

Looking at the explanatory power of the model, we see that the adjusted R-square is about 13% and 14%. This means that approximately 14% of the variance in TEC and NTEC respectively is explained by the variables in the model. This is mainly in line with previous research (Agyapong et al., 2016). Given the complexity of innovation, it is an acceptable indicator of how much can be explained within the discussion of capabilities for innovation (Molden and Clausen, 2020).

## **5 Discussion**

In this paper, we have elaborated on the relationship between project innovation capabilities and innovation at the project-level. We argue that firm-level capabilities inform project-level capabilities in a reciprocal way (Davies and Brady, 2016), as the latter draw on the former to function. Since innovation capabilities generally facilitate the development of innovation outputs at the firm-level (Breznik and Hisrich, 2014; Lawson and Samson, 2001; Strønen et al., 2017), we wanted to examine to what extent such capabilities at the project-level facilitate TEC and NTEC innovation output at the project-level. Based on theory (Lawson and Samson, 2001) and prior research (Molden and Clausen, 2020), we developed theoretical insights postulating that internal and external project innovation capabilities enable firms to create higher technological and non-technological innovation output at the project-level (Morris, 2013).

Our results lend support to the hypotheses derived in the theory (see Table 5). Internal project innovation capabilities and external project innovation capabilities impact both TEC and NTEC in line with our expectations. The coefficients for both types of project innovation capabilities are positive and significant. Recall that project innovation capabilities (both internal and external to the firm and the project) are related to firm innovation capabilities in that they are reciprocal and mutually dependent on each other (Davies and Brady, 2016; Molden and Clausen, 2020). This means that project-level innovation capabilities can act as a proxy for firm-level capabilities. Based on these

theoretical arguments, we use project innovation capabilities to capture the relationship between innovation capabilities and innovation outputs. Moreover, the project innovation capabilities are captured at T1 while outcome variables (TEC and NTEC) are measured at T2. Although not a solid causal claim, it suggests a certain causal relationship. Moreover, we added a range of controls at both firm- and project-level.

We interpret these findings in two distinct ways. First, project innovation capabilities matter for both TEC and NTEC. Our interpretation is twofold. The first is related to the link between firm-level and project-level capabilities. We find that project-level innovations are related to project-level capabilities. Given that firms organise their innovation activities as projects (Tranekjer and Søndergaard, 2013), we see a potential in that the projects draw on capabilities at the firm-level (Kostopoulos et al., 2019; Evald et al., 2021; Davies and Brady, 2016). Firm-level explanation such as project management (Morris, 2013), learning abilities (Brady and Davies, 2004), sensing and seizing new opportunities (Teece, 2007), and handling complex problems (Brady and Davies, 2014) plays into project capabilities (Davies and Brady, 2016). In other words, know-how and know-what in the firm play in identifying contingency factors induced by the different levels of analysis (West and Bogers, 2014; Davies and Brady, 2016).

Second, the relationship between project innovation capabilities and project innovation outputs is shown in our analysis. Experience with innovation at the firm-level firm plays into innovation projects when they set the standard for how projects are managed and conducted (Kostopoulos et al., 2019). Moreover, we see that both internal- and external project innovation capabilities matter for project innovation outputs in line with our expectations (Brunswick and Chesbrough, 2018). In addition to inheriting capabilities from the firm-level, innovation culture also plays a role (Santos-Vijande et al., 2021). These points support our empirical findings suggesting that firms can affect their project portfolio and increase the probability of success both in the culture and structure of the firm. This is supported by our data and analysis.

The final models we estimated yielded a different result. Here we see that where internal and external innovation capabilities are added to our model simultaneously, the effects are tied to the type of output (i.e., TEC and NTEC). External capabilities matter most for TEC controlled for our set of controls and internal capabilities. This suggests that alliances, collaboration, and work with external sources matter more for TEC than NTEC. Moreover, this is related to a broader set of findings on the impact of ‘science, technology, and innovation’ innovation mode (STI) on innovation (Alhusen et al., 2021). Our results lend themselves to previous research on STI and make theoretical sense about the difference between external resources in the TEC innovation process, as well as being mostly relevant to TEC compared to NTEC. This makes sense given that TEC, due to its technological nature, more often requires access to a certain hands-on skill within the type of technology attempted to produce. In other words, collaborations with actors without the firm is more likely to yield TEC innovation (open innovation (Chesbrough, 2003; West and Bogers, 2014). On the other hand, the opposite rings true with NTEC. We see, from our analysis, that internal capabilities have a significant impact on NTEC while external capabilities do not. NTEC is typically the creation of new sales channels and new methods for organising responsibilities and decisions within the company. This is partly analogous to a second type of innovation mode; ‘doing, using, and interacting’ (DUI) (Apanasovich, 2016). Through internal processes of DUI are more conducive to creating NTEC and are thus in line with our findings.

**Table 5** Hypotheses tested

| <i>Hypothesis</i>                                                                    | <i>Finding</i> |
|--------------------------------------------------------------------------------------|----------------|
| H1a: internal project innovation capabilities → technological innovation outputs     | Supported      |
| H1b: external project innovation capabilities → technological innovation outputs     | Supported      |
| H2a: internal project innovation capabilities → non-technological innovation outputs | Supported      |
| H2b: external project innovation capabilities → non-technological innovation outputs | Supported      |

The theoretical reasoning and empirical results in our paper has extended extant research on innovation capability to the project-level. This is an important extension since innovation pans out at the project-level (Hoegl et al., 2008; Vos and Achterkamp, 2006).

Further, there is a time lag between innovation capabilities and actual innovation output in our analysis. This time lag was introduced to respond to the concern in the literature that extant research has confounded the capacity to innovate with actual innovation (Kahn, 2018). Importantly, we still find that project innovation capabilities enable the creation of innovation output (Lawson and Samson, 2001). This reinforces the theoretical notion that an organisation's innovation capability is a source of innovation in itself: through sensing, seizing, and reconfiguration (Teece, 2007), organisations enable innovation at the project-level that organisations with lesser developed innovation capabilities would not be able to accomplish.

Our results are in line with an organisation-centric view of innovation (Clausen et al., 2020) which highlights the agency and capabilities of the organisations, where firms actively (re) combine ideas, and internal and external resources into innovation. Importantly, our research extends this perspective to the project-level. Our empirical results reinforce the importance of such an extension: we find that project innovation capabilities have a stronger influence on the creation of innovation input than initial project goals. Thus, while goals are an important starting point in the innovation journey, it is organisations with the capacity to act on project goals and to search internally and externally for resources, that create higher innovation output from investment in innovation projects. A key theoretical implication of the research in this paper is that innovation capabilities enable organisations to manage the uncertainties and complexities of the innovation journey as it manifests at the project-level. This is another testimony to the importance of innovation capabilities for organisations searching for innovation. Overall, the obtained results suggest that project innovation capability is a key factor when managing the process of innovation as it manifests at the project-level. This shows that project innovation capabilities enable firms to pursue a dynamic search for innovation at the project-level, which pays-off in terms of higher innovation output.

## 6 Conclusions

Innovation management research shows that project innovation capabilities enable innovation at the firm-level (Iddris, 2016). In this paper, we have extended this line of research by developing the theoretical argument that firms' innovation capabilities are also more likely to create innovation at the project-level. This theoretical argument was developed into a set of hypotheses stating a positive relationship between internal and

external project innovation capabilities and innovation outputs at the project-level. We tested these hypotheses using a survey of innovation projects from Norway and regression analysis. Our results show that internal and external project innovation capabilities have a positive influence on technological and non-technological innovation at the project-level.

Our findings have several implications for managers. First, managers should pay attention to the link between firm- and project-level capabilities. By investing in the former they would benefit from better capabilities at the latter. Second, firms should distinguish explicitly between TEC and NTEC where different forms of project-level capabilities. As our result suggests, the relative impact of internal and external varies depending on which output the project aims towards (e.g., TEC or NTEC).

Our research also has implications for innovation policy. First, innovation policy should recognise that different capabilities are conducive to different outputs (i.e., TEC and NTEC). In other words, policy instruments, such as tax credits, loans, or grants, are dependent on whether the intended output is a TEC or NTEC. Second, policy instruments should focus on the project-level capability in addition to the firm-level. By doing so policy can enhance efficiency and help firms become more aware of how innovation is conducted within the firm.

Implications for theory is three-fold. First, future research should aim to dig deeper into the mechanisms through which project-level capabilities reflect capabilities at the firm-level, and vice versa. By doing so we could get a much-needed understanding of how this process works and what the boundary conditions are. Second, studies using longer time series as well meaning that focal concepts in this paper is measured at more than two points in time. Through more frequent time series, it is easier to bring causal claims. Finally, future research should develop more nuanced measures of focal constructs such as TEC and NTEC, as well as capabilities at both the firm- and project-level. By introducing more comprehensive measures, it is possible to draw better and more solid conclusions.

This study has some limitations that might constitute opportunities for future research. First, the study is limited due to the data from Norway that we obtained from a public organisation (Innovation Norway). Thus, we did not have the opportunity to develop empirical measures of the theoretical concepts of interest but had to rely on items in the database. This is a general weakness of the use of secondary data. However, on the positive side, we would not have been able to collect such abundant data at the project-level ourselves. Second, we have relied on a subjective measurement of the key concepts of interest, relying on respondents' own subjective assessment of innovation and innovation capabilities. However, we have taken many steps to examine and mitigate potential bias from our subjective measurement approach, such as utilising a large sample, we have measured key concepts as latent variables and common method bias has been examined (Jordan and Troth, 2020), and we have used repeated cross-section in the hypothesis testing. These steps should reduce and mitigate bias stemming from subjective measurement. Finally, while the survey was conducted at two points in time, additional time points would be preferable, opening avenues for future research on project innovation capabilities.

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## Notes

- 1 Innovation Norway is a Norwegian organization that aims to contribute to the development of Norwegian businesses by means of capital and expertise [online] <https://www.innovasjon Norge.no/en/start-page/>.