Time and time-based organizing of innovation : influence of temporality on entrepreneurial firms' performance

Temporality in organizing innovation: Influence on entrepreneurial firms' performance

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Abstract

Time is a crucial yet scarce resource in innovation management. However, the way in which entrepreneurial enterprises (SMEs) allocate temporal resources in innovation remains largely unexplored. We propose a conceptualization of innovation polychronicity, which is defined as the extent to which a firm's innovation culture promotes simultaneous engagement in multiple innovation activities. Based on this conceptualization, we propose that either low or high levels of innovation polychronicity lead to better firm performance. Analysis of data gathered from a survey of 127 SMEs and archival sources provides support for the proposed U-shaped relationship. We further find that innovation synchronization moderates this relationship. The findings contribute to the broader literature on innovation and temporality in organizations.

Keywords: Innovation, polychronicity, synchronicity, performance, SMEs, Attention-based view

1. Introduction

In a context of growing hypercompetition (D'aveni, 1994) and increasingly fast industry clockspeeds (Carrillo, 2005; Nadkarni & Narayanan, 2007), the way in which a firm distributes and synchronizes its innovation resources on a temporal scale is important (Hassard, 1991; Hellström & Hellström, 2002; Stalk & Hout, 1990). Studies of temporal activities in innovation have focused on innovation speed, acceleration, or rhythm (e.g., Brown & Eisenhardt, 1997; Eisenhardt & Martin, 2000; Kessler & Chakrabarti, 1996). Central to these studies is the concept of recombinations of tangible and intangible resources.

Despite being considered important in the literature, the allocation of time as a resource to innovation activities has received limited attention. Although conceptualizations of the innovation process have focused on the type of innovation activity, there remains an imperfect understanding of how activities are sequenced and spaced (Langley, Smallman, Tsoukas, & Van de Ven, 2013; Wang & Dass, 2017). Temporal conditions for organizing innovation activities are seldom discussed, but they are increasingly salient. Despite significant multilevel efforts to understand the drivers of innovation success in firms, only a partial understanding of the temporal organization of innovation efforts has prevailed. Elsewhere, management scholars have called for a sharper focus on understanding temporality in organizational relationships, employee interactions, and performance (Langley et al., 2013; Mohammed & Nadkarni, 2014; Shujahat et al., 2019). Interpretations of time, the allocation of temporal resources, and the combination of temporal resources allow employees, teams, organizations, and alliances to boost returns from innovation efforts. In addition to the tangible and intangible resources invested in innovation activities, the management of temporal resources is essential to improving competitive advantage.

The issue of time is particularly important to entrepreneurial firms and small and medium-sized enterprises (SMEs), which are resource-scarce firms (Rosenbusch, Brinckmann, & Bausch, 2011), yet entrepreneurship and innovation studies have paid scant attention to how managing the temporal allocation of resources to innovation activities affects performance. Although the topic of time has been covered in related literature such as topics concerning speed to market and innovation speed (Griffin, Langerak & Eling, 2019), in this study, polychronicity covers the timing and the pattern of distribution of innovation resources and, thus, stands as an independent topic. In fact, only two studies have sought to link polychronicity with performance in samples of small firms (Bluedorn, 2002; Onken, 1999). Both failed to reveal consistent relationships, which implies that a clear picture of the way in which an organization distributes its innovation resources on a temporal scale is still lacking. Based on the unclear results of previous studies, we ask whether temporal resources should be allocated by pursuing multiple innovation projects simultaneously or by pursuing a selected few.

This study focuses on the temporal aspect of SME innovation by examining how innovation polychronicity influences financial performance. We extend polychronicity at the group (Hall, 1959) and organization levels (Slocombe & Bluedorn, 1999) to firm innovation culture and ask how SMEs should organize their innovation activities on a temporal scale in order to maximize performance. This paper explores in greater detail whether SMEs should allocate their temporal resources by pursuing multiple innovation projects simultaneously (i.e., high innovation polychronicity) or by pursuing a selected few (i.e., low innovation polychronicity, also known as monochronicity). Based on the attention-based view of real-options reasoning (Ocasio, 1997) and the idea that polychronicity is a managerial attention structure (Souitaris & Maestro, 2010), we propose that a low level of innovation polychronicity

helps maintain the focus on a few select innovation activities because it forces task prioritization and sequential innovation execution (Souitaris & Maestro, 2010). Furthermore, this study posits that a high innovation polychronicity enables the simultaneous pursuit of various innovation opportunities and, thus, increases the loci of organizational responses (cf. Bluedorn, Kalliath, Strube, & Martin, 1999; Judge & Speitzfaden, 1995). A moderate level of polychronicity implies that, rather than having a combination of some advantages of both attention types, firm innovation culture may lack distinctive properties – homogeneity from low innovation polychronicity and heterogeneity from high innovation polychronicity – that aid firm performance. The proposed framework suggests that SMEs must choose whether to cultivate high or low levels of innovation polychronicity culture to facilitate performance outcomes, implying a U-shaped relationship.

This study also explores the possible moderating role of innovation synchronization. Given that a firm manages its tangible and intangible resources with a low or high level of innovation polychronicity, innovation synchronization enables sharper focus at low levels of innovation polychronicity and greater coordination at low levels of innovation polychronicity. Innovation activities are uncertain and, despite the use of goals and schedules (Camisón-Haba et al., 2019; Perlow, 1998; Xie et al., 2018) as the means to achieve temporal control, multi-level coordination and cross-level coordination in innovation invariably cause different departments to meet innovation timeframes at different paces (Kahn, 1996; 2001). Synchronization enables better coordination when seeking to achieve innovation goals at different paces. We, therefore, propose that the hypothesized U-shaped pattern is moderated by innovation synchronization.

The results of our empirical analysis support our theoretical claims, showing that innovation polychronicity has a U-shaped relationship with firm performance and that this U-

shaped relationship is moderated by innovation synchronicity. By demonstrating that the level of innovation polychronicity, together with innovation synchronicity, is a key factor influencing firm performance in SMEs, this study makes two contributions to the literature. First, over the past few decades, research has increasingly called for time to be incorporated into organizational research (Zimbardo & Boyd, 2015). We extend the polychronicity literature from the group or top management team (TMT) level (e.g., Bluedorn et al., 1999; Hall, 1959; Souitaris & Maestro, 2010) to firms' innovation culture. It is, therefore, demonstrated that the level of polychronicity matters for firm performance. Temporal dynamics are very much at the heart of resource-constrained SMEs. However, as noted by Souitaris and Maestro (2010, p. 669) "…scholars still know very little about how time or temporal constructs impact actors in new ventures." Our study is one of the first to examine the temporal aspects of innovation activities in the SME context.

Second, the proposed moderator, innovation synchronicity, provides additional insights into the management of temporal resources within a firm. The organizational psychology literature has increasingly focused on the influences of individual temporal personality on individual performance (Zimbardo & Boyd, 2015) or the constellation of temporal personality in team-on-team performance. In the team literature, however, synchronization has been reported as smoothing a team's organizational functioning through better coordination and control (Mohammed & Harrison, 2013; Puffer, 1989). Nevertheless, temporal misfits are bound to occur as an organization attempts to manage competing innovation priorities and allocate resources (cf. Pérez-Nordtvedt, Payne, Short, & Kedia, 2008). Flexible pacing is necessary in order to enable an in-sync preference to improve temporal alignment toward innovation. We extend this

narrative to the organization level in the context of innovation and find that these temporal factors influence inter-temporal resource allocation dynamics in innovation.

The remainder of the paper proceeds as follows: Section 2 provides an overview of the literature on time in innovation research, as well as the concept of innovation polychronicity, concurrently formulating the two research hypotheses. Section 3 then introduces the research setting, the sample used in the study, and the methodology used to test the hypotheses. Section 4 presents the regression results. Section 5 discusses the study's theoretical contributions and concludes by citing limitations and offering suggestions for future research.

2. Theoretical background and hypotheses

2.1. The notion of time in innovation research

Time and time-based competition have reached all aspects of organizational research (for a review, see Ancona, Okhuysen, & Perlow, 2001). In innovation research, time is an important backdrop against which innovation is conducted. Innovation operates under temporal uncertainty (when the innovation will come to fruition so that it can be strategically responsive), temporal ambiguity (the type, sequencing, and speed of innovation activities), and conflicting temporal demands on organizational resources (cf. O'Connor & McDermott, 2004). The temporal demands not only shape how innovation activities are scheduled, synchronized, and allocated at multiple levels of the firm but also influence how organizations perceive, use, and experience time in innovation activities (Berends & Antonacopoulou, 2014). For example, Kaplan and Orlikowski (2013) found that more radical innovations in organizations require intensive temporal work, referring to the redefining and reconnecting of an organization's past, present, and future.

Based on Ancona et al. (2001), time is defined as "a non-spatial continuum in which events occur in apparently irreversible succession from the past through the present to the future" (Ancona et al., 2001, p. 513). In the context of innovation, time could be construed as a series of non-spatial events of novel resource recombinations that occur within organizations (Eisenhardt & Martin, 2000). Depending on whether organizational innovation actions are attuned to industry clockspeeds or to internal initiatives of innovation pacing, the nature of time in innovation could be *cyclical* or *linear* (e.g., Brown & Eisenhardt, 1997; Eisenhardt & Martin, 2000; Kessler & Chakrabarti, 1996). In the context of linear time, the mapping of innovation activities refers to the sequencing, speed and duration of innovation activities (Cooper, 2008). At the simplest level, the mapping of innovation activities ranges from early-stage screening, through planning and product design, to prototyping. In the context of cyclical time, the elements of mapping include the synchronization, rhythm, and cyclicality of innovation routines. Synchronization of multiple innovation activities enables entrainment (adjusting the pace of activities, rhythm, and cycles in innovation activities) and temporal symmetry (agreement among actors on the temporal arrangement of innovation activities).

Time can also be conceptualized as *quantitative time* that, in the context of innovation, relates to the pace of innovation, or *socially constructed* time, which refers to the meanings and use of time for innovation activities (Orlikowski & Yates, 2002). A subjective interpretation of time affects how innovation activities, schedules, and interactions are designed, paced, and sequenced. In turn, the flow and cycle of temporal resources affect the efficacy of innovation activities (Roberts & Grover, 2012). In addition to the conceptualization and mapping of time, the way in which organizational employees perceive time and its passing influences temporal orientation, horizon, and style in approaching innovation activities (Alshanty & Emeagwali,

2019; Berends & Antonacopoulou, 2014; Johansson et al., 2019; Mohammed & Nadkarni, 2014). Similarly, perceptions of time affect temporal pacing in an organization, the way a firm responds to deadlines for innovation, and innovation success (Lenka et al., 2018). For example, recent results show that, at the team level, a team's shared temporal cognitions improve its performance (Abrantes, Passos, e Cunha, & Santos, 2018; Gevers, Li, Rutte, & van Eerde, 2019).

Based on the above discussion, the temporal conceptualization of innovation activities (related to the conceptualization of innovation activities over a temporal scale), the mapping of such activities on a temporal scale, and the interpretations of time by organizational actors are fundamental to polychronicity in the innovation process.

2.2. Innovation polychronicity

The nature of innovation polychronicity is rooted in the organization of innovation on a time scale. At the individual level, polychronicity is the degree to which individuals prefer to be engaged in two or more tasks simultaneously and believe that this approach is the best way to accomplish tasks (Bluedorn, 2002). Extending this definition to innovation efforts in a firm, polychronicity is the degree to which the innovation demands of an organization focus on multiple innovation activities. It is exemplified in innovation efforts such as the following: "intermittent pattern – resume A from a previous time, stop A and begin B, stop B and begin A, stop A and begin C, stop C and return to A" (Bluedorn, Kaufman, & Lane, 1992, p. 17). Studies have focused on polychronicity at the organizational level and have construed organizational polychronicity as an integral part of organizational culture and identity (Bluedorn et al., 1992). Organizational polychronicity, proposed by Slocombe and Bluedorn (1999), is related to organizational demands for multitasking, and it refers to a culture of simultaneous multitasking.

Polychronicity is an important temporal element of organizational culture given the increasing need to respond to a changing environment quickly to create advantages and erode the advantages of rivals. A changing environment requires increased polychronicity because the organization must process multidimensional information, consider varied resources, and make effective decisions in high-speed environments (Carrillo, 2005). When top managers consider multiple alternatives simultaneously, performance improves (Eisenhardt, 1989). Innovation polychronicity enables the simultaneous pursuit of resource and knowledge recombinations through multilevel coordination among employees and functions.

Innovation polychronicity refers to a multiplicity of innovation activities simultaneously undertaken by a firm at multiple levels. Polychronicity is particularly well suited to the temporal organization of innovation efforts that require complex problem solving and creativity (cf. Nickerson & Zenger, 2004). According to Onken (1999, p. 231), "Polychronicity is one of the temporal elements of an organization's culture" where "members value organizing activities by scheduling two or more events at one time." Extending the polychronic cultural framework from the national level to the organizational level (Schein, 2010, p. 232), in a polychronic culture, "individuals interact with several people at once and are continually involved with each other," the "flow of information is continuous", the "center of the organization is constantly communicating with many people simultaneously and is handling many projects simultaneously", and organizations are adept at handling "unstable conditions." These characteristics together form the requisite critical mass for innovation polychronicity. Innovation polychronicity involves the broader organizational culture in relation to time-use patterns for innovation-related task engagement. These patterns range from monochronic to polychronic. Innovation polychronicity provides the attention structure for focusing on multiple innovation

requirements. It enhances the ability to switch between tasks, manage interruptions, seek information, transform and commercialize knowledge, develop resource combinations, and facilitate a systemic response-innovation approach that provides simultaneous attention to innovation needs and makes possible the interpretation of innovation activities in a broader strategic context.

The notion of innovation polychronicity originated with Ofori-Dankwa and Julian (2001), who argued that firms must manage future-to-present time orientation related to exploration, present-to-future time orientation related to exploitation, past-to-present time orientation related to regeneration, and present-to-past time orientation to maintain organizational continuity. They cite "interactive and catalytic effects of different polychronic activities" (Ofori-Dankwa & Julian, 2001, p. 426) that are central to pursuing multi-dimensional innovation goals of exploration, exploitation, the renewal of innovation capabilities, and the maintenance of continuity. Innovation polychronicity is necessary for systemic problem solving to address competing demands in an increasingly hypercompetitive environment (Baer, Dirks, & Nickerson, 2013; Ferraris, Giachino, Ciampi & Couturier, 2019). Innovation polychronicity could be related to the multiplicity of innovation projects in terms of six dimensions. These are duration (time spent on multiple innovation activities), temporal location (distribution of multiple innovation activities on a time scale), sequence (the order in which multiple innovation tasks are conducted), the distribution of deadlines (for multiple innovation actions), cyclicality (of multiple innovation projects), and rhythm (the alternation of the intensity of innovation activities across multiple innovation activities) (cf. Lee, 1999).

2.3. The U-shaped relationship between innovation polychronicity and firm performance

We posit that polychronicity in innovation processes has a U-shaped relationship with firm performance. Low levels of innovation polychronicity could be beneficial for firms. An organization may prefer to focus on a single innovation activity and be monochronic in its innovation efforts. Firms with a monochronic approach to innovation activities tend to shield themselves from distractions in the environment, and they may have a single-minded approach to innovation with narrower information-processing and knowledge-combination schema. Relying on a singular innovation plan, firms can hone their innovation efforts by systematically conceptualizing and mapping innovation activities. This approach also allows the firm to create common interpretation frameworks across employees to allocate resources and tasks with a singular innovation personality throughout the firm. The temporal focus that results from lower innovation polychronicity reduces cognitive load in the organization, eases pressure to achieve multiple goals simultaneously, and allows for a clearer innovation vision. Lower innovation polychronicity could lead to fewer interruptions and improve performance (Perlow, Okhuysen & Repenning, 2002) through the timelier completion of tasks, fewer errors, a greater ability to think creatively, and better decision making (Appelbaum, Marchionni, & Fernandez, 2008). By adhering to fewer simultaneous innovation tasks, an organization can concentrate its resources and potentially increase its innovation speed due to a preference for task closure (Benabou, 1999; Bluedorn et al., 1992). Consequently, lower innovation polychronicity should improve performance.

However, moderate levels of polychronicity should lower firm performance. Studies in social psychology have shown that moderate levels of polychronicity are detrimental because significant cognitive conflict may arise in terms of the interpretation, allocation, timing, duration, and completion of activities (Benabou, 1999; Bluedorn et al., 1992; Mohammed and Nadkarni,

2014; Waller, Giambatista, & Zellmer-Bruhn, 1999). A moderate level of polychronicity in innovation requires competing innovation priorities that are mapped through both polychronic and monochronic lenses, resulting in competing innovation activities and efforts. The entrainment and temporal symmetry may be even more challenging because both monochronic and polychronic innovation activities must be managed in parallel in an organization, and the allocation of scarce resources to two competing temporal preferences could create an increasingly large burden on innovation efforts. Moderate innovation polychronicity leads to competing temporal perceptions among employees, resulting in poorer coordination, timing, and execution of innovation activities. Competing levels of low and high polychronicity could lead to conflicts in temporal perceptions and misalignment of innovation resources, and could create unwanted time pressures to innovate across organizations. A moderate level of innovation polychronicity increases coordination complexity because it is difficult to give undivided attention to an innovation activity or to synchronize multiple innovation activities (Benabou, 1999; Bluedorn et al., 1992). Lacking homogeneity from lower innovation polychronicity or greater heterogeneity from higher innovation polychronicity, moderate polychronicity should significantly lower performance.

In contrast, high levels of polychronicity should increase performance by allowing firms to engage in multiple innovation efforts simultaneously. The polychronic innovation approach allows an organization to pursue multiple innovation possibilities to improve its long-term strategic position. Because a significant number of innovations fail, a polychronic firm with shared temporal perceptions of pursuing multiple innovation activities has well-aligned temporal entrainment and temporal symmetry across the organization to allow for the pursuit of multiple innovation tasks. For example, Judge and Speitzfaden (1995) found that managers with varying

time horizons in their investment portfolio had better financial performance. Greater polychronicity is associated with improved idea creation and problem solving, and it leads to the consideration of multiple alternatives in decision making (Nutt, 2002). It also enables improved cognitive capacity and information-processing routines because the organization simultaneously uses multiple knowledge frameworks to complete complex innovation tasks (Wickens, 2002). Polychronicity in innovation allows firms to switch between alternate and competing innovation frameworks to recombine knowledge by considering diverse innovation possibilities (Halbesleben, Novicevic, Harvey & Buckley, 2003) and improve problem solving (Wickens, Sandry & Vidulich, 1983). Research suggests that interruptions resulting from polychronicity could increase efforts in knowledge transfer and acquisition (Zellmer-Bruhn, 2003). Context changes from multitasking to polychronicity facilitate task switching. Despite the disruptive effects of context change, it yields knowledge and learning benefits (Mark, Voida, & Cardello, 2012). Based on the above discussion, we propose the following:

Hypothesis 1. Polychronicity has a U-shaped relationship with firm performance: Firm performance decreases with polychronicity until an inflection point is reached and then increases with polychronicity.

2.4. The moderating role of innovation synchronicity

Synchronization increases coordination. At low or high polychronicity levels, synchronicity – or as Montoya-Weiss, Massey, and Song (2001, p. 1252) describe it "aligning the pace of effort" – in innovation activity enables improved management of the mapping of temporal activities and shared perceptions of innovation priorities on a temporal scale. Innovation synchronicity, which is rooted in the notion of temporal coordination, enables the

flow of knowledge and feedback sharing to reduce information overload and lower conflict (cf. Prahalad & Krishnan, 2002).

At low levels of polychronicity, innovation synchronization can help further build focus and improve innovation. Synchronization strengthens the self-regulation mechanism when the focus is on fewer innovation activities. Based on action regulation theory, goal-directed behaviors, which are increasingly possible under lower polychronicity, are strengthened by regulatory processes facilitated by synchronicity (Lee, Farhoomand, & Ho, 2004; Wadhawa & Rao, 2003). Synchronicity allows for a better orientation toward and formulation of plans to improve the execution and valuation of activities, and it improves information processing (Petruzzelli, Ardito & Savino, 2018). At low polychronicity, because there is a greater focus on a set of innovation activities, synchronization allows for improved communication, better information processing, and improved interpretation and coordination of innovation activities (Hinds & Bailey, 2003).

At moderate levels of polychronicity, the efficacy of synchronization may be lower because the organization could oscillate between low and high preferences for polychronicity in innovation activities, and the synchronization of mapped innovation activities or a common understanding of time may not increase the efficacy resulting from synchronization.

High levels of polychronicity induce competing mapping activities and divergent employee perceptions of time. Synchronicity is particularly salient because polychronicity increases asynchronicity in the expectations and management of urgent and less urgent innovation priorities when multiple innovation priorities are pursued under polychronicity. Because multiple innovation activities cut across functions under increasing polychronicity, synchronization is increasingly important in improving the negotiation of the sequencing,

synchronization, and entrainment of innovation resources and activities. Innovation polychronicity requires the orchestration of resources at different paces, so reduced consensus, coordination problems, and conflict could lower performance. The synchronicity of innovation activities allows for stronger consensus by facilitating communication and coordination to improve agreement regarding the mapping of innovation activities. Lower synchronicity could lower cognitive conflict and improve information processing. Synchronicity increases the ability to manage competing relationships across individuals and functions under innovation polychronicity.

Hypothesis 2: Innovation synchronicity moderates the U-shaped relationship between polychronicity and firm performance: At high (low) levels of innovation synchronicity, both low and high levels of polychronicity could lead to higher (lower) performance.

3. Method

3.1. Sample

To test the proposed hypotheses, we used data collected from a postal survey of manufacturing firms in Sweden and archival financial data on those same firms. The Swedish context was suitable for two reasons. First, as a small economy, innovation is highly central to most firms in Sweden. According to the European Innovation Scoreboard (European Union, 2015) and the Global Innovation Index (Global Innovation Index, 2015), Sweden is a leader in innovation and technology, and innovation routines are salient to Swedish firms at all levels of the economy. Second, the Swedish government requires all firms, irrespective of size and age, to disclose financial information. This information, certified by a chartered accountant, is highly reliable and mitigates problems with common method bias. We used a sample of SMEs for two

reasons. First, temporal dynamics are important for SMEs because of resource constraints. Second, CEOs in such firms are intimately familiar with innovation architectures. For research on innovation polychronicity, which is commonly executed at the individual or team level, such informed respondents are required (Greer, Carr, & Hipp, 2016).

A random sample of 952 manufacturing firms with fewer than 250 employees was drawn from *InfoTorg*, a Swedish company database. This constituted our sampling frame. This frame was later adjusted to 943 because some firms had ceased operations, some had gone bankrupt, and some had hired staff and had more than 250 employees. The questionnaire and a cover letter were mailed to the CEO or R&D manager in the fall of 2015. After the initial mailing, two waves of reminder letters, and additional phone calls, 144 completed questionnaires were returned. Nine firms declined to participate or failed to provide complete information. Two firms did not belong to the manufacturing industry. We therefore received 133 useable responses (14.1 percent response rate). According to the dimensions of age and assets, there were no significant differences between respondents and non-respondents. After matching the questionnaire data with financial information, six additional companies were excluded because they were micro (< 10 employees) or large enterprises (> 250 employees). The final sample thus comprised 127 firms.

3.2. Measures

Appendix 1 lists the scale items.

Firm profit performance is an important output measure for innovation activities in SMEs (Laforet, 2013). Based on the archived financial statements obtained from the Orbis database, profit performance was measured as the mean profit margin from 2012 to 2015 to match the

questionnaire that was distributed to test the hypotheses. Profit margin is a relevant outcome variable in our study, since it covers the value of the products offered by firms. It is also considered an acceptable measure in innovation studies (Bloch & Metcalfe, 2017; Laforet, 2013).

The innovation polychronicity scale was adapted from Bluedorn et al. (1999) and Bluedorn et al. (1992). We used the five-item version of the scale, of which two items were reverse-scored. All items were rated on a 5-point Likert scale (1 = "strongly disagree" and 5 = "strongly agree"), with a Cronbach's alpha of .78.

The *innovation synchronization* scale was adapted from previous studies (Mohammed & Nadkarni, 2011; Montoya-Weiss et al., 2001). All four items were rated on a 5-point Likert scale (1 = "strongly disagree" and 5 = "strongly agree"). Cronbach's alpha was .74.

The *control variables* controlled for alternative explanations of our results. Previous research suggests that organizational slack – readily available but unused resources – can provide resources for innovation (Bourgeois, 1981). We controlled for organizational slack using the firm's current ratio (Bourgeois, 1981). To control for available resources, we also included financial solidity (equity/asset ratio) for 2014. To control for unique proprietary assets that indicate a firm's technological capabilities, we controlled for the number of patents held by each firm (Lee et al., 2004). To control for structural differentiation, we included a dichotomous variable coded as 1 if the firm had branches and 0 if not (Hakala, Sirén, & Wincent, 2016). Because firm size proffers significant innovation advantages (Acs & Audretsch, 1987), we included firm assets for 2015. These variables were obtained from the Orbis database. At the individual level, we control for the CEO's age and gender (0 = male; 1 = female) because these

factors may affect the strategic direction of a firm. These two variables were collected in the survey.

3.3. Analytical approach

We tested the hypotheses with hierarchical regression analysis using Stata 15 software. Regression analysis is the best suited method to explore non-linear relationships and interaction effects that include non-linear baselines (Aiken & West, 1991). Before conducting the regression analysis, we mean-centered all study and control variables, including the interaction terms (Aiken & West, 1991). To check for the presence of multicollinearity, we calculated the variance inflation factors (VIFs) for each regression model. All VIFs were lower than the acceptable limit of 5 (O'Brien, 2007). The highest mean VIF was 1.23. These values suggest that multicollinearity did not influence the model results. Because of the small sample, instead of introducing industry dummies, we clustered the standard errors by industry SIC codes. This approach enabled us to control for the possibility of different error variances for different sub-industries within the manufacturing sector (see Dunkelberg, Moore, Scott, and Stull, 2013 for a detailed discussion).

4. Results

Table 1 presents descriptive statistics and correlations among variables.

---Table 1 about here---

---Table 2 about here---

Table 2 presents four regression models, of which Model 3 and Model 4 test our hypotheses. As a baseline model, Model 1 contained only the control variables. Model 2

included the controls and the linear effect of innovation polychronicity, which was not significant ($\beta = .03$, p = n.s.). Model 3 evaluated Hypothesis 1, which proposed a U-shaped relationship between innovation polychronicity and firm performance. Results from Model 3 confirmed that the relationship was U-shaped ($\beta = 1.08$, $p < .05$). This model explained 16 percent of the variance in firm performance and improved significantly on Model 2 ($\Delta R2 = .01$, $F = 4.06$, d.f. = 1, 60, $p < .05$). The plotted relationship in Figure 1 lends further support to Hypothesis 1. Firm performance first decreased with innovation polychronicity and then increased after the level of innovation polychronicity exceeded .03, revealing a U-shaped relationship between innovation polychronicity and firm performance. The mean-centered inflection point of .03 means that, when innovation polychronicity exceeded the mean level, any further increase was positively related to firm performance.

Model 4 evaluated Hypothesis 2, which proposed that innovation synchronization would exercise a moderating effect on the relationship between innovation polychronicity and firm performance such that, at both high and low levels of polychronicity, performance should be higher for higher levels of innovation synchronization. Results from Model 4 confirmed that innovation synchronization moderated the U-shaped relationship ($\beta = 1.40$, $p < .05$). This model explained 19 percent of the variance in firm performance and improved significantly on Model 3 ($\Delta R2 = .03$, $F = 4.33$, d.f. = 3, 60, $p < .01$). However, contrary to expectations, the plotted relationship in Figure 2 shows that firm performance was higher only when innovation synchronization was high and polychronicity was low. We discuss these findings in greater detail in the discussion section.

---Figure 1 and 2 about here---

5. Discussion and conclusion

5.1. Implications

Although much research has highlighted the value of resource recombination and orchestration, time is increasingly considered an important resource in organizational research (Berends & Antonacopoulou, 2014). We have extended previous research (Mohammed & Nadkarni, 2011; 2014) by measuring temporal behaviors in innovation activities. Our results suggest that the effects of polychronicity form a U-shape, which shows that SMEs must commit to low or high – but not moderate – levels of polychronicity to boost performance. Higher levels of synchronization allow for improved coordination and buffers to manage innovation activities, which moderates the U-shaped relationship.

According to the proposed framework, it is advisable for firms to adopt either low or high innovation polychronicity. In addition to polychronicity, we show that synchronicity is essential to coordinate the mapping of innovation activities and to accommodate and facilitate social constructions of time that vary across levels and employees so that organizational members can jointly define, create, and act upon shared innovation activities. This finding provides support for Gherardi and Strati (1988), who argued organizational time comprises a plurality of times, and synchronization allows for better management of such pluralities in uncertain, ambiguous innovation processes.

Our theory and results target the organizational level, which is different to what has mostly been discussed and elaborated on in previous research. Psychology and organizational behavior studies have focused on the temporal characteristics of individuals based on their "time urgency (feeling chronically hurried), time perspective (cognitive bias toward being past, present, or future oriented), polychronicity (preference to engage in more than one task

concurrently), and pacing style (pattern of effort distribution over time in working toward deadlines)" (Mohammed & Harrison, 2013, p. 244). Although individual differences in these temporal preferences could lead to variations in patterns of interactions (Mohammed & Nadkarni, 2014), organizational manifestations of these temporal characteristics are increasingly important to gain a temporal advantage over the competition. This is feasible when temporal behaviors that crisscross and coalesce across a firm merge into the organization's temporal architecture for innovation. Extending the growing work on temporal diversity from the team to the organizational level, we assessed the temporal dynamics of innovation in an organization by studying entrepreneurial firms.

The findings also have implications for the seminal research by Lawrence and Lorsch (1967) and the contingency literature in innovation (Damanpour, 1996), which shows that time orientation influences the level of differentiation and integration. The influence of synchronization allows organizations to entrain innovation efforts that provide a temporal fit between internal capabilities and external competitive needs. The proposed temporal architecture for innovation helps manage change (Staudenmayer, Tyre, & Perlow, 2002), improves innovation dynamics, and potentially signals a firm's well-tuned innovation dynamics to external collaborators. Overall, the framework explains how organizations regulate and tune the attention to improve the temporal alignment of resources.

5.2. Limitations and future research

The findings of this study must be interpreted in light of its limitations. First, we used CEO responses regarding the temporal architecture of innovation in firms. Although the sample concentrated on SMEs, and CEOs in such firms are expected to know the innovation dynamics

(Ali, Ali, Leal-Rodríguez & Albort-Morant, 2019; Balkin, Markman, & Gomez-Mejia, 2000; Danneels, 2002) and take an active role in innovation strategies, we call on future research to further explore the diverse knowledge, tasks, structures, and processes involved in the innovation process. This would constitute an important future direction in understanding the micro-dynamics of the temporal architecture for innovation. Second, although we controlled for industry effects and a range of firm performance characteristics that proxy resources and capabilities, the nature of micro- and meso-level flows of knowledge, activities, and temporal perceptions remain unexplored. We call on future studies to investigate the micro-dynamics of temporal innovation efforts using qualitative data. Temporal mapping and temporal bracketing strategies are particularly salient in studying this phenomenon (Langley & Abdallah, 2011). Third, our study focused on manufacturing SMEs in Sweden. Therefore, the findings may not be generalizable to larger firms beyond Sweden, and beyond the period of study. Specifically, larger firms may be less sensitive to polychronicity. For them, new product speed and strategic timing of product launches may be more important in order not to cannibalize current products and to keep control of their target markets. Smaller and entrepreneurial firms do not necessarily face such issues. For those companies, internal timing and management of innovation resources may be essential.

The current study does not open the black box of complex temporal relationships and innovation dynamics. Consistent with studies over the last few decades that have focused on the relationship between temporal dynamics and performance, there have been increasing calls for understanding micro-level temporal dynamics. Future studies can explore how time is managed in different innovation activities, including product development, stages of innovation activity, idea development, and product launch. Do the temporal preferences of the CEOs of SMEs

influence the temporal personality of integration in an organization? Understanding these unique temporal strategies could further inform the temporal innovation literature. Future studies could focus on the influence of factors in the CEO's temporal personality such as temporal depth, time urgency, and polychronicity to develop a multilevel model of CEO-department-employee dynamics in the development of temporal architectures. Past studies have focused on the key element of fit between context and polychronicity. Neither polychronicity nor monochronicity is detrimental. However, work and environmental demands influence the returns from these temporal preferences (König & Waller, 2010). This notion of fit in a multitasking environment could be salient in explaining how different organizational resources and fit could affect the level of success from polychronicity in innovation. Moreover, we believe that polychronicity and the internal dynamics related to it could be measured in many ways and, thus, we encourage future research to explore these issues.

We believe that our measure and use of polychronicity may need refinement in future studies about the exact management of innovation in firms. Furthermore, we believe alternative constructs could moderate the relationship to innovation tested in our study. Recently, Mohammed and Nadkarni (2014) have suggested that leader effectiveness increases team performance by helping to overcome problems related to temporal resource allocations. This finding calls for additional moderators. Although leaders or organizational control mechanisms can partially mitigate temporal problems in innovation, temporal reflexivity can be used to explain how organizations resolve frictions in the innovation process. With shared agreement and a willingness to engage in temporal reflexivity behaviors, organizations may develop temporal buffers or make do with temporal constraints through idiosyncratic routines in the context of broader temporal understanding. Some shared cognitions might be more effective in

exploitation-type innovations, whereas others might be more effective in exploration-type innovations. Shared temporal cognitions are most effective in preventing or reducing negative outcomes because these cognitions focus on exploiting diverse resources and temporal views. This understanding minimizes the potential negative effects of diversity. Once conflicts exist, shared cognitions can also help mitigate the effects of such conflicts. From the exploitation-innovation perspective, shared task cognitions can help weaken the negative effect of process conflict on team performance and satisfaction by enabling team members to focus on an overarching innovation goal (Jiang, Wang, Chu & Zheng, 2019; Smith, Busi, Ball, & Van der Meer, 2008). Future work on shared cognitions might consider when and how the different types of shared cognitions influence function and top management behaviors and outcomes.

5.3. Conclusion

We have proposed a temporal architecture for organizing innovation. Understanding how organizations temporally manage innovation resources is critical to understanding why organizations with similar resource configurations perform differently. The findings of our study indicate that lower or higher levels of polychronicity are positively associated with performance in SMEs. Synchronicity in innovation activities influences the U-shaped relationship between innovation polychronicity and SME performance. We believe that the proposed framework and findings have implications for research and for innovation in firms.

The proposed framework develops the research of Mohammed and Harrison (2013, p. 245), who state: “the received wisdom throughout the decades leans heavily in the direction of synchrony, coordination, harmony, and collective flow.” According to Mohammed and Harrison (2013 p. 245), in a team, as in a machine, where the “necessity of being synched up “in a system

where all of the gears and interchangeable parts are carefully coordinated … poor performance is commonly attributed to the inability to find a rhythm and team members being 'out of sync'". As we have shown, this machine metaphor can be extended to the firm-level temporal innovation architecture.

Table 1: *Descriptive statistics and correlations*

	Variables	Mean	SD	1	2	3	4	5	6	7	8	9
1.	Slack resources	2.05	3.74									
2.	Firm size [a]	155340.58	833182.91	.01								
3.	CEO age	48.18	8.46	–.05	.00							
4.	CEO gender	0.11	0.31	.00	.27	–.12						
5.	Number of patents	0.71	2.26	–.03	.02	.09	.03					
6.	Financial solidity	37.48	22.52	.35	.07	.06	.07	.11				
7.	Number of branches	0.36	0.83	–.05	–.03	.05	.00	–.08	–.11			
8.	Innovation polychronicity	3.04	0.81	–.08	–.04	–.02	.03	.12	–.08	–.10		
9.	Innovation synchronization	3.33	0.9	.03	–.02	–.02	.04	.09	.09	–.01	.12	
10.	Performance	1.44	14.46	.14	.27	.03	–.05	–.14	.19	–.02	–.05	–.08

Note: [a] Firm size is total assets 2015 in thousands of Swedish kronor (SEK); Firm performance refers to the mean profit margin for 2012 to 2015; All correlations |0.19| and above are significant at 0.05 or below (two-tailed); N = 127.

Table 2: *Hierarchical regression results for firm performance*

	Model 1	**Model 2**	**Model 3**	**Model 4**
Control variables				
Slack resources	.99	.99	.92	.86
	(.83)	(.84)	(.82)	(.81)
Firm size	22.87***	22.88***	22.82***	22.81***
	(3.69)	(3.78)	(3.80)	(3.68)
CEO age	.31	.31	.34	.77
	(.78)	(.79)	(.77)	(.77)
CEO gender	–6.27	–6.27	–5.99	–6.12
	(7.51)	(7.54)	(7.46)	(7.45)
Number of patents	–82.78	–82.91	–89.86	–83.09
	(49.92)	(50.02)	(50.46)	(52.12)
Financial Solidity	2.59	2.59	2.72	2.83
	(1.41)	(1.44)	(1.45)	(1.50)
Number of branches	–.20	–.19	–1.35	–.52
	(1.79)	(1.91)	(2.23)	(2.08)
Direct effects				
Innovation polychronicity		.03	–.06	–.09
		(.99)	(1.01)	(.99)
Innovation polychronicity squared [H1]			1.08*	1.16*
			(.54)	(.53)
Innovation synchronization				–2.30
				(1.52)
Moderation effects				
Innovation polychronicity × Innovation synchronization				–2.25*
				(.95)
Innovation polychronicity squared × Innovation synchronization [H2]				1.40*
				(.66)
F-statistic	16.14***	17.02***	13.26***	13.02***
R^2	.15	.15	.16	.19
ΔR^2		.00	.01*	.03**

Note: N = 127 in all models; Huber-White sandwich robust standard errors clustered by SIC codes in parentheses; *$p < .05$, **$p < .01$, ***$p < .001$ (two-tailed tests); Significances after ΔR^2 are from Wald linear restriction test.

Figure 1: *U-shaped effect of innovation polychronicity on firm performance*

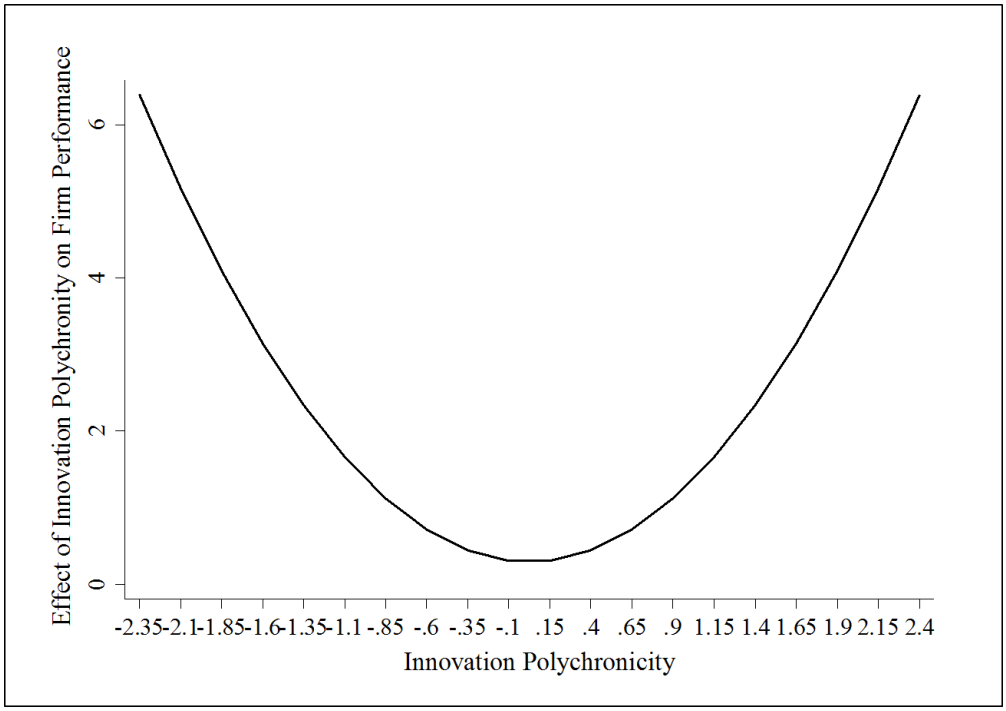
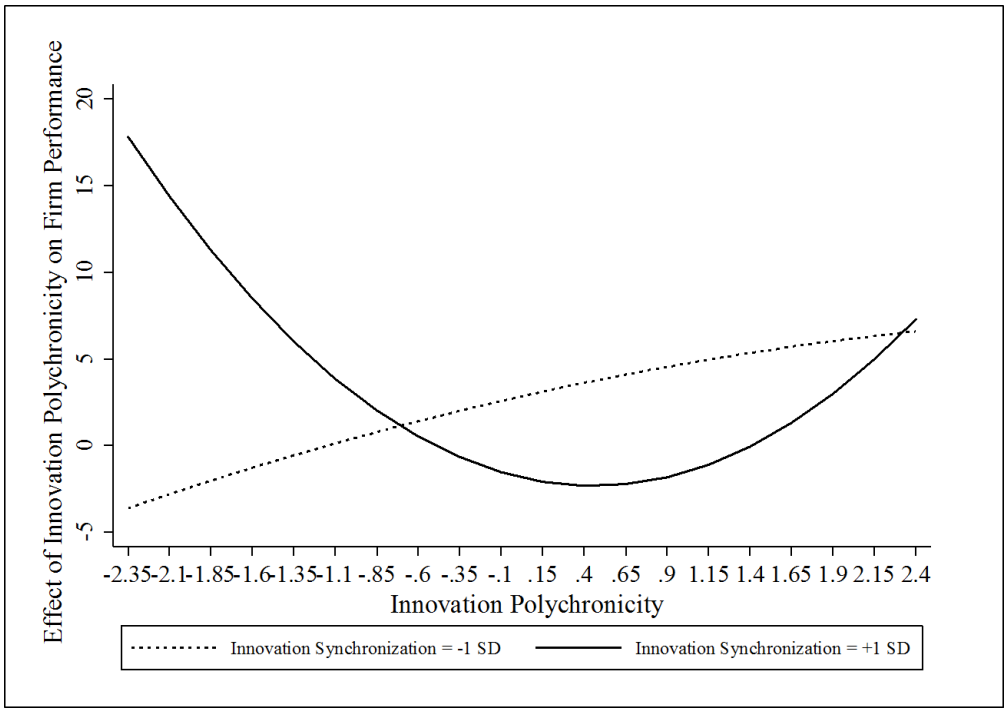


Figure 2: *Moderation effect of innovation synchronization*



Appendix 1: Innovation Polychronicity and Synchronicity Scale Items

Respondents were asked to indicate the extent to which they agree or disagree with the following statements related to innovation projects at all levels and across all functions in their organization. The response options ranged from 1 (strongly disagree) to 5 (strongly agree).

Innovation polychronicity

- We believe people should try to do many things simultaneously.
- We would rather focus on one task of the innovation process each day than on parts of several projects. (reverse-scored item)
- We tend to juggle several innovation activities simultaneously.
- We think it is best and tend to complete one innovation task before beginning another. (reverse-scored item)
- We believe it is best for people to be given several innovation tasks and projects to perform simultaneously.

Innovation synchronicity

- We are flexible in how we pace employees and departments.
- We are good at adapting to differences in department paces.
- We tend to be very patient with slower department paces.
- We are willing to go with the flow of activities among departments.

REFERENCES

Abrantes, A. C. M., Passos, A. M., e Cunha, M. P., & Santos, C. M. (2018). Bringing team improvisation to team adaptation: The combined role of shared temporal cognitions and team learning behaviors fostering team performance. *Journal of Business Research*, 84, 59-71.

Acs, Z. J., & Audretsch, D. B. (1987). Innovation, market structure, and firm size. *Review of Economics and Statistics*, 69(4), 567-574.

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Thousand Oaks, CA: Sage.

Alshanty, A. M., & Emeagwali, O. L. (2019). Market-sensing capability, knowledge creation and innovation: The moderating role of entrepreneurial-orientation. *Journal of Innovation & Knowledge*, 4(3), 171-178.

Ancona, D. G., Okhuysen, G. A., & Perlow, L. A. (2001). Taking time to integrate temporal research. *Academy of Management Review*, 26(4), 512-529.

Appelbaum, S. H., Marchionni, A., & Fernandez, A. (2008). The multi-tasking paradox: Perceptions, problems and strategies. *Management Decision*, 46(9), 1313-1325.

Baer, M., Dirks, K. T., & Nickerson, J. A. (2013). Microfoundations of strategic problem formulation. *Strategic Management Journal*, 34(2), 197-214.

Balkin, D. B., Markman, G. D., & Gomez-Mejia, L. R. (2000). Is CEO pay in high-technology firms related to innovation? *Academy of Management Journal*, 43(6), 1118-1129.

Benabou, C. (1999). Polychronicity and temporal dimensions of work in learning organizations. *Journal of Managerial Psychology*, 14(3/4), 257-270.

Berends, H., & Antonacopoulou, E. (2014). Time and Organizational Learning: A Review and Agenda for Future Research. *International Journal of Management Reviews*, 16(4), 437-453.

Bloch, H., & Metcalfe, S. (2017). Innovation, creative destruction, and price theory. *Industrial and Corporate Change*, 27(1), 1-13.

Bluedorn, A. C. (2002). *The Human Organization of Time: Temporal realities and experience*. Stanford University Press.

Bluedorn, A. C., Kalliath, T. J., Strube, M. J., & Martin, G. D. (1999). Polychronicity and the Inventory of Polychronic Values (IPV) The development of an instrument to measure a fundamental dimension of organizational culture. *Journal of Managerial Psychology*, 14(3/4), 205-231.

Bluedorn, A. C., Kaufman, C. F., & Lane, P. M. (1992). How many things do you like to do at once? An introduction to monochronic and polychronic time. *The Executive*, 6(4), 17-26.

Bourgeois III, L. J. (1981). On the measurement of organizational slack. *Academy of Management Review*, 6(1), 29-39.

Brown, S. L., & Eisenhardt, K. M. (1997). The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organizations. *Administrative Science Quarterly*, 42(1), 1-34.

Camisón-Haba, S., Clemente-Almendros, J. A., & Gonzalez-Cruz, T. (2019). How technology-based firms become also highly innovative firms? The role of knowledge, technological and managerial capabilities, and entrepreneurs' background. *Journal of Innovation & Knowledge*, 4(3), 162-170.

Carrillo, J. E. (2005). Industry clockspeed and the pace of new product development. *Production and Operations Management*, 14(2), 125-141.
Cooper, R. G. (2008). What leading companies are doing to re-invent their NPD processes. *PDMA Visions Magazine*, 9, 6-10.
D'Aveni, R. A. (1994). *Hypercompetition–Managing the Dynamics of Strategic Maneuvering*. New York: Free Press.
Damanpour, F. (1996). Organizational complexity and innovation: developing and testing multiple contingency models. *Management Science*, 42(5), 693-716.
Danneels, E. (2002). The dynamics of product innovation and firm competences. *Strategic Management Journal*, 23(12), 1095-1121.
Dunkelberg, W., Moore, C., Scott, J., & Stull, W. (2013). Do entrepreneurial goals matter? Resource allocation in new owner-managed firms. *Journal of Business Venturing*, 28(2), 225-240.
Eisenhardt, K. M. (1989). Making fast strategic decisions in high-velocity environments. *Academy of Management Journal*, 32(3), 543-576.
Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they? *Strategic Management Journal*, 21(10-11), 1105-1121.
European Union (2015). Innovation Union Scoreboard 2015.
Ferraris, A., Giachino, C., Ciampi, F., & Couturier, J. (2019). R&D internationalization in medium-sized firms: The moderating role of knowledge management in enhancing innovation performances. *Journal of Business Research*.
Gherardi, S., & Strati, A. (1988). The temporal dimension in organizational studies. *Organization Studies*, 9(2), 149-164.
Gevers, J. M., Li, J., Rutte, C. G., & van Eerde, W. (2019). How dynamics in perceptual shared cognition and team potency predict team performance. *Journal of Occupational and Organizational Psychology*.
Global Innovation Index (2015). Global Innovation Index 2015. 6 October 2018 (retrieved from http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards/index_en.htm)
Griffin, A., Langerak, F., & Eling, K. (2019). The evolution, status and research agenda for the future of research in NPD cycle time. *Journal of Product Innovation Management*, 36(3), 263–280.
Greer, C. R., Carr, J. C., & Hipp, L. (2016). Strategic staffing and small-firm performance. *Human Resource Management*, 55(4), 741-764.
Hakala, H., Sirén, C., & Wincent, J. (2016). Entrepreneurial orientation and international new entry: The moderating role of autonomy and structures in subsidiaries. *Journal of Small Business Management*, 54, 90-112.
Halbesleben, J. R., Novicevic, M. M., Harvey, M. G., & Buckley, M. R. (2003). Awareness of temporal complexity in leadership of creativity and innovation: A competency-based model. *The Leadership Quarterly*, 14(4), 433-454.
Hall, E. T. (1959). *The Silent Language* (Vol. 3). New York: Doubleday.
Hassard, J. (1991). Aspects of time in organization. *Human Relations*, 44(2), 105-125.
Hellström, T., & Hellström, C. (2002). Time and innovation in independent technological ventures. *Human Relations*, 55(4), 407-426.
Hinds, P. J., & Bailey, D. E. (2003). Out of sight, out of sync: Understanding conflict in distributed teams. *Organization Science*, 14(6), 615-632.

Johansson, A. E., Raddats, C., & Witell, L. (2019). The role of customer knowledge development for incremental and radical service innovation in servitized manufacturers. *Journal of Business Research*, 98, 328-338.
Jiang, W., Wang, L., Chu, Z., & Zheng, C. (2019). Does leader turnover intention hinder team innovation performance? The roles of leader self-sacrificial behavior and empathic concern. *Journal of Business Research*, 104, 261-270.
Judge, W. Q., & Speitzfaden, M. (1995). The Management of Strategic Time Horizons within Biotechnology Firms: The Impact of Cognitive Complexity on Time Horizon Diversity. *Journal of Management Inquiry*, 4(2), 179-196.
Kahn, K. B. (1996). Interdepartmental integration: a definition with implications for product development performance. *Journal of Product Innovation Management*, 13(2), 137-151.
Kahn, K. B. (2001). Market orientation, interdepartmental integration, and product development performance. *Journal of Product Innovation Management*, 18(5), 314-323.
Kaplan, S., & Orlikowski, W. J. (2013). Temporal work in strategy making. *Organization Science*, 24(4), 965-995.
Kessler, E. H., & Chakrabarti, A. K. (1996). Innovation speed: A conceptual model of context, antecedents, and outcomes. *Academy of Management Review*, 21(4), 1143-1191.
König, C. J., & Waller, M. J. (2010). Time for reflection: A critical examination of polychronicity. *Human Performance*, 23(2), 173-190.
Laforet, S. (2013). Organizational innovation outcomes in SMEs: Effects of age, size, and sector. *Journal of World Business*, 48(4), 490-502.
Langley, A., & Abdallah, C. (2011). Templates and turns in qualitative studies of strategy and management. *Research Methodology in Strategy and Management*, 6, 201-235.
Langley, A., Smallman, C., Tsoukas, H., & Van de Ven, A. H. (2013). Process studies of change in organization and management: unveiling temporality, activity, and flow. *Academy of Management Journal*, 56(1), 1-13.
Lawrence, P. R., & Lorsch, J. W. (1967). Differentiation and integration in complex organizations. *Administrative Science Quarterly*, 1-47.
Lee, H. (1999). Time and information technology: monochronicity, polychronicity and temporal symmetry. *European Journal of Information Systems*, 8(1), 16-26.
Lee, H., Farhoomand, A. F., & Ho, P. (2004). Innovation through supply chain reconfiguration. *MIS Quarterly Executive*, 3(3), 131-142.
Lenka, S., Parida, V., Sjödin, D. R., & Wincent, J. (2018). Exploring the microfoundations of servitization: How individual actions overcome organizational resistance. *Journal of Business Research*, 88, 328-336.
Mark, G., Voida, S., & Cardello, A. (2012). A pace not dictated by electrons: an empirical study of work without email. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 555-564). ACM.
Mohammed, S., & Harrison, D. A. (2013). The clocks that time us are not the same: A theory of temporal diversity, task characteristics, and performance in teams. *Organizational Behavior and Human Decision Processes*, 122(2), 244-256.
Mohammed, S., & Nadkarni, S. (2011). Temporal diversity and team performance: The moderating role of team temporal leadership. *Academy of Management Journal*, 54(3), 489-508.

Mohammed, S., & Nadkarni, S. (2014). Are we all on the same temporal page? The moderating effects of temporal team cognition on the polychronicity diversity–team performance relationship. *Journal of Applied Psychology*, 99(3), 404.
Montoya-Weiss, M. M., Massey, A. P., & Song, M. (2001). Getting it together: Temporal coordination and conflict management in global virtual teams. *Academy of Management Journal*, 44(6), 1251-1262.
Nadkarni, S., & Narayanan, V. K. (2007). Strategic schemas, strategic flexibility, and firm performance: The moderating role of industry clockspeed. *Strategic Management Journal*, 28(3), 243-270.
Nickerson, J. A., & Zenger, T. R. (2004). A knowledge-based theory of the firm – The problem-solving perspective. *Organization Science*, 15(6), 617-632.
Nutt, P. C. (2002). Making strategic choices. *Journal of Management Studies*, 39(1), 67-96.
O'Brien, R. M. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality & Quantity*, 41(5), 673-690.
Ocasio, W. (1997). Towards an attention-based view of the firm. *Strategic Management Journal*, 18(S1), 187-206.
O'Connor, G. C., & McDermott, C. M. (2004). The human side of radical innovation. *Journal of Engineering and Technology Management*, 21(1), 11-30.
Ofori-Dankwa, J., & Julian, S. D. (2001). Complexifying organizational theory: Illustrations using time research. *Academy of Management Review*, 26(3), 415-430.
Onken, M. H. (1999). Temporal elements of organizational culture and impact on firm performance. *Journal of Managerial Psychology*, 14(3/4), 231-244.
Orlikowski, W. J., & Yates, J. (2002). It's about time: Temporal structuring in organizations. *Organization Science*, 13(6), 684-700.
Pérez-Nordtvedt, L., Payne, G. T., Short, J. C., & Kedia, B. L. (2008). An entrainment-based model of temporal organizational fit, misfit, and performance. *Organization Science*, 19(5), 785-801.
Perlow, L. A. (1998). Boundary control: The social ordering of work and family time in a high-tech corporation. *Administrative Science Quarterly*, 328-357.
Perlow, L. A., Okhuysen, G. A., & Repenning, N. P. (2002). The speed trap: Exploring the relationship between decision making and temporal context. *Academy of Management Journal*, 45(5), 931-955.
Petruzzelli, A. M., Ardito, L., & Savino, T. (2018). Maturity of knowledge inputs and innovation value: The moderating effect of firm age and size. *Journal of Business Research*, 86, 190-201.
Prahalad, C. K., & Krishnan, M. S. (2002). The dynamic synchronization of strategy and information technology. *MIT Sloan Management Review*, 43(4), 24-33.
Puffer, S. M. (1989). Task-completion schedules: Determinants and consequences for performance. *Human Relations*, 42(10), 937-955.
Roberts, N., & Grover, V. (2012). Leveraging information technology infrastructure to facilitate a firm's customer agility and competitive activity: An empirical investigation. *Journal of Management Information Systems*, 28(4), 231-270.
Rosenbusch, N., Brinckmann, J., & Bausch, A. (2011). Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs. *Journal of Business Venturing*, 26(4), 441-457.
Schein, E. H. (2010). *Organizational Culture and Leadership* (Vol. 2). John Wiley & Sons.

Shujahat, M., Sousa, M. J., Hussain, S., Nawaz, F., Wang, M., & Umer, M. (2019). Translating the impact of knowledge management processes into knowledge-based innovation: The neglected and mediating role of knowledge-worker productivity. *Journal of Business Research*, 94, 442-450.

Slocombe, T. E., & Bluedorn, A. C. (1999). Organizational behavior implications of the congruence between preferred polychronicity and experienced work-unit polychronicity. *Journal of Organizational Behavior*, 20(1), 75-99.

Smith, M., Busi, M., Ball, P., & Van der Meer, R. (2008). Factors influencing an organisation's ability to manage innovation: a structured literature review and conceptual model. *International Journal of Innovation Management*, 12(04), 655-676.

Souitaris, V., & Maestro, B. (2010). Polychronicity in top management teams: The impact on strategic decision processes and performance of new technology ventures. *Strategic Management Journal*, 31(6), 652-678.

Stalk, G. Jr, & Hout, T. H. (1990). *Competing Against Time: How Time-Based Competition is Reshaping Global Markets*. New York: Free Press.

Staudenmayer, N., Tyre, M., & Perlow, L. (2002). Time to change: Temporal shifts as enablers of organizational change. *Organization Science*, 13(5), 583-597.

Wadhawa, S., & Rao, K. (2003). Flexibility and agility for enterprise synchronization: knowledge and innovation management towards flexagility. *Studies in Informatics and Control*, 12(2), 111-128.

Waller, M. J., Giambatista, R. C., & Zellmer-Bruhn, M. E. (1999). The effects of individual time urgency on group polychronicity. *Journal of Managerial Psychology*, 14(3/4), 244-257.

Wang, X., & Dass, M. (2017). Building innovation capability: The role of top management innovativeness and relative-exploration orientation. *Journal of Business Research*, 76, 127-135.

Wickens, C. D. (2002). Multiple resources and performance prediction. *Theoretical Issues in Ergonomics Science*, 3(2), 159-177.

Wickens, C. D., Sandry, D. L., & Vidulich, M. (1983). Compatibility and resource competition between modalities of input, central processing, and output. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 25(2), 227-248.

Xie, X., Zou, H., & Qi, G. (2018). Knowledge absorptive capacity and innovation performance in high-tech companies: A multi-mediating analysis. *Journal of Business Research*, 88, 289-297.

Zellmer-Bruhn, M. E. (2003). Interruptive events and team knowledge acquisition. *Management Science*, 49(4), 514-528.

Zimbardo, P. G., & Boyd, J. N. (2015). Putting Time in Perspective: A Valid, Reliable Individual-Differences Metric. In *Time Perspective Theory; Review, Research and Application* (pp. 17-55). Springer, Cham.