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Paul Knott

University of Canterbury Business School

Christian Walsh

University of Canterbury Business School

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Christian Walsh and Paul Knott

University of Canterbury Business School, Christchurch 8140, New Zealand.

Email: Christian.walsh@canterbury.ac.nz; paul.knott@canterbury.ac.nz.

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Navigating Temporal Complexity in Nascent Innovation

We present a longitudinal study of how managers in seven technology-based firms navigated the temporal complexity inherent in developing nascent innovations. Informed by practice theory, the study provides empirical and contextually-specific analysis of how these managers used temporal intuition as they sought to achieve entrainment between multiple temporal structures. The temporal structures we identified sit within four distinct temporal orientations linear time, non-linear time, event time, and cyclic time. Participant managers sought to ensure a common temporal orientation in order to enable entrainment, while grappling with the potential for conflict between temporal orientations arising from the uncertainty inherent in the context. We show how the degree of entrainment between different internal and external stakeholders' temporal structures can have significant implications for the progress of an opportunity.

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Introduction

A number of temporal constructs have been examined in strategy and innovation research, including pace of decision making (Perlow *et al.*, 2002; Eisenhardt, 1989; Gersick, 1994; Wally and Baum, 1994; Eisenhardt and Brown, 1998); cultural attitudes towards time and implications for strategy (Voss and Blackmon, 1998; Snyder, 2018; Hay and Usunier, 1993); and the influence of individual temporal perspectives (Das, 1987; Jones *et al.*, 2017). However, “less attention has been paid to what managers and others actually *do* to intervene with respect to important time-related phenomena, and to how their temporally-oriented practices and activities accomplish strategic outcomes” (Bansal *et al.*, 2022).

In this paper we examine how managers navigate the temporal complexity inherent in innovation opportunities (Garud *et al.*, 2011; Halbesleben *et al.*, 2003). Among our points of departure for the paper is that our study was explicitly informed by practice theory, including cognitive practices. We seek understanding of temporal practices in a way that moves beyond the “‘cold cognition’ model of the strategic decision maker” (Hodgkinson and Sadler-Smith, 2018) that characterises earlier scholarship in this area.

Temporal complexity in innovation

In this work, we draw on social and subjective concepts of time such as event time, process time and cyclical time, rather than solely the linear objective clock time (Lee and Liebenau, 1999; Crossan *et al.*, 2005; Ancona *et al.*, 2001; Snyder, 2018). The complexities of time based decisions in innovation has been referred to as the temporal landscape, or timescape (Halbesleben *et al.*, 2003; Adam, 2000). Much research on time and strategic decision making has focussed on pace of decisions. Eisenhardt’s influential study of strategic decision making in high-velocity environments identified that quick decision makers used more real time data than others and were more often described as intuitive (Eisenhardt, 1989). Wally and Baum (1994) similarly associated intuition with speed of strategic decision making. In contrast, other studies have shown how emphasis on speed may lead to degraded decision-making (Perlow *et al.*, 2002). Gersick (1994) found that instead it was more effective, in the context of venture capital backing, to pace strategic decisions in a way that synchronised or entrained decision-making cycles with those of key external partners.

The notion that there is a need for synchronicity dovetails with the wider concept of a window of opportunity within which the firm must act (Busenitz and Barney, 1997; Perlow *et al.*, 2002; Mitchell and Shepherd, 2010). It must not just take the appropriate action, but take this action at the most opportune time. Scholars have proposed that fit between a firm’s internal cycles (Hopp and Greene, 2018) and those of the external environment has implications for performance (Perez-Nordtvedt *et al.*, 2008), while lags in observation, decision-making and action make for difficulty in achieving entrainment (Simandan, 2018). Prior studies have examined entrainment in different contexts, including internationalisation (Khavul *et al.*, 2010), acquisitions (Shi and Prescott, 2012) and at individual-team level in experimental settings. However, there is a lack of prior concern for how managers try to achieve entrainment from a practice perspective (Labianca *et al.*, 2005) or in the context of nascent innovation.

Intuition has been found to have a significant role in how people make strategic decisions particularly under time pressure or uncertainty (Eisenhardt, 1989; Eisenhardt and Brown, 1998; Wally and Baum, 1994; Sinclair *et al.*, 2009). Dual-process theories of cognition broadly state that we have an intuitive, affective, subconscious “system one” and a rational,

analytic, conscious “system two”, that work in parallel (Hodgkinson *et al.*, 2009; Kahneman, 2011). Hodgkinson and Healey (2011; Hodgkinson and Healey, 2014) highlight the importance of affect and emotions stemming from the sub-conscious when examining strategic decision making. Recent developments in the study of intuition support the view that intuition is not a single phenomenon (Gore and Sadler-Smith, 2011; Sinclair, 2011), and that there are at least four distinct types, including temporal intuition as a “slow-to-form, affectively charged evaluation of timing for prospective action and pace of change based on complex patterns of multiple cues” (Walsh *et al.*, 2022b).

The aim of this study is to empirically uncover the temporal practices managers use as they navigate the development of innovative opportunities, with a particular focus on how they achieve, or seek to achieve, entrainment in the process.

Methods

We collected data from seven participants over a period of approximately two years. Each participant was in a CEO or similar position in an existing technology-based SME, and in each case the study focused on the process by which they developed and evaluated a nascent innovative opportunity for the firm. Table 1 details the participants and opportunities.

A simple yet robust method was required that would help capture their thinking at that point in time and would allow comparison over time while avoiding the pitfalls of one-off self-reporting (Hodgkinson, 2002). Cognitive maps were selected as the main tool for structuring the conversations and documenting how the managers view the opportunity space (Ackermann and Eden, 2010). Capturing individuals’ cognitive maps at repeated intervals over time allowed for closer examination changed aspects. Repeat sessions with each participant took place at three-month intervals over a two-year period. Each session began with a re-examination of the previous causal map in its codified version. The participant was then asked specifically changed nodes on the map. All conversations were recorded for subsequent transcription, coding and analysis (Miles and Huberman, 1994; Saldana, 2011).

Brief findings

To summarise findings for this brief paper, we can discuss participants’ interpretation of temporal pressures external and internal to the firm, and their approaches to attempt to achieve entrainment between such considerations. These findings are summarised in Table 2.

The first temporal pressure uncovered was ongoing trade-offs that had to be made in prioritising limited resources. The participants were highly conscious of the rate of resource usage, which was primarily based on linear clock based time, and were judging this against the rate of technical progress being made to meet the external opportunity.

A second temporal pressure was related to the participants’ perceptions of the internal capabilities of their organisations. The opportunities in many cases signified a significant change in scale of operation, and so while there were external demands for growth of the organisation, judgements had to be made about how this would be balanced with the organisation’s ability to adapt. This was based on non-linear time as growth rates are rarely linear.

The third was the observed or projected adoption rate of the new idea, the control or influence of external parties on key events in the idea’s development, and the time/risk/reward profile of the opportunity. The participants had a sense that time-to-market

influenced expected returns, as product development literature leads us to expect. They were attempting to judge how fast they could, or should go, in order to optimise the market entry timing. This draws on event time, where the market release or entry is a significant event in time that focussed and defined the attention of participants.

There were also two temporal pressures that were based on cyclic time. First, many participants required multiple testing iterations, engaging with users in the design and development process. The ability to rapidly cycle through the iterations of testing and feedback was seen as key to success. However, this needed to be balanced with managing customer or partner expectations through these iterations. The second cyclic time based pressure was the sales cycle. In some cases this needed to be balanced with the procurement processes of key customers.

Discussion

The notion of temporal structures (Orlikowski and Yates, 2002) allowed us to examine the time based practices the participants adopted. We discerned several orientations of temporal structures, namely linear time, non-linear time, event time and cyclic time. The competing and contradictory nature of these orientations suggest a very complex environment. We found that participants in this study deployed temporal intuition (Walsh *et al.*, 2022a) in order to navigate this complexity. Note this is very different to using expert intuition to make forecasts based on previous experience, which typically leads to poor outcomes (Kahneman, 2011; Miller and Ireland, 2005).

There was often a sense of urgency in participants' decision making and action (Perlow *et al.*, 2002; Eisenhardt, 1989). The use of intuition has previously been found to be an antecedent of rapid strategic decision making (Wally and Baum, 1994), yet also urgency found detrimental if it becomes self-reinforcing and degrades the quality of decisions (Perlow *et al.*, 2002). This supports the need for a meta-cognitive awareness of decision making practices relating to temporal factors (Halbesleben *et al.*, 2003), including the use of temporal intuition.

While we have articulated the four orientations of temporal structures as distinct concepts, we found that in practice these are interrelated and overlapping. In some instances the dominant orientation may depend on the perspective of the individual and the timescale at which the structures are being perceived (Orlikowski and Yates, 2002). For example while an overall rate of change may appear to be linear in the short term, when viewed at a longer timescale it may be non-linear or even cyclic. We found that linear time is ever present due to resource usage largely being linked to people's time, which is generally linked to linear clock time. As shown in figure 1, linear time is central to the timescape (Adam, 2000; Halbesleben *et al.*, 2003). In the stylised charts of fig 1, clock time runs on the x-axis, with resource usage or intensity on the y-axis. Achieving entrainment between different temporal structures relies on ensuring there is a common temporal orientation.

Implications

We aim to make three contributions with this work. First, we highlight the significance of temporal intuition in navigating temporal complexity while developing innovative opportunities. Temporal intuition (Walsh *et al.*, 2022a; Walsh *et al.*, 2022b) coupled with iterative market engagement (McGrath and MacMillan, 2009; Goss and Sadler-Smith, 2018) are salient in forming an affective view of uncertain and conflicting temporal pressures.

Along with this, we provide empirical support for the role of temporal structures in strategic practice (Orlikowski and Yates, 2002). Notably, we show how strategic entrainment (Ancona and Chong, 1996) with internal and external stakeholders' temporal structures can have significant implications for developing an opportunity. We suggest that entrainment is not solely a factor relating to cyclic time based structures, as previously studied, but also applies to linear, non-linear and event time based structures.

Third, we suggest that conflicts between different orientations of temporal structures can be particularly problematic for managers of nascent innovation (Halbesleben *et al.*, 2003). Managers need to be aware when assumed linear rates are in fact non-linear; when certain steps in event time signify changes in rates of both internal and external change; and when linear time may actually be cyclic when viewed from a different scale.

Tables and Figures

Participant	Role	Innovation leadership experience	Nascent innovation	Interview sessions
B	CEO	20+ years	New market for hardware product	6
D	Founder/ Director	20+ years	New hardware product for existing market	7
S	CEO	16 years	New market for hardware product	7
C	CEO	20+ years	New geographic market development	3
G	Founder/ Director	17 years	New software products for new markets	6
M	Founder/ Director	17 years	New technology investment	6
A	Founder / CEO	16 years	New software product & market	7
Total	-	-	-	42

Table 1: List of participants and opportunities

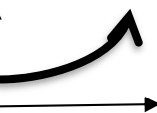
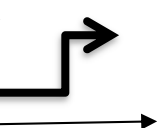
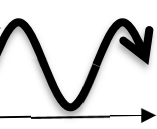
Primary temporal orientation		Entrainment being sought between temporal structures		Indicative quotes
Linear time		Resource burn rate	Rate of technical development	"It's almost like you need to dig a trench and you have spades. And you also want to buy an excavator. Can you afford to buy an excavator? No. Can you build an excavator? Yes we can, but you will have to stop digging the trench." (Participant A)
Non-linear time		Organisational change capacity	Organisational growth rate	"Part of it is our own maturity as an organisation as well. Can we, you know one of the ways we kill a weed sometimes is by giving it a growth hormone. You know it grows so rapidly that it kills its resources and dies." (Participant M)
Event time		Speed to market / entry timing	Market return profile	"Interesting when it comes to timeframe and urgency, because that's part of that, you know is it two years? If it's two years it'll have lower value for us, so if the answers here are positive, then this is probably relatively high, so we need to get it out in the marketplace fast." (Participant D)
Cyclic time		User testing iterations	Customer / partner enthusiasm	"We've raised interest with customers and people already so we need to be careful we tell them it's been a flop it's been problem and move on, we can get away with that, but if we're intending to go in with a product then we need to get on with it." (Participant D)
		Sales cycles	Procurement processes	"We are making progress along all these lines but this project is quite slow and the sales cycle is somewhat unexpectedly very, very slow. And I mean people come to meetings they really spend their time but to take it through the organisation is taking a lot of time." (Participant A)

Table 2. Temporal structures that participants were attempting to entrain, and orientation of each

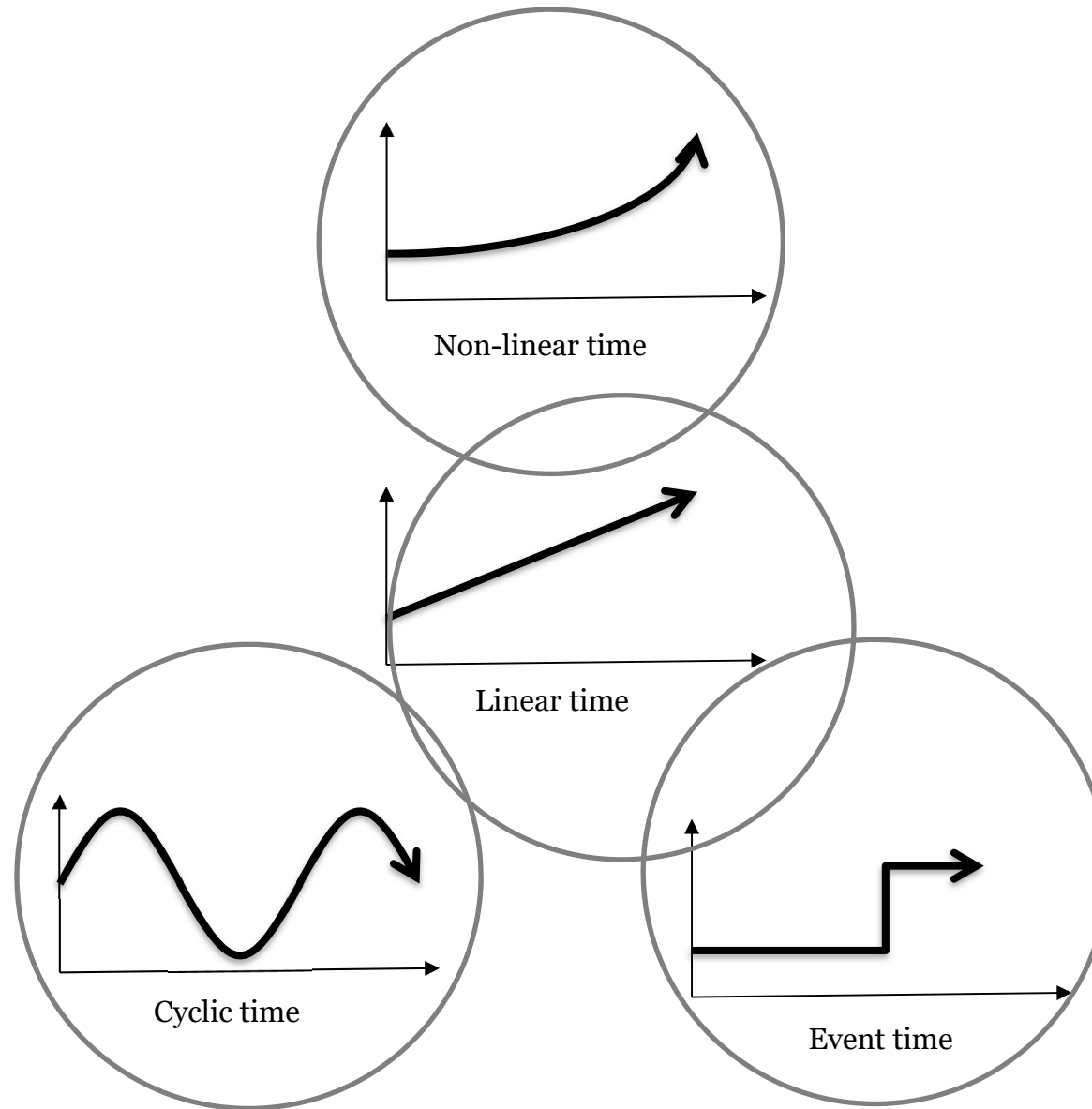


Fig. 1. Temporal orientations to be navigated in the timescape.

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