

Startup time, innovation and organizational emergence: A study of USA-based international technology ventures

John Stayton¹ · Vincent Mangematin²

Published online: 19 July 2016

© Springer Science+Business Media New York 2016

Abstract The acceleration of new technology venture launch and growth is an important and rapidly growing field of practice for university-based accelerators, incubators, and technology transfer offices. Based on four comparative case studies of fast-launching clean tech startups in the USA (two of which were university-affiliated), this paper explains how some technology startups are able to develop innovative products, form organizations, internationalize, and release products into global markets very rapidly, and highlights implications for university-sourced ventures. Findings show that two processes, “product emergence” and “organization emergence,” have to be managed strategically, with time as a critical variable to be considered. This paper suggests that there are dynamic tensions between temporal, financial, and human resources in the technology startup process. To start up quickly, the new international technology venture compresses two parallel timelines: product launch and organization launch, which can also accelerate the internationalization process. This study identifies the organizational formation pivot as a risky but necessary transition from a lean, informal, fast-paced technology development project to a structured, legally compliant organization, in the case of a university-sourced venture fully independent from the university that spawned it, that can be trusted for transactions and investment.

Résumé Accélérer le lancement, la croissance et l’internationalisation des start-ups: tel est l’objectif des accélérateurs universitaires, des incubateurs et des services de valorisation de la recherche. A partir de la comparaison de quatre start-ups technologiques aux Etats Unis (dont deux affiliées à l’Université), ce papier étudie les mécanismes qui permettent aux jeunes pousses de mettre rapidement des produits

✉ John Stayton
stayton@sonoma.edu

¹ Executive Director, Graduate and Executive Programs School of Business and Economics, Sonoma State University, 1801 E Cotati Ave, Rohnert Park, CA 94928, USA

² Grenoble Ecole de Management, 12 rue Pierre Semard, 38000 Grenoble, France

sur le marché, d'organiser l'entreprise et de s'internationaliser. Le temps est une variable critique. Cet article suggère que le processus de démarrage de l'entreprise génère de fortes tensions financières, humaines et temporelles car l'entreprise compresse le temps pour tenir deux échéances en parallèle: lancement de produit et de l'organisation. Les accélérateurs jouent principalement en rattrapage d'une lacune de l'équipe fondatrice que ce soit pour avoir accès aux marchés domestiques, pour un accès à l'international ou pour des compétences managériales ou scientifiques. La compression du temps conduit les entreprises à se développer une organisation simplifiée et légère et à mettre sur le marché des produits à viabilité minimum. Les start-ups universitaires ont un meilleur accès international et nécessitent des compétences managériales pour se développer rapidement.

Keywords Technology startups · Venture creation speed · New venture creation · International entrepreneurship · University business incubators · Academic entrepreneurship

Mots clés organisations naissantes · jeunes pousses technologiques · accélération · création d'entreprises · entrepreneuriat international · entrepreneuriat scientifique

JEL Classification 3 Entrepreneurship and 4 International Business

Summary Highlights

Contributions: This study explores the speed of new technology startup time, including simultaneous innovative product development, organizational creation, and internationalization, and makes important contributions to the study of time and entrepreneurship and to the practices of university-based incubators.

Research questions/purpose: How can the nascent international technology venture quickly and simultaneously launch new products or services, organize the company and internationalize? How are some technology ventures able to launch more quickly than others?

Basic methodology and information: Qualitative, inductive research for this paper includes four in-depth case analyses of clean tech startups in the USA that launched very quickly, including two that internationalized and two that were affiliated with university-based incubators. Data from 34 in-depth, semi-structured interviews and hundreds of pages of documents and archival records were organized and analyzed in Dedoose.

Results/findings: Findings show that two processes, product emergence and organizational launch, are impacted in different ways by compressing the venture launch timeframe. Tensions are identified between time, financial resources, and human workload. All four ventures launched rapidly for reasons that were financially driven, not market driven. While the startup teams were motivated by compressed timeframes, individuals were also susceptible to burnout.

Limitations: This study is based on four in-depth case analyses for the purposes of extending and improving theoretical understanding, and is not intended to provide a representative sample of technology ventures. Empirical research will be required to verify the findings and recommendations. All cases were based in the USA for comparability, with the understanding that the frameworks developed could be applied internationally, but applicability to other countries has not been tested.

Theoretical implications and recommendations: A new model of venture emergence stages of development reveals the organizational formation pivot that is especially precarious for startups that launch rapidly. The dynamic relationships between time, financial resources, and human workload need to be managed strategically, with understanding of the advantages and trade-offs of compressing the launch timeframe.

Practical implications and recommendations: University business incubators can provide early-stage technology ventures with physical resources, advice, and connections to the global academic community for rapid product development and internationalization, thus minimizing the search for funding until after product release, as well as provide timely legal and organizational development support during the organizational formation pivot to help establish structured, legally compliant enterprises that can be trusted for internal and external transactions.

Future research directions: Additional inductive research is needed on the temporal dimension of subsequent stages of entrepreneurial growth and development. Empirical research is required to verify the concepts developed in this paper. More exploration is needed of temporal and developmental differences between web/mobile app ventures and other technology startups.

Introduction

Expanding internationally usually comes as a second step after companies start up and launch products or services (Autio et al. 2000; Johanson and Vahlne 1977). This paper analyzes how time can be compressed to shorten the startup and internationalization process. It also explains why exposure to internationalization and international networks is a pre-condition for internationalizing quickly, which has been established by previous international entrepreneurship studies (Andersson et al. 2013; Coviello 2006; Evers and O’Gorman 2011). University-industry collaborations can provide the international networks that help to rapidly launch university spinouts into domestic and foreign markets.

Time is recognized as a key dimension in entrepreneurship that needs more study (Busenitz et al. 2003; McMullen and Dimov 2013; Welter 2011; Zahra et al. 2014). There is a “temporal tension” between the current state and the entrepreneur’s intention (desired state), which motivates the entrepreneur to drive the pace of venture launch (Bird 1992). Entrepreneurship is the journey of resolving that tension, with time as a critical dimension, a view that encourages a process-focused approach to entrepreneurship studies (McMullen and Dimov 2013). Zahra et al. (2014) posit that despite decades of research touching on various

aspects of the temporal dimension of entrepreneurship, "...our knowledge of time as a dimension of context remains fragmented at best (p. 242)."

The study of venture creation speed is a subset of the study of time and entrepreneurship. The concept of time "compression" was introduced by Eisenhardt and Tabrizi (1995) to describe the process of squeezing together the steps necessary to achieve a product launch goal in a shorter time frame. This was contrasted with the "experiential" model of releasing what is now known as a "minimum viable product," and rapidly reiterating based on experience with users, which can also result in faster product launch (Ries 2011). While the speeding up of new technology product development is generally regarded as benefiting the firm (Eisenhardt 1989a, b; Kessler and Bierly 2002; Kessler and Chakrabarti 1996; Markman et al. 2005), compressing the organization's birth and development may be problematic (Brush et al. 2008; Capelleras et al. 2010; Dierickx and Cool 1989). This is especially important for university-supported startups, which can lack the managerial experience to move quickly through critical startup phases (Vohora et al. 2004).

The focus on time and international venture creation has primarily focused on the speed of internationalization and the "born global" firm that derives competitive advantage by rapidly expanding into international markets (Autio et al. 2000; Weerawardena et al. 2007). The capabilities developed by new technology ventures as they innovate and create products for market positively impact the success of internationalization efforts (Knight and Cavusgil 2004). But the role of speed and the respective rhythms of venture creation, product launch, and internationalization remain in shadow.

In addition to addressing the temporal dimension of international venture creation, this paper also contributes to the study and practices of university technology transfer and entrepreneurship programs. Universities have an important stake in rapidly commercializing technologies, whether developed as a result of faculty-led research or as a result of incubating student-led entrepreneurial projects (Shah and Pahnke 2014). University business incubators (UBIs, including university-based accelerator, incubator, and technology transfer programs) speed the commercialization of university-sourced technologies (Grimaldi and Grandi 2005; Lee and Osteryoung 2004; Mian 1997). The scientific research from universities plays an important role in entrepreneurship (Cunningham et al. 2015; Guerrero et al. 2015), and international networks, like those found in the academic community, can help with rapid internationalization (Coviello and Munro 1995; Coviello 2006; Musteen et al. 2010; Yu et al. 2011).

How can the nascent international technology venture simultaneously launch new products or services, organize the company, and internationalize? This paper seeks to explain why some ventures are able to launch companies with innovative products and gain domestic and international market traction very quickly. By examining four comparative case studies of fast startups, including two nurtured by UBIs and two with very early international sales, we explore nascent technology organizations from the first intention to create a product through organizational emergence, product innovation, and product market introduction to a signal of market traction for the newly developed product. All companies were selected from the clean tech industry. The cases focus on the initial resources and conditions of the enterprise, the capabilities of the startup teams, and changes in the available resources and capabilities during the time period examined.

The dynamic relationships between financial resources, human workload, and time compression emerged as central themes of the analysis. Time is a resource to be managed strategically, partially substitutable for financial resources, with awareness of the advantages, trade-offs, and risks of compressing or decompressing a launch timeframe. While the duration of what constitutes a “fast” technology startup may vary from country to country based on local regulatory regimes and access to markets (Misra et al. 2012), the impacts of compressing that timeframe will create similar relational dynamics between temporal, human, and financial resources in any country.

The rest of the paper is structured as follows: The next section examines current knowledge on organizational creation time, innovation time, and internationalization time. The subsequent section explains the research design and how data have been collected to explore the mechanisms by which startup technology firms achieve rapid product and organizational emergence. This is followed by the main findings, based on the comparative case analysis. The discussion underlines the specificity of time as a resource. It also highlights the importance of the management of the timeline as a lever for influencing financial resources, organizational tensions, and the time required for launching start-ups. Implications for UBIs are explained in the conclusions.

Research background

The rapid simultaneous emergence of organizations and innovative products is a complex endeavor. To better understand the international technology startup process, we need to understand the relationship of time with three areas of study: innovative product development; organizational creation and development; and internationalization. Studies have examined pieces of these relationships, but there is no coherent framework that encompasses and explains these scattered pieces of the puzzle. This paper is an attempt to make sense of the temporal dimension of the nascent international technology startup. It is helpful to understand four areas of study as background for this research: innovation speed (in any size technology firm), the stages of venture creation (not specifically about speed of venture creation), venture creation speed (although not necessarily in international technology firms), and internationalization speed.

Innovation speed

Innovation speed has been under scrutiny because time-to-market is a competitive dimension. Bluedorn and Denhardt (1988) discuss time as a critical organizational resource, mentioning the importance of “temporal structures” that control cycles of work. Innovation speed is a measure of the time spent between idea conception and commercialization (Kessler and Chakrabarti 1996). Research suggests that getting innovative products to market quickly benefits the firm (Eisenhardt 1989b; Kessler and Bierly 2002; Kessler and Chakrabarti 1996; Markman et al. 2005). However, there are differences in innovation conditions and processes between incumbent firms and startups (Antolín-López et al. 2015).

The ability to speed up innovation leads to competitive advantage (Gupta and Wilemon 1990; Kessler and Chakrabarti 1996; Markman et al. 2005). Fast decision-making in technology ventures results in improved performance (Eisenhardt 1989b). Barriers to accelerating new product development can be managed (Gupta and Wilemon 1990). Chen et al. (2005) found that speed to market generally positively influenced new product success, but the effect was moderated by market uncertainty. Quality and innovativeness are not antonymic with speed. While some analyses have shown that speeding up new product development may negatively impact quality (Crawford 1992; Lukas and Menon 2004), multiple studies have found a symbiotic relationship between product innovation speed and product quality (Goktan and Miles 2011; Kessler and Bierly 2002; Menon et al. 2002; Stanko et al. 2012). Stanko et al. (2012) conclude that speed to market leads to both better quality and lower costs—there is not necessarily a trade-off between them. They further found that products that are highly innovative result in a more positive relationship between speed and quality than less innovative products. Similarly, Goktan and Miles (2011) suggest that the radicalness of product and process innovations are positively correlated with the speed at which those innovations take place.

Innovation speed is most important in fast-paced technology industries in which, as Eisenhardt and Tabrizi (1995, p. 104) point out: “Fast product development emerges as more uncertain than predictable, more experiential than planned, and more iterative than linear.” While innovation speed is related to the external environment, some internal conditions also influence it: powerful project leaders and multifunctional teams are important for rapid product development (R. G. Cooper and Kleinschmidt 1994; Eisenhardt and Tabrizi 1995), while planning and extrinsic performance rewards negatively impact it (Eisenhardt and Tabrizi 1995).

Universities have a stake in innovation speed. University-based start-ups and spin-offs provide many benefits to the market because they are often based on innovative science (Guerrero et al. 2015). Final technological development needs to be undertaken as well as proof-of-concept, as most principal investigators of Universities and Public Sector Research Organizations remain in academia (Cunningham et al. 2015). The role of UBIs is to facilitate rapid commercialization of innovation by developing a large pipeline of ideas and rigorous selection processes; providing holistic capacity development for entrepreneurial teams, with regular monitoring and evaluation; and facilitating access to internal and external networks and sources of funding (Patton et al. 2009).

Stages of new venture creation

What does it mean to start up a venture quickly? Presumably, it means to either skip steps in the entrepreneurial process or move through them very quickly. While there is no consensus model of the stages of venture creation, numerous models are offered in the literature and in practice on how entrepreneurs are assembling resources (Ciabuschi 2012). Table 1 presents nine of these models, ranging from three to six stages. They include different perspectives, four from research journals (including one about university spinouts), three from books, one from a textbook, and one normative description from the venture capital industry.

The concept of time is not included in most of these models. They discuss stages and/or sequence of activities, but not timeframes. The exception is Reynolds and White

Table 1 Stages of new venture creation

Source	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
(Galbraith 1982) Journal	Proof of principle	Prototype	Start-up	Natural growth	Strategic maneuvering	
(Gartner 1985) Journal	Identification of business opportunity	Accumulation of resources	Marketing products and services	Production	Organization building	Response to gov't and society
(Adizes 1988) Management book	Courtship	Infancy	Go-go (growth stage)	Adolescence		
(Bhave 1994) Journal	Opportunity	Technology setup and organization creation	Exchange			
(Reynolds and White 1997) Scholarly book	Conception	Gestation	Infancy	Adolescence		
(Evers et al. 2014) Scholarly book	Inception	Growth	Expansion	Maturity		
(Vohora et al. 2004) Journal	Research	Opportunity framing	Pre-organization	Re-orientation	Sustainable returns	
(Hisrich et al. 2010) Textbook	Identifying and evaluating opportunity	Writing business plan	Determining and filling resource gap	Managing enterprise		
VC-defined Normative, used by venture capital firms	Seed or concept—family and friend funded	Startup—angel funded	First (market penetration) VC funded	Second (profitability) VC funded	Third (mezzanine) VC or specialized funds	Fourth (near harvest) M&A or IPO

(1997), but their consideration of startup time lumps together all new ventures, from the mom-and-pop store to the international technology venture. The lack of consideration of the temporal dimension is an issue both in the entrepreneurship literature (McMullen and Dimov 2013) and the internationalization literature (Welch and Paavilainen-Mäntymäki 2014).

The time horizon for the startup process, including activities engaged and their duration and sequence, varies depending on the industry (Liao and Welsch 2003). Vohora et al. (2004) examined university-based “spinout companies” and mapped phases of development with “critical junctures” between them. Bird (1992) introduced the idea of time pacing to describe the frequency of milestones in the entrepreneurial process. When Brown and Eisenhardt (1997; Eisenhardt and Brown 1998) studied time pacing in the computer industry, they found that many successful organizations set ambitious, self-constructed timeline intervals for new product releases.

Venture creation speed

Venture emergence occurs when four conditions have been achieved: intention, boundaries, resources, and exchange (Katz and Gartner 1988). The speed of venture emergence can be measured by the amount of time required to meet these four conditions, completed when exchanges in the form of sales have taken place (Schoonhoven et al. 1990). International exchanges (exports) by the new firm mark the completion of emergence for the international new venture (Kundu and Katz 2003).

While there have been many studies of speed and innovation, understanding of the relationship between speed and venture creation is still developing (Capelleras et al. 2010). Time to market is an important factor for innovative startups (Heirman and Clarysse 2007). There have been a few studies of specific factors that impact the time of venture creation, based on panel data and surveys (Capelleras et al. 2010; Capelleras and Greene 2008; Clausen and Korneliusen 2012; Heirman and Clarysse 2007; Schoonhoven et al. 1990). But this approach does not capture the full picture of how some innovative technology ventures start up more quickly than others.

Some interesting results emerged from those studies. An important longitudinal study of 98 technology ventures by Schoonhoven et al. (1990) identifies factors that influence speed-to-market, including a particularly interesting result that increased spending (implying more financial resources available to the firm) was correlated with increased time-to-market. This finding challenges the assumption among venture investors that investing more resources accelerates innovative product launches. Clausen and Korneliusen (2012) found that entrepreneurial orientation, which includes the strategic, process-development and decision-making capacities of a firm that lead to the creation and market release of innovative products, has a positive impact on speed-to-market. There are indications that nascent entrepreneurs who aggressively pursue venture creation are more likely to launch their companies (Carter et al. 1996). Capelleras and Greene (2008) found that prior experience positively impacts speed of venture creation, as well as support from suppliers and customers; planning is detrimental; and the relationship between speed and growth is positive but weak. The latter result was contradicted by a later study that found that startups that take more time to launch subsequently have greater growth than those that take less time (Capelleras et al. 2010). Heirman and Clarysse (2007) found that the amount of startup capital has little

influence over time-to-market, and that having employees who were involved with developing products prior to launch leads to faster time-to-market, with the surprising exception of software firms. There is also evidence that launching a firm rapidly may hurt the enterprise in the longer run (Brush et al. 2008; Capelleras et al. 2010; Dierickx and Cool 1989).

Mostly based on statistical analysis, these studies have been ambiguous and sometimes contradictory. New ventures that are developing innovative technology products are engaged in complex undertakings. The studies in this area have raised interesting questions; in-depth comparative case studies can provide more insights on the processes by which time-to-startup and time-to-market can be reduced simultaneously.

Speed of new venture internationalization

Traditionally, international business scholars described internationalization at the firm level as an incremental process (Johanson and Vahlne 2003; 1977) from near to far, facilitated by gains in resources. The more recent field of international entrepreneurship initially focused on internationalization guided mainly by particular elements of entrepreneurial orientation (Dess and Lumpkin 2005, Kessler and Chakrabarti 1996)—i.e., entrepreneurial characteristics of autonomy, innovativeness, pro-activeness, competitive aggressiveness, and risk taking. The number of early-stage technology companies that are rapidly internationalizing is increasing dramatically (Madsen 2013). The international new venture is defined by Oviatt and McDougall (1994) as “a business organization that, from inception, seeks to derive significant competitive advantage from the use of resources and the sale of outputs in multiple countries.” For our study of nascent international ventures, internationalization is marked by the achievement of early foreign sales. Oviatt and McDougall’s framework provides an important theoretical foundation that has subsequently been deepened and extended (S. A. Zahra 2005). Etemad (2004) proposes a meta-framework for international entrepreneurship using a systemic approach that nests the entrepreneur level within the firm level, which is in turn nested within the market level, thus integrating several lines of research.

Internationalization is usually seen as a second stage of the innovation process, except for the new venture that has achieved rapid internationalization, sometimes called the “born global” (Autio et al. 2000; Weerawardena et al. 2007). The founding team plays an important role in the timing of internationalization: Denicolai et al. (2015) underlined that firms founded by entrepreneurial teams are more likely to be both innovative and international than family firms or sole-entrepreneur firms. Turcan and Juho (2014) explore how new ventures internationalize beyond the start-up phase, emphasizing the need to develop substantive capabilities to internationalize, requiring time and financial resources. In a similar vein, Andersson and Evers (2015) build on international opportunity recognition and dynamic capabilities literature to explain how dynamic capabilities of the firm can be created for international opportunity identification leading to international firm growth.

While internationalization is widely accepted as being a process, few studies of internationalization have taken a temporal, process-based approach (Welch and Paavilainen-Mäntymäki 2014). Autio et al. (2000) links the speed of initial internationalization with subsequent international growth. Chetty et al. (2014) promote a nuanced and multi-dimensional approach, recognizing that internationalization speed may vary

over time as companies learn and then expand, and may accelerate or decelerate over time. Casillas and Acedo (2013) propose the explicit examination of the role of speed in the internationalization process as a means to identify and explain patterns of internationalization. Casillas and Moreno-Menéndez (2013) found that the depth of international activities in a country increases international growth in the short run, but that the learning accumulated from entering diverse countries is more favorable for long-term growth.

In studies of speed and international new ventures, one theme that has emerged is the importance of networks for accelerated internationalization (Acedo and Jones 2007; Musteen et al. 2010; Oviatt and McDougall 2005; Yu et al. 2011). The networks of the entrepreneurial team play a key role in internationalization (Coviello and Munro 1995; Coviello 2006; Evers and O’Gorman 2011). It takes time and resources to build these networks from scratch, so ventures that are successful at rapidly internationalizing may require access to existing networks (Johanson and Vahlne 2003). The scientific community is an international network embedded in universities. Universities have the opportunity to help facilitate relations with external networks (Grandi and Grimaldi 2003), such as university-industry collaborations, which could accelerate the internationalization process for university-affiliated ventures.

To speed up the process of startup creation and growth, reducing time to international markets for innovative products while quickly launching an emerging organization, it is necessary to understand the mechanisms by which innovation and organizational emergence can be accelerated (Capelleras et al. 2010; Eisenhardt and Tabrizi 1995; Markman et al. 2005). Capelleras et al. (2010, p.319) underline that “a better understanding of temporal events such as creating a new venture will require additional methodologies. In effect, there is a need for future research that explores more fully the actual processes of venture creation and temporal transitions by using a case study approach. It would be of particular interest to explore how organizational capabilities are developed over time in the venture gestation process.”

Time is a specific resource that cannot be acquired. International technology entrepreneurs seeking to launch enterprises quickly have to manage competing pressures: compressing time to innovate, time to form the company, and time to internationalize. This paper explores the mechanisms by which *startup technology firms achieve rapid product innovation, organizational emergence, and internationalization*. The focus is on mechanisms that are internal to the startup firm (and therefore able to be influenced by internal or external actors), not on factors beyond the firm’s control, such as market conditions, global forces, economic cycles, or the behavior of competitive firms. Whether given market conditions are national or global, some startup firms are able to develop innovative products and emerge more rapidly than others.

Research design and method

To understand how companies compress the time frame of venture launch, exploratory research without preconceived notions, as is possible with case research, is important. Ideally, comparative case studies for theory building

start with a minimum of theories or hypotheses under consideration (Eisenhardt 1989a). The research question is explored with the case study research method using a multiple-case, replication design to ensure the validity of results by eliminating idiosyncratic findings (Yin 2009). Four startups were studied using in-depth, semi-structured interviews; company internal documents (e.g., business plans, incubator applications, and board meeting notes); and publicly available records and articles. The study used an embedded design to encourage a rich and granular understanding of the research topic and subjects (Yin 2009).

The level of analysis is the firm, but the firm's founding is part of the study. The "firm" level of analysis may, at the earliest stages, only include the entrepreneur or the start-up team, as well as the firm's pre-launch resources and conditions. Company and individual names have been changed in this paper to ensure anonymity.

Conducting the cases in one industry was important because there can be differences in time-to-market in different industries based on competitive factors and the regulatory environment (Kessler and Chakrabarti 1996; Evers 2010). Theoretical sampling (Eisenhardt 1989a) was conducted drawing from four sectors of the clean tech industry for replication purposes and for sufficient diversity in the extreme examples to ensure that theoretical constructs would be generalizable. In other words, this study sought to balance the consistency that exists for an industry within the macro-environment with a diversity of examples to develop theoretical constructs that could be applicable across industries.

As described in Table 2, the four venture creation cases in this study represent four scenarios under consideration during the timeframe studied: one was nurtured by a UBI and quickly internationalized; one was nurtured by a UBI and did not internationalize, one had no university affiliation and quickly internationalized, and one had no university affiliation and did not internationalize. For the purpose of full disclosure, it should be noted that the startup that joined a UBI and achieved international sales was involved in an academic course and UBI managed by one of the authors. That author has no ongoing relationship with the startup, never had a personal financial relationship with the startup, and did not have a role in advising the startup during its tenure at the UBI.

With the global focus on venture acceleration (Hallen et al. 2014), we need to better understand the relationship between time and venture emergence. Capabilities, strategies, and conditions leading to rapid innovation and organizational emergence need to be identified in order to be empirically tested. Understanding the simultaneous speed of innovative product and firm emergence, and the consequences of that speed, is important to entrepreneurs, investors, and incubation professionals (including at UBIs), as well as scholars.

Table 2 Case internationalization and university affiliation

	Not university affiliated	Nurtured by UBI
Did not internationalize	G-Home	Evenout
Internationalized	Techlight	Oil-less

Scope delimitation

This research had the following boundaries, summarized in Table 3:

1. *Startups to be studied were in the clean tech industry.* Some degree of commonality among companies was desired so that the research did not have to control for industry differences. Also, the authors possessed specialized knowledge needed to understand industry-specific lingo, historical events that impacted the industry, and other factors specific to the clean tech industry that made data collection and analysis more efficient and well informed.
2. *Startups to be studied were based in the USA.* Because regulatory and market structures vary across countries, thus resulting in different timeframes for technology startups (Misra et al. 2012), all of the startups came from one country. The analysis did not need to control for national differences, but results should be generalizable internationally. Four qualified ventures were located and data was collected between January 2012 and December 2014.
3. *Time period studied was from first indication of an emergent organization until a clear signal of market traction.* This time period was selected because it includes innovative product design, organizational emergence, product introduction to the market, enough market acceptance to indicate that the startup could be a viable business, and enough foreign sales to indicate whether it could be considered “born global.” The first indication of an emergent organization could include documented intention, resource gathering, some type of internal or external exchange, or establishment of an organizational boundary, which are the four conditions for organizational emergence outlined by Katz and Gartner (1988). A clear signal of market traction could include a major distribution deal, significant sales growth, or a sizable sale to a major industry firm. All four ventures released products and achieved market traction during the time frame studied.

In these four cases, the time period from the first sign of organizational emergence to market traction was very quick—25 months or less. Determining what “rapid” (or “quick” or “fast,” terms also used in this paper) meant was an

Table 3 Venture scope delimitation characteristics

Venture	Industry segment	Location in US	# informants	Period of study	Waiting period ^a	End of period	Sign of innovation
Oil-less	Biofuels	West Coast	11	16 months	3 months	2011	Patent
Evenout	Grid storage	Mid-Atlantic	6	24 months	6 months	2014	R&D time
G-Home	Green building	Pacific NW	6	25 months	13 months	2011	Patent
Techlight	Solar	West Coast	5	25 months	14 months	2007	Patent

^a As defined by Schoonhoven et al. (1990)

iterative process. Based on experts' experience and conversations with startup professionals, the original timeframe considered was approximately 2 years. After talking to dozens of clean tech startups, four willing and qualified firms were located for the study that started up within 25 months. External validation was sought to verify that this was indeed significantly faster than the average technology startup. Schoonhoven et al. (1990) conducted a study in a technology market with similar characteristics—hardware (with software elements) in a rapidly developing market with considerable regulatory changes and incentives. That study considered “waiting time” (from launch to first sale), which is a subset of the timeframe of this study. The duration of the startup time as defined in this study and of “waiting time” were calculated for each firm and are included in Table 3. The mean “waiting time” of the Schoonhoven et al. study was 21.07 months, with a standard deviation of 11.19. All four firms in this study were within the fastest 26.4 % of firms as defined by Schoonhoven et al. (1990). It should be noted that, in general, technology startups try to launch quickly. So these were among the fastest of the fast.

4. *The completion of the time period studied occurred within 8 years of case study data collection.* The time period was in the recent past so that documentation was more likely to be available, and so that the memories of interview subjects would be more accurate and complete.
5. *The startup developed an innovative product or service.* This was indicated by patent filings and/or product introductions new to a market. Three of the four startups applied for patents within the timeframe studied, and the fourth invested significant time and resources in research and development to adapt an existing product for an entirely new use in a different industry.

Data collection

An initial phone meeting was conducted with entrepreneurs or cofounders to identify key stakeholders during the study period, including cofounders, early team members, contractors, advisors, university officials, and early customers. The first interview was with the founding entrepreneur to establish an initial timeline and to gather basic information. A second interview with that person was conducted, usually toward the end of the data collection process, to answer questions that emerged. In all, 34 interviews were conducted with 28 informants, described in Table 4, with data uploaded to Dedoose (cloud-based qualitative data analysis software).

To triangulate information, additional data were requested during the process, including documents such as journals, business plans, board meeting notes, investment competition applications, and product descriptions. Other data were gathered through secondary research, garnering newspaper articles, incorporation documents, and patent filings.

Interviews were semi-structured, allowing deeper questioning on pertinent threads of conversation. The interview guide included seven topics: Foundational Information (including key milestones and other timeline information); Organizational

Table 4 Case interview informants

Oil-less: 11 informants	Evenout: 6 informants	G-Home: 6 informants	Techlight: 5 informants
Cofounders (3): CEO, CFO, CMO	Cofounders (2): CEO, CTO	Founder: CEO (1)	Cofounders (3): CEO, CTO, Investor/Chair
Other startup team members (2)	Service contractors (2)	Technology director (1)	Other startup team members (2)
Accelerator advisors (3)	Accelerator advisors (2)	Finance director (1)	
Early customer (1)		Other startup team members (3)	
University lab managers (2)			

Development; Funding; Resource Use; Product Innovation and Launch Speed; Substantive Capabilities to Dynamic Capabilities; and Market Making.

Data analysis and findings

Interviews were transcribed, uploaded to Dedoose, and coded. Documents were uploaded, reviewed, and analyzed. Initially, each case was considered separately, and timelines for each case were developed mapping the events described in the data. Second order analysis was conducted to find meaningful patterns in the data. When grouping second order analysis themes during the first case studied (Oil-less), the distinction (described in “[Two distinct, simultaneous emergence processes](#)” section) between the process of developing an innovative product and the process of creating an organization emerged. These processes unfold simultaneously and in parallel in new technology ventures. Comparison of coded data and second order analyses from the four cases led to most of the findings described in this paper. Comparison of the timelines resulted in the Stages of Development model depicted in [Table 5](#) and the identification of the organizational formation pivot described in “[Stages of development in fast startups](#)” section.

[Table 5](#) describes some characteristics of the ventures. Four case study synopses were constructed with special attention given to timelines.

Case analysis synopses

Company and individual names have been changed in this paper.

Oil-less Steve Bingham received his Chemical Engineering degree from a technical university before entering the workforce in a trade unrelated to his degree. He started a few small home-based side-businesses to enhance his income. After a few years, he decided to pursue an MBA degree from a small, private university. While there, he got a job in operations at a biofuel manufacturing plant. In his second year of the MBA program, to prepare for his capstone business plan project, he wanted to come up with a

Table 5 Characteristics during time period studied

	Oil-less	Evenout	G-Home	Techlight
Founding team	Entrepreneur and two MBA classmates	Married couple	Entrepreneur and friend with technical know-how	Entrepreneur, coworker, and father
Initial context	Working on MBA project	Unemployed, looking for opportunity	Entrepreneur's second venture	Desire to switch industries to solar
University affiliation	UBI, MBA program, lab research	UBI	None	None
Sources of funding	Startup team, family	Self, family, SBA loan	Self, family	Founding team
International activity	Sales	None	None	Parts sourcing; sales
Internal informants	Entrepreneur, cofounders, startup team members	Cofounders	Cofounders, ex-employees, executive	Cofounders, startup team members
External informants	Advisors, early customer, attorney, strategic partners	Contractors, advisors		Advisor
Teammate departures	3	2 and partner firm	4	3

scalable idea using his chemical engineering background. His big idea came at work when he was purchasing petroleum-based products for the equipment maintenance at a biofuel facility. He realized that there could be a sizable market for biologically based industrial products. However, he had limited resources to pursue developing these kinds of products, which require a lab with sufficient equipment to test products to ASTM standards.

Steve knocked on the door of the Chair of the science department in early fall of 2010 to see if he could use university laboratory and equipment in their new science building to work on his project. That was the first intention he demonstrated of commercializing his idea (and the beginning of our timeline). The Chair told him to make an appointment, so Steve returned the next day after setting an appointment. The Chair sent him to a chemistry professor, a retired chemical engineer from a global oil company, who thought it would be an inspirational applied learning opportunity for biology and chemistry majors. The professor agreed not only to let Steve use the lab and equipment for R&D, he provided student lab assistants and interns. He coordinated resources and monitored Steve's work, providing valuable technical advising in the process. During that semester, Steve worked on developing petroleum-free products, and after about 4 months developed an innovative product formulation that that passed all four ATSM standards. He decided to patent the formulation.

In January 2011, Steve started his MBA capstone course, and he now had his business idea. He also decided this was more than an academic exercise and applied to join a UBI. He was not accepted, since he did not have a specific product or market yet. He started by considering the automotive market, but abandoned this idea because of the extensive testing and approval process that would be required to put such a product on the market. He pivoted to developing industrial products, but the cost of producing a sufficient amount to enter the market without funding was daunting. He knew he needed a product and some revenue to attract investors. He also needed a way to manufacture his product, so he approached the CEO of the biofuel facility where he worked. The CEO agreed to let Steve use equipment if it was during his off-hours, when the equipment was not in use, and if he cleaned up after himself.

In April, in order to create and market a product with his limited resources, Steve pivoted again to a petroleum-free product for a niche consumer sport and recreation market. He quickly developed a formulation to test. Over the next couple of months he experimented and tested until he developed a minimum viable product. He recruited some MBA classmates, who became his startup team. Everyone worked in exchange for promises of ownership shares.

In June, after graduating from the MBA program, Steve again applied to the UBI, and this time he was accepted. This gave him office and warehouse space, access to domestic and international connections, and weekly mentoring. He applied to many startup business plan and investor competitions in the USA and EU to attain validation and funding. (Oil-less placed well in three global competitions over the next year, which brought significant exposure and a modest financial award, but no immediate investors).

In early July, Oil-less released and sold their first product. They bottled the product by hand in the back room of the UBI. The initial product did not work very well in the opinion of expert customers, so they went back to the lab until they had addressed all of

the product issues. In the process, they developed a second formulation to capture more of their niche market.

All of this occurred in the first year.

Meanwhile, there was some turnover on his team, who were still unable to be compensated. A sales professional came and went after about 3 months. A couple of the MBA graduates left, needing more stable employment. Steve was left with a team of three. They were selling and promoting products through guerilla marketing, while seeking additional funding. They would throw product-bottling parties, convincing friends to join their production line in exchange for pizza and beer. In November, the company incorporated with assistance from an attorney provided by the UBI (prior to that they operated as a sole proprietorship), and in December they achieved a significant international distribution deal that included an immediate order for 500 bottles of the product. They also engaged in their first international sales, and it became clear that they were entering a global market for their product. This was a clear sign that they had achieved market traction. While the startup team did not have previous international business experience, they had access to international networks through the UBI, business plan competitions, and distributor relationships.

Evenout In late January 2012, Gary Watkins, an experienced electrical engineer in the mid-Atlantic region who had been laid off from a major telecommunications company, decided to go to a power industry trade show to explore entrepreneurial opportunities. He returned home and developed an idea for a product that could help regulate grid demand, providing power when demand was greatest and rates were highest, reducing the need for “peaker plants.” Peaker plants are turned on only when demand and therefore rates are highest, and are the dirtiest, most polluting suppliers of energy into the grid. In February, he talked to his wife Lisa, a former engineer who had been raising their kids, about his idea, his first signal of intention to start up a company. Within a few weeks they decided to cofound the venture and he started working on the product, modifying off-the-shelf components. A month after that, he contacted a former co-worker, who had relocated to the West Coast, to write the software needed to make his product work. Lisa had incorporated a company a couple of years earlier that she had decided not to pursue, and brought it off the shelf to serve as the corporate entity for Evenout. She also became CEO of the firm, allowing Gary to focus on the technology development.

In May, Lisa submitted an application to a global clean tech startup competition. They were accepted into the competition, providing free mentoring and classes. She went on a steep learning curve to understand how to start up a technology company while Gary was developing the product. In July, he contacted the regional grid operator to research tying the products into the grid. He was surprised to find out that while the law had recently changed allowing such relationships, the actual mechanisms and protocols for doing so had not been established. Evenout needed to develop a viable product to be installed with individual customers while also working with the grid operator to enable the device to interface with the power grid.

New technologies were being developed to support a more efficient “smart grid,” and regulatory changes were being implemented to allow entrepreneurial opportunities to create more grid efficiency. In this newly emerging business model, it was the grid operator who would ultimately compensate enterprises like Evenout in exchange for

helping reduce the cost of energy during the most expensive times of day and year. Evenout would then share some of their revenue with their customers. In other words, Evenout would be paying their customers to be their customers, making a profit in the process.

By September, Evenout had a minimum viable product and solicited friends and neighbors to be customers. This milestone coincided with a modest family investment. However, issues with the grid operator were still being worked out, and this beta rollout brought out technical issues in the product itself that needed further development. By this time, they had access to three incubators as affiliates, including one UBI, providing startup mentoring services. They also needed help with sales if they were to scale. In January, they partnered with a sales organization to generate more customers. In February, they secured a booth at a trade show, where they got the more than 60 customers needed to rigorously test their product at a minimum scale.

By May of 2013, Gary and Lisa realized that the work it would take to convince a sufficient number of individual customers of their business proposition was not viable at that time. They shifted gears to market to multi-unit property management companies so they could conduct large numbers of installations with a single contract. They severed the partnership with the sales organization, procured another family investment, and scrambled to work out issues with the grid operator so that they could start generating revenue.

In September 2013, they paid the grid operator a hefty connection fee and finally went live with their product installations. They discovered that their business model did not generate as much revenue as expected. This was a low point for Gary and Lisa, but Gary kept developing the product to make it more responsive and efficient while Lisa continued to pursue large multi-unit contracts. In February 2014, at the same time that they secured a sizable SBA loan, they closed a contract with a large property management company. This signaled market traction for Evenout. Gary and Lisa did not have previous international business experience and their initial business model precluded internationalization in the short term. Therefore, they did not seek connections to international networks, although they had exposure through the global startup competition.

G-Home Larry Paxton, who had started up a modestly successful internet-based specialty products company with a global market, had an idea for another business. He lived in an old home in the Pacific Northwest that was very inefficient, and there was no existing reasonably priced way to increase its efficiency. That led to his idea for a new type of energy-efficiency product with a large (potentially global) market. In January 2009, Larry Paxton contacted and hired his friend Jerry Perkins, who was a creative and resourceful craftsman in the building trades, to help develop his product, thus signaling his intention to start a new venture. In February, he filed paperwork to create an LLC. They installed a first iteration of the product in February in Larry's home. Within a couple of months it failed miserably, but this gave them a starting point for a process of rapid reiteration and testing. By August, they had developed the product enough to file for a patent.

The next several months were all about product development, with Jerry leading the effort. Larry ran his Internet venture while also managing this new startup. The product did not just need to be invented and tested, it needed to be designed for manufacture at

scale, and in a way that would minimize installation costs and mistakes. From March through June 2010, four other friends and connections were brought onboard to start developing marketing, sales, production, and installation processes. In May 2010, Larry leased a 10,000 square foot facility for R&D, production, and offices. In June, they started developing technical measurement equipment to ensure successful installations, including a software application to store the data and make it accessible for their manufacturing facility as well as independent installers. In July, they reached a milestone: they had developed a minimum viable product that was ready for production.

In August of 2010, Larry left his role as CEO of his Internet venture to be able to work full-time with G-Home. He solicited funds from family and friends to be able to start production. In September, he hired a consultant with deep financial and operational experience to develop HR and financial systems. This brought major changes to the culture and organization of G-Home as they prepared to go to market. In November, G-Home incorporated and sold its first products. In December 2010, the consultant was hired full-time as Director of Finance (which included HR). Two of the people who started earlier in the year left voluntarily when they realized they did not have the skills and capacities needed for a highly professional production environment. In January 2011, an article about G-Home was published in the major city newspaper, leading to a rapid increase in sales and a clear signal of market traction. G-Home did not internationalize during this time period. While Larry had experience accessing global markets through online sales in his previous venture, he made the strategic decision to internationalize slowly with G-Home's customized home-improvement products.

Techlight In late December 2004, Warren Campbell and his father Frank were driving to a family event. Warren was an engineer at a global technology company headquartered in Northern California, and Frank was a VC, consultant, and former executive. They both thought that Warren may have entrepreneurial talent, and were brainstorming business ideas. Warren wanted to develop a business in the solar industry because he was passionate about environmental causes and believed that solar energy was the key to our energy future. He recalled an issue with his home solar installation, and thought that he could come up with a better device to improve the solar installation process. A couple of weeks later, in early January 2005, he produced a concept paper that signaled his first intention to develop and commercialize a new solar technology accessory with global demand.

In February, Warren contacted his friend and former coworker Terry Gray to help him on the software side in exchange for shares in his future company. Terry agreed and they both worked on a prototype in their time outside of their jobs. Frank served as advisor and helped out 1 day per week. Warren was itching to work on the idea full-time, and when his employer, in June, offered a generous severance package to those employees who would volunteer to leave, Warren jumped on the opportunity. He started working for Techlight full-time in August 2005, with 9 months of pay from his former employer to support him. His first action was to develop a summary business plan.

Warren also recruited other friends, neighbors, and coworkers to come on board part-time in exchange for future shares. By fall of 2005, there were three other members of the startup team. In September, he and Terry decided to use an off-the-shelf

processor for the device, rather than develop a custom processor, greatly accelerating the product development cycle.

Techlight incorporated in November 2005, an effort led by Frank, who became the board chair. He created formal processes with regular board meetings starting in January 2006 (consisting of Warren, Terry, and himself), voting procedures and proper notes. In December of 2005, Techlight filed its first patent. In January 2006, the company received a modest capital infusion from the three cofounders, primarily from Frank.

The first half of 2006 was used to complete product development (hardware and software) and develop marketing materials. They formed an agreement with a distributor in July. They decided to introduce their minimum viable product at a solar industry fair in August 2006. They got some interest and made a few sales. In October, they shipped their first products to those initial customers. Also in October, they showcased their new product at an international solar industry trade show.

During that fall, the other three members of the early team (not including Warren and Terry) left the venture or were dismissed as the company formalized roles and processes.

During 2006, Warren engaged in advocacy with a state task force developing new standards for California's solar initiative. The new rules were released in January 2007, and Techlight's device was an important technology for meeting the new standards. This led to an immediate and significant spike in sales, a strong signal of market traction. In addition, there was strong interest from other countries, particularly in the EU, since several European countries had significant incentives promoting solar development. With the experiences of the startup team working for a global technology company, and international connections through their distribution network, Techlight was well positioned for international growth. By 2008, about 25 % of sales were outside of the USA.

Two distinct, simultaneous emergence processes

The first case analysis revealed that there are two simultaneous processes in technology startups: product emergence and organizational emergence.

Product emergence: As mentioned in "[Innovation speed](#)" section, accelerating the development and release of innovative products in technology companies generally improves outcomes. The four ventures studied were all product and technology oriented in the earlier phases of their emergence, and all informants agreed that there was no downside to developing and releasing their products quickly. In all cases, there were technical issues and/or a lack of important features with the earliest releases, but this allowed them to solicit customer feedback to help with their design and manufacturing processes.

Organization emergence: It is not clear from the literature and from these cases that accelerating organizational emergence generally leads to better outcomes. All four ventures faced challenges that emerged from the earliest phase of organizational emergence that was characterized by undefined roles (everyone does whatever needs to be done) and ad hoc decision-making. For Oil-less and Techlight, these challenges included agreements regarding ownership and decision-making that were not

formalized in legal documents. Techlight made equity agreements with individuals whose contributions to the company were quite limited.

Stages of development in fast startups

The entire period in this study is considered “early stage” in the launch, growth, and maturation of a startup venture. While three of the four cases were in industry sectors with global markets, this period of study was primarily a preparatory phase for internationalization. The achievement of international sales concluded the period of study for Techlight and Oil-less. While many accelerators and incubators are primarily interested in admitting ventures that have already achieved a signal of market traction, UBIs are well positioned to support entrepreneurial teams during the early stage addressed in this paper. This is because the innovative ideas are often spawned at universities and they have the breadth of resources available to support early stage ventures (Lee and Osteryoung 2004). Table 6 characterizes the two separate, simultaneous processes during the emergence of a technology startup.

Table 6 shows the two timelines operating in parallel. The entrepreneur starts with an idea and starts experimenting to figure out if there is a product that could be developed and viable. The entrepreneur calls on people he/she knows well and makes informal agreements with them to help out, and with whatever scarce resources are available starts prototyping a product. Decision-making is ad hoc so that progress can be made quickly. At some point in developing a product, at least one pivot in product strategy is usually required to develop a product that is marketable. For Techlight, this meant integrating an off-the-shelf electronic device rather than developing their own circuit boards. For Oil-less, this meant re-configuring the product for a smaller but easier-to-enter market. While one or more pivots on the product side is typical, it is not a necessity or requirement for starting up quickly. The startup team then settles on a minimum viable product that they can introduce to the market as quickly as possible.

The organizational formation pivot is always necessary for technology startups that adopt a “lean startup” (Ries 2011) approach, which included all four firms in this study. None of the firms studied spent much time on organizational development during the earliest phases—they were too busy developing their products. The organizational formation pivot occurs at about the time the first product is released into the market. In order to systematize manufacturing and organizational processes and successfully emerge as a viable and growing organization, there has to be a pivot to formalize agreements and professionalize management. The firm must provide the structure for employees, customers, suppliers, and future investors to conduct legal and reliable transactions to produce, purchase, market, and service the products domestically and internationally (for the born global firm). The chaos that would otherwise ensue would cause a firm to stumble and soon fail. Oil-less showed signs of this when the founder and his team were at odds—the team was ready for more professional management, while the founder continued to hold down another job and operate in an opportunistic, ad hoc manner. Companies that make this organizational pivot are able to systematize manufacturing and organizational processes so that an innovative product can be released and demand met, with

Table 6 Stages of fast venture development

Product emergence	Stage 1 Idea formation and selection	Stage 2 Prototyping	Stage 3 Pivot (usual)	Stage 4 Development of minimum viable product	Stage 5 Systematization of production	Stage 6 Continuous improvement
Organization emergence	Team formation	Ad hoc decision-making and extraordinary resourcefulness			Organization formation pivot	Formalization of agreements and professionalization of management
	Stage 1	Stage 2			Stage 3	Stage 4

professional management that can successfully bring the product to market and operate a sustainable company. Systematizing manufacturing is also necessary to reduce costs and continuously improve the product in response to customer feedback.

Patterns and common characteristics

While each company had a singular emergence story, patterns emerged upon analysis. Sometimes there were similarities in their answers to specific questions. In other cases, the patterns were discovered when reading all of the excerpts under a specific code.

Motivation for speed One common factor that emerged in the interviews with founders was that they were not motivated to start up quickly for reasons related to market timing. They were all motivated to start up quickly in order to start generating revenue before they ran out of funds. When asked why they started up so quickly, the CEO of Techlight said, “I would say primarily at the time of what we were thinking the critical thing was just burn. How long can I go without salary? How long can we afford to pay (my cofounder)? And that kind of thing.” When asked about resources, Evenout’s CEO said, “...the other resource that is incredibly scarce is time.” It became clear in all cases that there was an important and dynamic relationship between time and financial resources, and this became an important theme of this analysis.

After the organizational formation pivot, the global technology startup is ready for the external funding required to scale internationally. This can accelerate growth. Prior to the organizational formation pivot, fast startups tend to receive little or no external funding, because funding is more expensive at such an early stage (in terms of ownership stake) and it is more time-consuming to pursue, with lower chances of success. During the timeframe of this study, all four ventures received modest capital infusions from family members. None of the ventures received any other external funding.

Startup team composition Entrepreneurial teams are much more common in technology firms than solo entrepreneurs (Cooper, et al. 1990; Lechler 2001). Another commonality among all cases was that the initial startup team was sourced from people that the original entrepreneur (the person with the initial idea) already knew, as described in Table 6. Oil-less started when the CEO invited MBA classmates to become cofounders. G-Home’s founder invited a friend with technical skills to join him. The relationships between cofounders of the four firms were different from each other, but cofounders who knew each other well started all four firms. This pattern emerged for two reasons: (1) it saved time to work with people who the founders knew instead of trying to recruit talent; and (2) because the entrepreneurs were known and trusted by the people working with them, they were able to make delayed or reduced compensation arrangements based on future equity stakes. The exception to the latter point was the CEO of G-Home, who paid early team members and did not offer them ownership stakes.

Workload pressures The pressure on the teams was intense in all cases. Oil-less, Techlight, and Evenout had to get the products to market in order to start receiving compensation. G-Home, started by an internet entrepreneur, put pressure on the team to perform as he saw his savings dwindle. There is an important and dynamic relationship between time and the startup team workload, including personal costs to the effectiveness and the mental, physical, and emotional health of the startup team member. As the CTO of Evenout said, “There’s a risk that it may not work well enough soon enough to meet your next objective. So it consumes a lot of emotional energy.”

A holistic approach to workload (which considers stress and mental effort) is important to consider—it is more than just work hours per week. One approach to conceptualizing this broader definition of workload is known as “subjective mental workload” (Hart and Staveland 1988), originally developed to assess workload for machine operators. The most established and well-known system for measuring subjective mental workload is NASA-TLX (task load index), which includes six rating scales: mental demand, physical demand, temporal demand, performance, effort, and frustration level (Hart and Staveland 1988). Other measures have also been developed that try to capture subjective mental workload, including Subjective Workload Assessment Technique (SWAT) and Workload Profile (WP), with varying degrees of diagnostic effectiveness (Rubio et al. 2004).

Another approach to assessing workload is to measure burnout. The term burnout is characterized by three underlying dimensions: exhaustion, depersonalization, and reduced ability to accomplish tasks (Maslach et al. 2001). The most established assessment of burnout is the Maslach Burnout Inventory (MBI) (Maslach and Jackson 1981). Originally developed for workers in human services, it was later expanded to include all professions with the MBI-General Survey (MBI-GS). Both of these MBI scales measure three dimensions: exhaustion, cynicism, and inefficacy (degree of ineffectiveness at work) (Maslach et al. 2001). Subjective mental workload and burnout assessments have been applied in many countries. An excessive workload resulting from a compressed startup timeframe leads to issues of burnout no matter where it happens.

Early startup team departures While startup teams were comprised of connections of the founders, that did not prevent them from leaving. As pointed out in Table 5, all four ventures had early team members who quit because of workload issues. Sometimes the workload intensity was due to temporal pressures. For example, according to Evenout’s CTO, “(An early team member) worked ... six hours a night (in addition to his regular job) for three months until he discovered that he could no longer function as a human being. He went beyond a normal burnout and just could not go any further.” Table 7 describes the roles of early team members who separated from the venture.

Scarce financial resources also impacted the intensity of the workload. This also caused early team members to leave the startup. As the CEO from Oil-less said, “They would come to me and say, ‘You know what, I think I am going to find a job. I love this a lot, and guess what, I have to make some money. I got kids at home.’” Another dynamic relationship that emerged was between financial resources and workload intensity, which became an important area for exploration.

Table 7 Roles of team members that left venture

Oil-less (3)	Evenout (2)	G-Home (4)	Techlight (3)
Sales professional	Programmer	Operations director	Mechanical engineer
CTO	CFO	Sales manager	Sales professional
Operations manager		R&D associate	Marketing manager
		Operations manager	

Tensions between resources

Temporal and financial resource dynamics Starting up quickly reduces the tensions between temporal and financial resources by saving scarce resources, which can delay the need for external funding and lead to more favorable investment terms while providing market advantages.

Financial (or equivalent) resources are important to entrepreneurs and have an important relationship with time.¹ Financial resources allow nascent international technology entrepreneurs the ability to buy parts or raw materials, secure facilities, compensate founding team members (sometimes), attend or exhibit at industry trade shows, explore international market opportunities, hire contractors for specialized needs, etc.

While it turned out that market timing was very important for some of the ventures studied, none of the entrepreneurs mentioned market timing as an important motivation for starting up quickly. In all cases, they were driven by the need to generate revenue before running out of funds. As the founder of G-Home said, "...there was this terrible, terrible sense of my bank account being drained and just this severe urgency around trying to make more progress before we ran out of money."

The first mechanism highlighted in our study is the trade-off between startup rapidity and resource collection. This could help explain the finding by Schoonhoven et al. (1990) that higher expenditures (and therefore more funding) were associated with a longer startup timeframe. Significant funding (that is not draining one's personal bank account) can reduce the sense of urgency. Less funding means the startup team has less time to achieve milestones, requiring speeding up progress. In other words, scarcity of financial resources speeds up technology venture launch. Of course, there are constraints to how much funding can be limited—a venture cannot be launched for nothing. The best way to phrase this may be: international technology ventures start up most quickly with the minimum funding required to remain viable. This temporal-financial tension also drives extraordinary resourcefulness (as with Oil-less), which can further reduce startup costs.

Securing investors before having a product developed that is generating revenue is arduous, time-consuming, and unlikely to succeed. If an entrepreneur were able to

¹ "Or equivalent" is included because entrepreneurs can be extraordinarily resourceful in order to extend their "runway" before running out of funds. For example, Oil-less arranged for the use of a chemistry lab in a small university in exchange for giving some talks to classes and providing opportunities for chemistry majors to get practical experience as research assistants. When the term "financial resources" is used in this paper, it should be understood to include financial equivalents.

secure angel investment before generating revenue, it would typically be very expensive for the entrepreneur in terms of ownership stake or other deal terms. The further along the venture founders can get before accepting funding, the more they will be able to retain ownership and control. This is why the startups studied were so highly motivated to launch as quickly as possible using only personal funding and support from family and friends. This is consistent with a finding of Gartner et al. (2012), who found that entrepreneurs with more personal resources are less likely to seek early stage financing, presumably in order to maintain more ownership and control of their enterprises. By starting up quickly, entrepreneurial teams are more likely to self-fund their ventures before running out of cash.

A good example is Techlight, who only raised funds from family, friends, and the founding team until they launched and achieved some market traction. The father of the entrepreneur was a venture capital professional who chaired the board of directors and worked 1 day per week for Techlight as an unpaid consultant. He made sure investment was limited in order to maintain control in the family and to motivate the startup team to get their product to market as quickly as possible. When they did start accepting external funding, they were able to issue only common stock to the investors (with no special voting rights), and the entrepreneur who sourced the idea maintained a majority stake in the firm until acquisition a few years later (after the period of study), following internationalization.

Reducing the time and financial resources necessary to start up can be a source of competitive advantage—the emerging company will be more flexible and resilient than a comparable venture that is burdened by creditor or investor obligations. Even if it was not their reason for starting up quickly, the earlier market timing that results from starting up quickly can be beneficial. Techlight was particularly fortunate in this regard. Their product was released just a few months before a state policy was announced that required such a product for solar installations to qualify for incentives. Their timing could not have been more perfect. If they had released their product a year later, they would have entered a more competitive landscape. It turned out they were in a “winner-takes-all” market niche, and they were able to claim the market globally. Table 8 describes the temporal/financial tension implications in four different situations (financial resource collection, external funding delays, control of the firm, and market advantages).

Temporal and human resource dynamics To start up quickly, the entrepreneur with the initial idea needs to be able to work with people she/he knows well and trusts. There is not enough time to recruit the best possible candidates. There is not enough time to build relationships and trust, or to develop formal agreements that can take the place of informal trust. G-Home started with two friends that had worked together on previous projects. Evenout’s founding team was a married couple. Oil-less was started by a team that spent 2 years together in an MBA program. The Techlight founding team was comprised of two engineers that worked together for a technology company, along with the father of one of them. In those early phases of product and organizational development, ventures continue to add to their teams through existing connections without any formal hiring processes, and often with informal, verbal agreements.

Those early relationships are characterized by ambiguous role boundaries (everyone does whatever needs to be done), long hours, and a sense of team camaraderie that can

Table 8 Temporal/financial resource tension implications

Implications of the dynamic tension between temporal and financial resources:

1. Prior to product release, new international technology ventures will start up most quickly with the minimum financial resources required to remain viable.
2. By starting up quickly, entrepreneurs delay the need for external funding and attain more favorable investment terms when they are ready to scale internationally.
3. By starting up quickly, entrepreneurs are more likely to maintain control of their companies.
4. By starting up quickly, entrepreneurs can achieve domestic and international market advantages.

Implication	Oil-less	Evenout	G-Home	Techlight
1	**	**	*	**
2	**	**	**	**
3	**	**	**	**
4		*	**	**

Exemplified this implication (**). Partially exemplified this implication (*). Did not exemplify this implication (no stars)

occur in small teams operating under extreme pressure. Workload intensity is high. As a startup team member from G-Home put it, “It was literally a really majestic time of utter stress, because we were facing problems weekly that we were solving.” The pressure is temporal: from products that need to be developed and released before funding runs out, and from the financial need of those undercompensated startup team members to draw a sufficient salary once funding or revenue milestones are attained. The pressure is also universal, occurring within technology startups globally.

Once a minimum viable product is completed and ready to introduce to prospective customers, the organization needs to shift to become more professional, enabling legally compliant and mutually satisfactory domestic and international customer relations, supplier relations, employee relations, and future investor relations. To make this shift (the organizational formation pivot), roles, ownership agreements, and compensation packages need to be formalized. Members of the startup team may not have the appropriate skills and experience for these new roles. As the finance director for G-Home said, “...in a company with 15 or fewer employees you can’t afford to have people who you know aren’t very productive. Some of those people weren’t, but they filled a need at a time and place when finding the absolute right person could have been very difficult given the tenuous thing.” Entrepreneurs and team members may have different understandings of the informal, verbal agreements that were made in the early days. This can lead to, at the very least, difficult conversations and can result in startup team members resigning, being fired, or being demoted to lesser roles than they had expected. The Techlight CEO described this transition:

“There was that early group of co-founders, who were sort of the ones that wanted to be involved and then there was a shift from that group to a group that I actually pulled in and hired myself. That was a painful, challenging transition, essentially having to phase out people who either really didn’t have the time or weren’t suited for the roles that I originally had them in. That sort of goes along

with the seriousness of that thing, that isn't just a club anymore, we are trying to do a business and if somebody is not doing the job, I am sorry but we have to move on. That was kind of a difficult transition....”

A start-up team member from G-Home described his realization regarding his role:

“Once you start getting deeper than my experience, I found myself like, I could learn this stuff, but it would be better at this point to find somebody who already knows it, because we want to get out to market now. And I was very clear with (the entrepreneur) when it was time for me to go and I got another offer and I said this is best for both of us. And he agreed, he saw that I could definitely do it, but somebody else could do it faster.”

The tension that exists between temporal and human resources is exacerbated by speed—the differing needs of product development (fast is desirable) and organizational development (fast is problematic). Fast organizational development is problematic because the only ways to compress the time frame is to skip steps in the organizational development process, outsource them, or do them in a cursory manner. Problems arise when products are released into domestic and international markets too early, when more structured roles, processes, and policies are needed.

Table 9 portrays the temporal/human tension implications in four different situations (startup team formation, startup team dynamics, trade-off between product and organization development, and the organization formation pivot).

Financial and human resource dynamics Human resources are expensive, especially in technology firms with highly skilled workforces. People are needed to make organizations work, but businesses will seek to minimize that expense in order to be

Table 9 Temporal/human resource tension implications

Implications of the dynamic tension between temporal and human resources:

1. Entrepreneurs in fast startups form teams with connections who are known and trusted.
2. Fast product development is characterized by ad hoc decision-making, ambiguous roles, team spirit, long hours and high pressure.
3. Startup teams engaged in fast product development give minimal attention to organizational development activities prior to the first product release.
4. In order to sell products and scale internationally, the organization needs to professionalize, often requiring difficult transitions for startup team members regarding roles, compensation and/or ownership agreements.

Implication	Oil-less	Evenout	G-Home	Techlight
1	**	**	**	**
2	**	**	**	**
3	**	**	**	**
4	**	*	**	**

Exemplified this implication (**). Partially exemplified this implication (*). Did not exemplify this implication (no stars)

as profitable as possible. This tension is often alleviated through outsourcing, automation, and layoffs.

In a startup technology enterprise with scarce resources, offering early team members some type of equity offering, such as convertible notes, frequently reduces this tension. This costs the startup nothing at the time, although it can raise issues later. Upon incorporation, one of the startups studied gave shares to 13 people, including several whose contribution turned out to be marginal, at best. Valuing team members' contributions before they have started working on a project is a challenge for any startup. When the startup is trying to launch very quickly, it is unlikely that the entrepreneur is going to take the time to thoroughly consider (or solicit advice regarding) the deals she or he makes with each of the founding team members.

Those startup team members will need to start getting paid at some point, since they cannot pay their rent or feed their families with equity agreements in a risky technology startup. This tension increases workload intensity. Some of those early teammates will work longer hours and at a faster pace in order to reduce the time until they can receive sufficient compensation. Many just are not cut out for it. As the Oil-less CEO said, "(a startup team member) was in for about three months, then he was out, (another startup team member) was in also for three months, and then out, and (a third startup team member) was in for about four months, then out. It seems to be like people decide whether they want or can do it, in about three months."

The escalating pressure on the early team can take its toll on human resources in the form of burnout. Just as there are limits to how little cash it can take to start up an enterprise, there are limits to how many hours and how much stress a startup team member can manage. Again, the Oil-less CEO: "Burnout was a total issue just because I was still like working fulltime plus and it was just tough." Table 10 displays financial/human tension implications in three different situations (equity as remuneration, startup team workload intensity, and team member exit).

Table 10 Financial/human resource tension implications

Implications of the dynamic tension between financial and human resources:

1. Founders often use offers of equity to help resolve tensions between human and financial resources. In the fast startup, equity agreements can be especially informal and ad hoc. While many countries have regulatory regimes that try to limit this form of compensation, arrangements are often informal and unwritten and therefore difficult to control.
2. The need to be compensated can drive founding team members to work more intensely for more hours to further reduce the product launch timeline.
3. The intense financial and temporal pressure on the startup team can result in burnout and/or separation from the venture.

Implication	Oil-less	Evenout	G-Home	Techlight
1	**	*		**
2	**	**	*	**
3	**	*	**	**

Exemplified this implication (**). Partially exemplified this implication (*). Did not exemplify this implication (no stars)

Discussion and contributions

This paper displays the mechanisms by which new ventures reduce time to *achieve rapid product and organizational emergence and begin internationalization*. Tensions crystallize around time. The main contribution of the paper is the recognition of time as an enabling mechanism that impacts the speed and success of firm creation, product launch, and internationalization of technology startups. Time is a resource for organizations (Bluedorn and Denhardt 1988), and for the nascent entrepreneur, time is a limited and extremely valuable resource. Time interacts with other startup resources, especially financial and human resources. An important characteristic of time is that it cannot be acquired. The only way to have more time is to acquire more financial resources to provide additional time for organizational emergence, product development, and international exchanges. An important way that time impacts human resources is through workload intensity. It is worth considering the dynamics of the interactions between time, financial resources, and workload intensity in order to see how they impact both the creation and launch of an innovative product and the creation and launch of the new organization that produces it. This discussion makes three different points: first, it underlines the specificity of time as a resource; second, it highlights the importance of the management of the timeline; and third, it explores the management of tensions as a vehicle for speeding up the international startup process.

Time as a resource Time is cognized by humans as a spatial dimension (Núñez and Cooperrider 2013). We think of time in terms of distance (e.g., we talk about how “long” an activity takes to complete). That space is filled with activities, existing as memories of past activities, actions in current time, and projected future activities. Time is the dimension that allows activity to exist. We set demarcations in those future projected activities called “goals.” We set goals and then we project the activities that will be required to achieve those goals. Nascent international technology entrepreneurs try to set goals to launch new enterprises with only an idea for a product and limited financial and human resources, in global markets characterized by conditions of uncertainty, complexity, and turbulence. The tension created between these unfulfilled goals and the current state creates entrepreneurial action (Bird 1992).

Contrary to other resources that can be acquired, time is given. It can be filled with activities with varying degrees of intensity, but, as highlighted within ethnographic studies of innovation in different industries (Hoholm and Araujo 2011; Kidder 1981), time is a unique resource for entrepreneurs because the pace at which it is consumed cannot be controlled. When more time is needed, more of other resources have to be acquired. In that sense, time is costly, and speeding up the creation and international growth of a new venture is a way to save money. This relationship between time and financial resources, indicating that startup time is reduced with fewer resources because entrepreneurial motivation and workload intensity are amplified, helps explain the Schoonhoven et al. (1990) finding that increased monthly expenditures are correlated with longer startup timeframes. Time is a very specific resource. Without raising additional funding to “buy” more time, the only way to increase time is to compress it so that more gets accomplished in a given timeframe.

Finally, time can also be an asset. Time can provide a competitive advantage, especially in international winner-takes-all markets (Oviatt and McDougall 1994;

Zahra et al. 2000). When companies compete to impose a new industry standard (in any country), or when the market requires rapid scale-up to become the dominant actor, time is a key resource to be reduced. The company must be the first to launch the product or service and to establish industry standards. This is a key reason why it is important for firms to rapidly scale their business model internationally (Zhang et al. 2015).

The importance of the timeline The simultaneous evolution of product development and firm creation is represented as two parallel series of stages in Table 6. Founding teams manipulate the time it takes to pass through those stages through motivational means. Workload intensity is the main mechanism for ventures to speed up the emergence process. The founders use external pressure to mobilize internal resources, especially human resources, to work more intensively and effectively. Founding teams reinforce existing tensions and constraints to compress time to market and time to organizational creation. A venture's timeline cannot be easily mapped out ahead of time into discrete stages. Stages of development are non-linear and timelines are idiosyncratic to companies (Vohora et al. 2004). A venture's timeline is a compromise between the different internal and external resource tensions, reinforced by the top management team to save resources or to compete in the marketplace. To start up quickly, the timeline is a mechanism to create momentum within the venture, and to mobilize all of the company's resources toward a common goal.

This is why creating and following a timeline that achieves goals for organizational emergence, product launch, and international sales is extremely difficult. International technology venture creation is an emergent process, so the compression of the timeline is more of a motivational tool than a time management tool. As such, it can only be a temporary mechanism, since it will eventually lead to overwork and burnout. Companies that startup quickly can have problems because reducing the timeframe for organizational emergence can mean skipping steps in organizational formation; making handshake deals with startup team members and early employees; and including team members that are willing and convenient but perhaps not the most qualified. This could explain the finding by Capelleras et al. (2010) that companies that take longer to start up have greater subsequent growth.

After the launch phase (about 2 years for the companies studied), different managerial mechanisms have to be implemented, resulting in the organizational formation pivot. Once the venture has navigated the organizational formation pivot, it is ready to scale internationally. UBIs support under-resourced and less experienced ventures by providing access to business networks and strengthening founding teams. UBIs have the additional advantage of access to existing international scientific networks, which can accelerate internationalization (Evers and O'Gorman 2011).

Managing tensions as a vehicle for the quick launch International technology ventures that launch quickly use the management of internal and external tensions to speed up innovation and venture creation. These tensions are used to compress the time required to create the organization and to bring the innovative new product to market.

Figure 1 shows how some of these tensions interact. If startup time is reduced, the amount of financial resources expended is reduced, and the amount of workload intensity (to accomplish startup goals in less time) is increased. This represents the

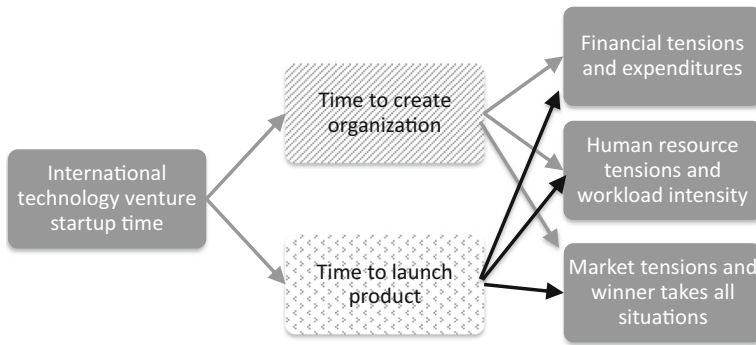


Fig. 1 Tension mechanisms to reduce startup time

high stress, high energy, do-whatever-it-takes, bootstrapping dynamic that characterizes the early stage technology startup. Limiting financial expenditures compounds the workload intensity in order to reach the revenue, funding, or exit targets that enable sufficient compensation to startup team members.

Because of these dynamics, the impact of reducing startup time generally improves the chances for the success of the new product release. However, the impact of reducing startup time generally decreases the chances of success for the organizational emergence process. In other words, reducing startup time increases the riskiness of the organizational emergence while improving domestic and international market prospects. Time is not only a source of tension. Time is a key variable to be strategically managed. Startup teams balance between collecting more investors and launching products and services more quickly. Reducing time to launch products and services also allows companies to internationalize more quickly and broadly. The founders' past experiences and access to networks are also important for rapid internationalization, as shown by Oil-less and Techlight. When founders have international experience and access to networks, as with academic entrepreneurs and managers in global technology companies, the pace of internationalization can accelerate. The launch timeframe influences the pace of internationalization and the opportunity for the product or service to become a dominant design in a "winner-takes-all" market configuration.

Conclusions

Time is a resource to be strategically managed for all technology ventures, which have to simultaneously move technologies into marketable stages and form founding teams. Time is a critical resource for international technology startups, because the amount of time it takes to start up a venture can impact resource requirements; ownership and control; and market timing and competitive advantage internationally. Launching ventures quickly is especially important for universities, because quicker commercialization results in more licensing revenue and more spin-offs (Markman et al. 2005). The dynamic tensions between time, financial resources, and human capital impact the success of product emergence and the success of organizational emergence in very different ways. The ideas and frameworks developed in this paper will contribute to the study of time and entrepreneurship, and the speed of venture emergence. Busenitz et al.

(2003, p. 302) raise the question of why some entrepreneurs “are able to act more quickly than others.” Zahra et al. (2014, p. 482) claim that “...the explicit treatment of time by entrepreneurship scholars has been sparse and unsystematic.” This paper explicitly explores time in a way that systematically addresses the question of why some entrepreneurs launch ventures more quickly than others.

Additional inductive research is needed on subsequent stages of growth and development of entrepreneurial ventures, examining how ventures that rapidly scale internationally are able to do so, if there are other critical junctures like the organization formation pivot that occur later in the life of the venture, and if there are unintended consequences to scaling quickly. The pace of internationalization of internet-based ventures is another intriguing area of study. Internet “app” ventures may operate on a different timescale from other industries, given the success of 90-day seed accelerators with launching internet-based ventures very quickly (Miller and Bound 2011). More exploration is needed of the temporal differences between ventures whose transactions and interactions take place on the Internet and ventures from other industries.

Empirical testing is needed to verify the findings. If the ideas presented are verified, they could be relevant to those involved with accelerating venture launch and growth, including non-profit economic development business incubators, UBIs, and for-profit seed accelerators. In particular, startup technology firms with strong university ties have higher productivity rates, profits, and investment than those without university ties, utilizing student assistance, faculty expertise, and university facilities and networks (O’Neal 2005). While there is evidence generally that supporting the development of managerial skills is important for UBIs (Nosella and Grimaldi 2009), this study suggests specific top management team support mechanisms and timing that UBIs could adopt. UBIs can provide support for venture organizational development, helping to formalize agreements and professionalize management while minimally distracting the startup team from their product development activities. To further assist startups, this research suggests UBIs could identify and recruit key hires with professional management skills to bring onto the venture’s top management team at the right time. They could help facilitate difficult conversations between founders and startup team members to reduce the threat of disruptive misunderstandings. They could coordinate external networks to provide opportunities for funding and international expansion (Grandi and Grimaldi 2003; Johanson and Vahlne 2003). Given the range of internal and external resources available to universities, many at no or low additional cost, these conclusions support evidence that UBIs are well positioned to accelerate new international technology venture creation while supporting their long-term viability (Lee and Osteryoung 2004).

The pace of innovation and venture creation is accelerating internationally. More research and theoretical development in the temporal dimension of early stage international technology ventures is needed to explore and explain this trend. The authors hope that this article will encourage more attention to these areas of scholarship and practice.

All processes performed in this research were in accordance with the ethical standards of the relevant institutional committee and with the 1964 Helsinki declaration and its later amendments. While this type of retrospective study does not require formal consent, it was obtained from all interviewees.

Acknowledgments The authors would like to thank the Special Issue editors James Cunningham, Natasha Evers, and Thomas Hoholm, as well as the two anonymous reviewers, for their insightful comments and suggestions on earlier drafts of this paper.

References

- Acedo FJ, Jones MV (2007) Speed of internationalization and entrepreneurial cognition: insights and a comparison between international new ventures, exporters and domestic firms. *J World Bus* 42(3):236–252. doi:[10.1016/j.jwb.2007.04.012](https://doi.org/10.1016/j.jwb.2007.04.012)
- Adizes I (1988) *Corporate lifecycles: how and why corporations grow and die and what to do about it*. Prentice Hall, Englewood Cliffs
- Andersson S, Evers N (2015) International opportunity recognition in international new ventures—a dynamic managerial capabilities perspective. *J Int Entrep* 13:260–276. doi:[10.1007/s10843-015-0149-5](https://doi.org/10.1007/s10843-015-0149-5)
- Andersson S, Evers N, Griot C (2013) Local and international networks in small firm internationalization: cases from the Rhone-Alpes medical technology regional cluster. *Entrep Reg Dev* 25(9–10):867–888. doi:[10.1080/08985626.2013.847975](https://doi.org/10.1080/08985626.2013.847975)
- Antolin-López R, Céspedes-Lorente J, García-de-Frutos N, Martínez-del-Río J, Pérez-Valls M (2015) Fostering product innovation: differences between new ventures and established firms. *Technovation* 41–42:25–37. doi:[10.1016/j.technovation.2015.02.002](https://doi.org/10.1016/j.technovation.2015.02.002)
- Autio E, Sapienza HJ, Almeida JG (2000) Effects of age at entry, knowledge intensity, and imitability on international growth. *Acad Manag J* 43(5):909–924
- Bhave MP (1994) A process model of entrepreneurial venture creation. *J Bus Ventur* 9:223–242
- Bird, B. J. (1992) The operation of intentions in time: the emergence of the new venture. *Entrepreneurship Theory and Practice* 17:11–21
- Bluedorn AC, Denhardt RB (1988) Time and organizations. *J Manag* 14(2):299–320. doi:[10.1177/014920638801400209](https://doi.org/10.1177/014920638801400209)
- 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). <http://doi.org/10.2307/2393807>
- Brush CG, Manolova TS, Edelman LF (2008) Properties of emerging organizations: an empirical test. *J Bus Ventur* 23(5):547–566. doi:[10.1016/j.jbusvent.2007.09.002](https://doi.org/10.1016/j.jbusvent.2007.09.002)
- Busenitz LW, West GP, Sheperd D, Nelson T, Chandler GN, Zacharakis A (2003) Entrepreneurship research in emergence: past trends and future directions. *J Manag* 29(3):285–308. doi:[10.1016/S0149-2063\(03\)00013-8](https://doi.org/10.1016/S0149-2063(03)00013-8)
- Capelleras J-L, Greene FJ (2008) The determinants and growth implications of venture creation speed. *Entrep Reg Dev* 20(4):317–343. doi:[10.1080/08985620701855683](https://doi.org/10.1080/08985620701855683)
- Capelleras J-L, Greene FJ, Kantis H, Rabetino R (2010) Venture creation speed and subsequent growth: evidence from South America. *J Small Bus Manag* 48(3):302–324
- Carter NM, Gartner WB, Reynolds PD (1996) Exploring start-up event sequences. *J Bus Ventur* 11(3):151–166. doi:[10.1016/0883-9026\(95\)00129-8](https://doi.org/10.1016/0883-9026(95)00129-8)
- Casillas JC, Acedo FJ (2013) Speed in the internationalization process of the firm. *Int J Manag Rev* 15(1):15–29. doi:[10.1111/j.1468-2370.2012.00331.x](https://doi.org/10.1111/j.1468-2370.2012.00331.x)
- Casillas JC, Moreno-Menéndez AM (2013) Speed of the internationalization process: the role of diversity and depth in experiential learning. *J Int Bus Stud* 45(1):85–101. doi:[10.1057/jibs.2013.29](https://doi.org/10.1057/jibs.2013.29)
- Chen J, Reilly RR, Lynn GS (2005) The impacts of speed-to-market on new product success: the moderating effects of uncertainty. *IEEE Trans Eng Manag* 52(2):199–212. doi:[10.1109/TEM.2005.844926](https://doi.org/10.1109/TEM.2005.844926)
- Chetty S, Johanson M, Martin OM (2014) Speed of internationalization: conceptualization, measurement and validation. *J World Bus* 49(4):633–650. doi:[10.1016/j.jwb.2013.12.014](https://doi.org/10.1016/j.jwb.2013.12.014)
- Ciabuschi F, Perna A, Snehota I (2012) Assembling resources when forming a new business. *J Bus Res* 65: 220–229
- Clausen T, Korneliussen T (2012) The relationship between entrepreneurial orientation and speed to the market: the case of incubator firms in Norway. *Technovation* 32(9–10):560–567. doi:[10.1016/j.technovation.2012.05.004](https://doi.org/10.1016/j.technovation.2012.05.004)
- Cooper RG, Kleinschmidt EJ (1994) Determinants of timeliness in product development. *J Prod Innov Manag* 11(5):381–396

- Cooper AC, Dunkelberg WC, Woo CY, Dennis WJ Jr (1990) New business in America: the firms & their owners. The National Federation of Independent Business Foundation, Washington, DC
- Coviello NE (2006) The network dynamics of international new ventures. *J Int Bus Stud* 37:713–731. doi:[10.1057/palgrave.jibs.8400219](https://doi.org/10.1057/palgrave.jibs.8400219)
- Coviello NE, Munro HJ (1995) Growing the entrepreneurial firm: networking for international market development. *Eur J Mark* 29(7):49–61. doi:[10.1108/03090569510095008](https://doi.org/10.1108/03090569510095008)
- Crawford CM (1992) The hidden costs of accelerated product development. *J Prod Innov Manag* 9:188–199
- Cunningham, J. A., Mangematin, V., O’Kane, C., & O’Reilly, P. (2015). At the frontiers of scientific advancement: the factors that influence scientists to become or choose to become publicly funded principal investigators. *The Journal of Technology Transfer*, 1–20.
- Denicolai S, Hagen B, Pisoni A (2015) Be international or be innovative? Be both? The role of the entrepreneurial profile. *J Int Entrep* 13:390–417. doi:[10.1007/s10843-015-0143-y](https://doi.org/10.1007/s10843-015-0143-y)
- Dess G, Lumpkin GT (2005) Entrepreneurial orientation as a source of innovative strategy. In: Floyd SW, Roos J, Jacobs CD, Kellermans, FW (eds) *Innovating strategy process*. Blackwell Publishing Ltd, Oxford, pp 3–9
- Dierickx I, Cool K (1989) Asset stock accumulation and sustainability of competitive advantage *. *Manag Sci* 35(12):1504–1512
- Eisenhardt KM (1989a) Building theories from case. *Acad Manag Rev* 14(4):532–550
- Eisenhardt KM (1989b) Making fast strategic decisions in high-velocity environments. *Acad Manag J* 32(3): 543–576
- Eisenhardt KM, Brown SL (1998) Time pacing: competing in markets that won’t stand still. *Harv Bus Rev* 76(2):59–69
- Eisenhardt KM, Tabrizi BN (1995) Accelerating adaptive processes: product innovation in the global computer industry. *Adm Sci Q* 40(1):84–110. doi:[10.2307/2393701](https://doi.org/10.2307/2393701)
- Etemad H (2004) International entrepreneurship as a dynamic adaptive system: towards a grounded theory. *J Int Entrep* 2(1):5–59. doi:[10.1023/B:JIEN.0000026905.90552.b5](https://doi.org/10.1023/B:JIEN.0000026905.90552.b5)
- Evers N (2010) Factors influencing the internationalisation of new ventures in the Irish aquaculture industry: An exploratory study. *J Int Entrep* 8(4):392–416
- Evers N, O’Gorman C (2011) Improvised internationalization in new ventures: the role of prior knowledge and networks. *Entrep Reg Dev* 23(7–8):549–574. doi:[10.1080/08985621003690299](https://doi.org/10.1080/08985621003690299)
- Evers, N., Cunningham, J. A., & Hoholm, T. (2014) *Technology entrepreneurship: bringing innovation to the marketplace*. Palgrave MacMillan, Basingstoke
- Galbraith J (1982) The stages of growth. *J Bus Strateg* 3(1):70–79
- Gartner WB (1985) A conceptual framework for describing the phenomenon of new venture creation. *Acad Manag Rev* 10(4):696. doi:[10.2307/258039](https://doi.org/10.2307/258039)
- Gartner WB, Frid CJ, Alexander JC (2012) Financing the emerging firm. *Small Bus Econ* 39(3):745–761. doi:[10.1007/s11187-011-9359-y](https://doi.org/10.1007/s11187-011-9359-y)
- Goktan AB, Miles G (2011) Innovation speed and radicalness: are they inversely related? *Manag Decis* 49(4): 533–547. doi:[10.1108/00251741111126477](https://doi.org/10.1108/00251741111126477)
- Grandi A, Grimaldi R (2003) Exploring the networking characteristics of new venture founding teams. *Small Bus Econ* 21:329–341
- Grimaldi R, Grandi A (2005) Business incubators and new venture creation: an assessment of incubating models. *Technovation* 25(2):111–121
- Guerrero M, Cunningham JA, Urbano D (2015) Economic impact of entrepreneurial universities’ activities: an exploratory study of the United Kingdom. *Res Policy* 44(3):748–764. doi:[10.1016/j.respol.2014.10.008](https://doi.org/10.1016/j.respol.2014.10.008)
- Gupta AK, Wilemon DL (1990) Accelerating the development of technology-based new products. *Calif Manag Rev* 32(2):24–44
- Hallen, B. L., Bingham, C. B., & Cohen, S. L. (2014). Do accelerators accelerate? A study of venture accelerators as a path to success. In *Academy of Management Proceedings* (p. 12955). Academy of Management. <http://doi.org/10.5465/AMBPP.2014.185>
- Hart SG, Staveland LE (1988) Development of NASA-TLX (Task Load Index): results of empirical and theoretical research. *Adv Psychol* 52:139–183
- Heirman A, Clarysse B (2007) Which tangible and intangible assets matter for innovation speed in start-ups? *J Prod Innov Manag* 24:303–315
- Hisrich RD, Peters MP, Shepherd DA (2010) *Entrepreneurship*, 8th Edition, 8th edn. McGraw-Hill Irwin, New York
- Hoholm T, Araujo L (2011) Studying innovation processes in real-time: the promises and challenges of ethnography. *Ind Mark Manag* 40(6):933–939. doi:[10.1016/j.indmarman.2011.06.036](https://doi.org/10.1016/j.indmarman.2011.06.036)

- Johanson, J., & Vahlne, J. (1977). The internationalization process of the firm—a model of knowledge development and increasing foreign market commitments. *Journal of International Business Studies*, 23–32.
- Johanson J, Vahlne J (2003) Business relationship learning and commitment in the internationalization process. *J Int Entrep* 1(1):83–101. doi:10.1023/A:1023219207042
- Katz J, Gartner WB (1988) Properties of emerging organizations. *Acad Manag Rev* 13(3):429–441
- Kessler EH, Bierly PE (2002) Is faster really better? An empirical test of the implications of innovation speed. *IEEE Trans Eng Manag* 49(1):2–12. doi:10.1109/17.985742
- Kessler EH, Chakrabarti AK (1996) Innovation speed: a conceptual model of context, antecedents, and outcomes. *Acad Manag Rev* 21(4):1143–1191
- Kidder, T. (1981) *The soul of a new machine*. Little Brown & Co., Boston
- Knight GA, Cavusgil ST (2004) Innovation, organizational capabilities, and the born-global firm. *J Int Bus Stud* 35(2):124–141. doi:10.1057/palgrave.jibs.8400071
- Kundu SK, Katz JA (2003) Born-international SMEs: BI-level impacts of resources and intentions. *Small Bus Econ* 20(1):25–47. doi:10.1023/A:1020292320170
- Lechler T (2001) Social interaction: a determinant of entrepreneurial team venture success. *Small Bus Econ* 16(4):263–278
- Lee SS, Osteryoung JS (2004) A comparison of critical success factors for effective operations of university business incubators in the United States and Korea. *J Small Bus Manag* 42(4):418–426. doi:10.1111/j.1540-627X.2004.00120.x
- Liao J, Welsch H (2003) Exploring the venture creation process: evidences from tech and non-tech nascent entrepreneurs. *Front Entrep Res* 2003:662–675
- Lukas B a, Menon A (2004) New product quality: intended and unintended consequences of new product development speed. *J Bus Res* 57(11):1258–1264. doi:10.1016/S0148-2963(02)00448-4
- Madsen TK (2013) Early and rapidly internationalizing ventures: similarities and differences between classifications based on the original international new venture and born global literatures. *J Int Entrep* 11(1):65–79. doi:10.1007/s10843-012-0099-0
- Markman GD, Gianiodis PT, Phan PH, Balkin DB (2005) Innovation speed: transferring university technology to market. *Res Policy* 34(7):1058–1075. doi:10.1016/j.respol.2005.05.007
- Maslach C, Jackson SE (1981) The measurement of experienced burnout. *J Occup Behav* 2:99–113. doi:10.1002/job.4030020205
- Maslach C, Schaufeli WB, Leiter MP (2001) Job burnout. *Annu Rev Psychol* 52:397–422. doi:10.1111/1467-8721.01258
- McMullen JS, Dimov D (2013) Time and the entrepreneurial journey: the problems and promise of studying entrepreneurship as a process. *J Manag Stud* 50(8):1481–1512
- Menon A, Chowdhury J, Lukas BA (2002) Antecedents and outcomes of new product development speed: an interdisciplinary conceptual framework. *Ind Mark Manag* 31:317–328
- Mian SA (1997) Assessing and managing the university technology business incubator: an integrative framework. *J Bus Ventur* 12:251–285
- Miller, P., & Bound, K. (2011). *The startup factories. The rise of accelerator programmes to Cerca con*
- Misra K, Memili E, Welsh DHB, Sarkar S (2012) The determinants of venture creation time: a cross-country perspective. *Int Entrep Manag J* 10(2):253–276. doi:10.1007/s11365-012-0226-3
- Musteen M, Francis J, Datta DK (2010) The influence of international networks on internationalization speed and performance: a study of Czech SMEs. *J World Bus* 45(3):197–205. doi:10.1016/j.jwb.2009.12.003
- Nosella A, Grimaldi R (2009) University-level mechanisms supporting the creation of new companies: an analysis of Italian academic spin-offs. *Tech Anal Strat Manag* 21(6):679–698
- Núñez R, Cooperrider K (2013) The tangle of space and time in human cognition. *Trends Cogn Sci* 17(5): 220–229. doi:10.1016/j.tics.2013.03.008
- O’Neal T (2005) Evolving a successful university-based incubator: lessons learned from the UCF technology incubator. *Eng Manag J* 17(3):11–26
- Oviatt BM, McDougall PP (1994) Toward a theory of international new ventures. *J Int Bus Stud* 25(1):45–64. doi:10.1057/palgrave.jibs.8490193
- Oviatt, B. M., & McDougall, P. P. (2005). Defining international entrepreneurship and modeling the speed of internationalization. *Entrepreneurship Theory & Practice*, (April), 537–553.
- Patton D, Warren L, Bream D (2009) Elements that underpin high-tech business incubation processes. *J Technol Transfer* 34(6):621–636. doi:10.1007/s10961-009-9105-7
- Reynolds PD, White SB (1997) *The entrepreneurial process: economic growth, men, women, and minorities*. Quorum Books, Westport, CT

- Ries E (2011) *The lean startup: how today's entrepreneurs use continuous innovation to create radically successful businesses*. Crown Business, New York
- Rubio S, Díaz E, Martín J, Puente JM (2004) Evaluation of subjective mental workload: a comparison of SWAT, NASA-TLX, and workload profile methods. *Appl Psychol* 53(1):61–86. doi:10.1111/j.1464-0597.2004.00161.x
- Schoonhoven CB, Eisenhardt KM, Lyman K (1990) Speeding products to market: waiting time to first product introduction in new firms. *Adm Sci Q* 35(1):177–207
- Shah SK, Pahnke EC (2014) Parting the ivory curtain: understanding how universities support a diverse set of startups. *J Technol Transfer* 39(5):780–792. doi:10.1007/s10961-014-9336-0
- Stanko M a, Molina-Castillo F-J, Munuera-Aleman J-L (2012) Speed to market for innovative products: blessing or curse? *J Prod Innov Manag* 29(5):751–765. doi:10.1111/j.1540-5885.2012.00943.x
- Turcan RV, Juho A (2014) What happens to international new ventures beyond start-up: an exploratory study. *J Int Entrep* 12:129–145. doi:10.1007/s10843-014-0124-6
- Vohora A, Wright M, Lockett A (2004) Critical junctures in the development of university high-tech spinout companies. *Res Policy* 33(1):147–175. doi:10.1016/S0048-7333(03)00107-0
- Weerawardena J, Mort GS, Liesch PW, Knight G (2007) Conceptualizing accelerated internationalization in the born global firm: a dynamic capabilities perspective. *J World Bus* 42(3):294–306. doi:10.1016/j.jwb.2007.04.004
- Welch C, Paavilainen-Mäntymäki E (2014) Putting process (back) In: Research on the internationalization process of the firm. *Int J Manag Rev* 16(1):2–23. doi:10.1111/ijmr.12006
- Welter F (2011) Contextualizing entrepreneurship—conceptual challenges and ways forward. *Enterp Theory Pract* 35(1):165–184. doi:10.1111/j.1540-6520.2010.00427.x
- Yin RK (2009) *Case study research: design and methods* (Fourth). Sage, Los Angeles
- Yu J, Gilbert BA, Oviatt BM (2011) Effects of alliances, time and network cohesion on the initiation of foreign sales by new ventures. *Strateg Manag J* 32:424–446. doi:10.1002/smj
- Zahra SA (2005) A theory of international new ventures: a decade of research. *J Int Bus Stud* 36(1):20–28
- Zahra SA, Ireland RD, Hitt MA (2000) International expansion by new venture firms. *Int Acad Manag J* 43(5):925–950
- Zahra S, Wright M, Abdelgawad SG (2014) Contextualization and the advancement of entrepreneurship research. *Int Small Bus J* 32(5):479–500. doi:10.1177/0266242613519807
- Zhang JJ, Lichtenstein Y, Gander J (2015) Designing scalable digital business models. In: Baden-Fuller C, Mangematin V (eds) *Advances in strategic management Volume 33: business models and modelling*. Emerald Group Publishing Limited, pp 241–277