Received: 1 February 2022 | Accepted: 1 April 2022

DOI: 10.1111/poms.13851

POMS

SPECIAL ISSUE ARTICLE

Operations for entrepreneurs: Can Operations Management make a difference in entrepreneurial theory and practice?

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Abstract

Although entrepreneurship-related papers have had some representation in *Production and Operations Management* (*POM*) over the past 30 years, the topic still seems a bit like a poor stepchild in the research of operations management (OM) scholars. Yet, entrepreneurship is important to the economy, and many schools are growing significantly their entrepreneurship programs and offerings but often without reference to or inclusion of operations courses. This paper is motivated by the question of the operations needs of new ventures and how they might differ from the needs of large, established firms. Toward that end, we review briefly the state of entrepreneurship scholarship in *POM* (and beyond), present our own (field-based) research (and cases), and propose a framework for what we call "operations for entrepreneurs," that we hope can be a basis for further productive research and curriculum development by the OM community.

KEYWORDS

entrepreneurial operations, evolutionary entrepreneurship, new ventures, operations for entrepreneurs, startup dynamics

1 | INTRODUCTION

Entrepreneurship has seemingly not been an important topic for research scholars in operations management (OM). In the review by Zhang et al. (2020) of 4188 OM papers published over a 20-year-period across the top five OM journals, entrepreneurship did not even merit a footnote. Yet, entrepreneurship is of importance in the economy and often gets credit for contributing significantly to the economic growth and development of regional and national economies (Eesley & Miller, 2018; Roberts & Eesley, 2011).

Entrepreneurship is a growth area for many business schools, and business school curricula are richly populated with courses about marketing for entrepreneurs, finance for entrepreneurs, Research & Development (R&D) and innovation for entrepreneurs, and leadership for entrepreneurs, but seemingly much less on operations. Business schools seem to have little to teach entrepreneurs about any distinctive OM needs.[1]

Do entrepreneurs need a body of operations knowledge that differs from what we teach in "mainstream OM?" If so, what are the operations needs of new ventures, and how do they differ from the needs of large, established firms? To try to address these questions, this paper reviews briefly the state of entrepreneurship and scholarship in *POM* (and beyond), presents a bit of our own (field-based) research (and cases), and proposes a framework for what we call "operations for entrepreneurs," both for teaching and for further research. Our work was motivated partly by a desire to develop a course for Master of Business Administration students (MBAs) and executives on Operations for Entrepreneurs. At the Massachusetts Institute of Technology (MIT), we have had a rich set of courses and programs in OM and an equally rich set in entrepreneurship, but virtually no content on operations directed at entrepreneurs. We could offer entrepreneurs our standard operations sessions on process design and management, quality, supply chains, product development, planning, scheduling, and so forth (as suggested by Phan & Chambers, 2013), but mostly with cases and context from mature firms. We perceived a gap in our curricular offerings and sought

Accepted by Chris Tang, after one revision.

to fill it. The papers reviewed below offer a rich menu from which to choose topics and content, but the challenge was how to organize these to teach OM to entrepreneurship practitioners, and how to identify what from the literature would be valuable to practitioners and what coverage might be missing.

Admittedly, this task, as posed, is quite open-ended and perhaps not even fully defined. Yet, given the dearth of literature and teaching material for entrepreneurial operations, we viewed our exploration as hypothesis-seeking. We were not (yet) out to prove or disprove any theories so much as to find or frame theories that might be worthy of assessment. Since the literature was thin, we chose to look to practice for threads to trace. We began by interviewing a range of active entrepreneurs, retired entrepreneurs, and executive education participants, and sought to write cases about informative/educational company experiences we found. Thus, our research consisted of interviews, site visits, and discussions in seminars, workshops, executive education programs, and conferences with entrepreneurs from North America, South America, Asia, Africa, and Europe, including participants attending MBA and executive courses taught at the MIT Sloan School of Management (MIT, USA), International Institute for Management Development (IMD, Switzerland), the Asia School of Business (ASB, Malaysia), and the Indian School of Business (ISB, India).

Our cases, therefore, were chosen using convenience sampling (Frey, 2018) and some snowballing (Goodman, 1961). However, the cases are not meant to generalize to any particular population of startups but rather to provide examples to help map the space of challenges and approaches found in entrepreneurial operations. No claim is made here as to exhaustive identification of such challenges and approaches.

Through this process, we developed several dozen case studies that illustrate various components of the evolutionary paths of entrepreneurial ventures. Some of these cases were written solely from publicly available sources, whereas others relied on internal informants (for some, we needed to disguise the company heavily so that the story remained clear, but the details were obscured to protect the company, industry, and individual identities). We have used many of these cases in our teaching, but for most, we have not created Harvard Business School (HBS)-caliber versions for public consumption.[2] Although our intent was to seek cases that highlighted aspects of *operations* challenges, most of the companies faced numerous *business* challenges, some of which had operations-relevant components to them.

We began this research in 2012, but a key aspect of our research methodology pivoted 3 years later. In early 2015, the MIT Sloan School entered into an agreement to launch a greenfield business school startup, the Asia School of Business (ASB), in Kuala Lumpur, as a collaboration with the central bank of Malaysia. Two of us were invited to lead this effort. We viewed this as an ethnographic (action research) opportunity to apply and test the ideas we were developing. An initial 2-year commitment stretched to over 7 years, but we have had a fertile ground to test and refine numerous ideas—and find more cases.

For the cases, we hoped to find some examples where companies were operations-centric and/or capabilities-centric at their earliest stage rather than customer-centric. Some of the practitioner literature, Aulet (2013) and Ries (2011) as examples, advises entrepreneurs to first figure out the relevant customer(s) and worry about operations capabilities later. Yet, we found some successful companies that seemed to do the opposite—they first built capabilities, often without a good sense of how those capabilities might eventually be taken up in the marketplace or by whom. We found some firms that ignored operations considerations early and paid dearly for that oversight later on. One of our aims was to make such advice more contingent—under what conditions should marketing and product considerations preempt operations capabilities in startups and when should operations and capability development play a much more substantive role (and perhaps even a pre-eminent role) from Day 1?

As we embarked on our interviews, we needed a classification scheme to organize our findings. The entrepreneurship literature (e.g., Joglekar & Lévesque, 2013) makes it clear that startup companies are not time-invariant phenomena that can be studied with steady-state models and frameworks. Entrepreneurial firms go through multiple stages of maturity, and the challenges faced by the firm can differ significantly depending on its stage in the evolutionary process. We found useful the simple, three-phase framework—startup, growth, and stability—for the entrepreneurial life cycle used, for example, by Tatikonda et al. (2013). For teaching purposes, we borrowed and extended the labels of Furr and Ahlstrom (2011) and called these phases: "Nail It, Scale It, and Sail It," which is memorable for students and works well in conjunction with metaphors (described in Section 3) that we use to evoke images that represent the nature of each phase.

In the earliest stage, *nailing*,[3] the organization works on ideation and creating a value proposition that works simultaneously for all the members in its proposed value chain (customers, employees, suppliers, distributors, investors, etc.). At this stage, early entrepreneurial intentions, initial resource endowments, rapid product prototyping, iterations and experimentation, and customer cultivation efforts all play important roles. Books for entrepreneurs such as *Business Model Generation* (Osterwalder & Pigneur, 2010), *Lean Startup* (Ries, 2011), and *Disciplined Entrepreneurship* (Aulet, 2013) provide much useful advice for firms in this stage when organizations are trying to nail down the parameters of their value propositions and business model.

In contrast, the *scaling* stage comes once a company has proven key aspects of its value proposition (e.g., product/service, technology, customers, pricing) and then must grow *in parallel* with its market alongside its production and delivery capabilities. We saw several cases where a firm successfully nailed its initial customer value proposition while focusing mainly on refining its product and initial markets and neglecting operations strategy. In some cases, the firms saw their demand explode but were unprepared to scale the volume to meet this demand, (e.g., see Banza, Ministry of Supply [MoS], and SkinnyGirl cases in Section 4). In some

cases, the founders relinquished or sold control due to their inability to scale.

The third stage, *sailing*, typically comes much later, after a company has realized a significant fraction of the growth opportunity of its value proposition. Although the firm may still be navigating the stormy seas of competitive, technological, and environmental challenges, the average growth rate is much lower, and the firm and its processes have reached a certain stage of maturity. Once it is sailing, the firm's focus may be more on the sustainability of the business, continuous improvement to navigate the market, and avoiding organizational rigidities that make firms susceptible to disruptive threats. Sailing the mature organization requires maintaining structured processes and stable organizational norms while pursuing continuous improvement across all aspects of the fleet and keeping an eye out for storms and turbulence. Strikingly, when we present this framework to leaders from mature firms, the modal response seems to be: "We know how to do scaling and sailing, but our culture is now moribund and unable to be innovative and entrepreneurial. Our biggest challenge is to shed some of our sailing culture and structure and re-introduce more risk-taking and nailing mentality." Thus, we have found that this framework appeals to potential intrapreneurs in mature firms as well as to entrepreneurs in new ventures.

For many firms, the progress through these stages may not be unidirectional, as setbacks may lead to "pivoting" and rethinking the entire value proposition or the value chain. In our cases, we saw numerous examples of firms beginning the scaling processes only to realize that they needed to cycle back for some "re-nailing." Some firms were very anxious to start scaling before the value proposition and business model were proven. Such entrepreneurs often insisted that they did not have time to wait and that the stages must be overlapping—start scaling before you finish nailing. Such are the pressures that many entrepreneurs experience—the initial cash is burning, and investors may be pressing for proof that the company can and will generate revenue.

Short descriptions of 14 of our case studies appear in Section 4. Our case selection is probably biased toward companies wrestling with scaling issues. However, we do have a few cases that shed some light on nailing issues, particularly ones where operations issues came to be a big hurdle. But, our criteria was to look at entrepreneurial firms with interesting operations aspects, and some firms that did not survive the early nailing stage would not have shown up as firms we would have the option to study (although our MediTech case provides one example). Also, we did not select any large, mature (sailing) firms and then try to develop case studies of their history as startups, although retrospectively, our case study on the Tesla Roadster (written in 2013) might be interpreted that way. Thus, many of our observations relate to scaling.

From our cases, we developed a list of 10 "scaling tools" that we began to share with entrepreneurs. We think of this set of tools as the beginning of a framework for teaching operations scaling to entrepreneurs (see also Hoffman & Yeh, 2018.) Not all of these tools fall within classical operations per se, but as noted above, most entrepreneurs face operations challenges within the contest of business challenges, and we believe that a course in Operations for Entrepreneurs, like many courses in Operations Strategy, will inevitably stray (productively) outside the confines of strict, traditional OM.

Section 2 below contains a review of literature from OM and beyond. Section 3 describes our framework with the 10 scaling tools that include: (1) processification, (2) professionalization, (3) culturalization, (4) automation, (5) segmentation, (6) platformization, (7) collaboration, (8) capitalization, (9) replication, and (10) evaluation. Section 4 provides a thumbnail sketch of 14 of our cases with some insights from these. Section 5 offers some conclusions and thoughts about future research.

2 | LITERATURE REVIEW

As noted above, very few papers addressing entrepreneurship have appeared in the OM literature over the past 20 years (Zhang et al., 2020). We list some exceptions below. However, outside of OM, the entrepreneurship literature has flourished but not typically with a focus on issues traditionally addressed in OM. We have catalogued a number of those papers as well, and we expand on some of the issues raised below.

2.1 | Entrepreneurial literature in OM

The first entrepreneurship paper published by *POM* appeared in Volume 1, Number 1. The authors (McDougall et al., 1992) raised 30 years ago exactly the issue we wanted to pursue:

> Several theories and models have been developed to represent the content and the process of manufacturing strategy (e.g., see Fine & Hax, 1985). A review of the manufacturing strategy literature shows that past research has focused predominantly on manufacturing strategy issues in relatively well-established firms. These studies have either ignored new-venture firms or have failed to treat these firms separately. There is a paucity of research on the manufacturing strategy of new-venture firms. New ventures need to be examined separately because they face unique challenges and opportunities in developing viable manufacturing strategies. (p. 54)

Their paper provides an empirical study of manufacturing firms, in which the authors examined 11 manufacturing strategy decision categories common in the literature at that time (e.g., Hayes & Wheelwright, 1984). The authors found that corporate-sponsored firms were more likely to focus resources on new product development and make use of proprietary technologies while seeking to engage a wide range of customers by offering high product variety.

TABLE 1 *JOM* and *POM* special issues

Topic/findings/frameworks	Literature
***JOM* special issue (2011)**	
Need for cross-disciplinary research at the intersection of operations management (OM) and entrepreneurship	(Kickul et al., 2011)
Product quality is more important than product innovativeness (supporting McDougall et al., 1992) Supplier-specific investment associated with success	(Song et al., 2011)
Alliance diversity enhances cost and quality	(Terjesen et al., 2011)
Entrepreneurial culture and orientation are important when building supply chain relationships	(Y. Li et al., 2011)
Manufacturing flexibility can support organizational formalization (culture and practices) and address uncertainty (building on Meyer & Rowan, 1977)	(Patel, 2011). See more on the tension between creativity and discipline in Shalley and Gilson (2017)
Process control and risk control measures need to augment innovation support policies (e.g., Hamel, 2020; Pinchot, 2000)	(Goodale et al., 2011)
***POM* special issue (2013)**	
Four stages of the dynamics of the life cycle for the entrepreneurial venture: discover, commit, organize, grow *Ten* domains of relevance to OM: (1) technology commercialization and adoption; (2) location, market selection, and network design, (3) product/service design and launch; (4) scheduling, batching, and task design; (5) lean operations, flexibility, line balancing, and process design; (6) inventory and supply chain management, (7) quality, reliability, and process improvement, (8) aggregate, capacity, workforce, and integrated planning, (9) project, portfolio, and risk management; and (10) environmental sustainability	(Joglekar & Lévesque, 2013)
New ventures should focus on investing in integration with one clearly superior complementary technology	(Anderson & Parker, 2013)
Less mature firms facing developer participation uncertainty must expand its portfolio more slowly than the established firm	(Bhargava et al., 2013)
Investment in relationships (alliances) leads to best outcomes of young biotech firms	(Hora & Dutta, 2013)
Four dynamic patterns of how fairness perceptions influence cooperation to achieve operations outcomes	(Van Burg & Van Oorschot, 2013)
Three phases of the entrepreneurial life cycle: startup, growth, and stability	(Tatikonda et al., 2013)
Rich examples of how OM research (e.g., "on innovation, management of new technology, new product development, reverse logistics, green supply chains, sustainable operations, and e-commerce") addresses issues relevant to entrepreneurs	(Phan & Chambers, 2013)
Four-phase life cycle model for knowledge management: (1) discover, (2) evaluate, (3) develop product and technology, and (4) commercialize	(Gaimon & Bailey, 2013)
POM research provides tools for entrepreneurs to build scalable, sustainable organizations, as well as leverage technology commercialization	(Shepherd & Patzelt, 2013)

Independent firms, with fewer resources, focused on superior project quality and sought a smaller number of customers that could provide large order sizes.

Despite this auspicious start, *POM* (and the OM field more generally) effectively fell silent for much of the next two decades with regard to papers on entrepreneurial operations. This silence was broken by Kickul et al. (2011) with the introduction of a special issue with five articles in the *Journal of Operations Management* (JOM) on "Operations management, entrepreneurship, and value creation: Emerging opportunities in a cross-disciplinary context." The *JOM* issue was followed a few years later by *POM* with the "Special Issue of *Production and Operations Management*: Technology Commercialization, Entrepreneurship & Growth Driven Operations," conceived and edited by Nitin Joglekar and Moren Levesque (Joglekar & Lévesque, 2013). Table 1 lists the papers in these two special issues.

Excluding the special issue, in the most recent decade, *POM* has published what might be called a "steady trickle" (∼2 per year) of operations papers that address entrepreneurship issues. These include several on entrepreneurial financing and incentives, such as Arya et al. (2021), Babich and Tang (2016), Zhaolin Li et al. (2021), Zhuoxin Li et al. (2020), Liu et al. (2021), Tanrısever et al. (2012), and Wei et al. (2021). There is also a small stream on entrepreneurs in emerging economies, including An et al. (2015), Chen et al. (2013), and Escamilla et al. (2021).

A related stream of literature, mostly not focused explicitly on entrepreneurship, but relevant to the challenges faced by entrepreneurs, is exemplified in the *POM* special issue on

the management of technology, edited by Gaimon et al. (2017). In that issue, some papers particularly relevant to entrepreneurs include Gaimon et al. (2017) who lay out some of the accomplishments and challenges in the innovation literature, Loch (2017) who discusses behavioral dynamics and cognitive biases inherent in innovation processes, and H. L. Lee and Schmidt (2017) who discuss supplier engagement in the innovation process.

In a related stream, the allocation of effort between operations and product development has been a focal point of several researchers. Gifford (1992) studied the allocation of limited entrepreneurial attention between increasing the profitability of current activities through process improvement and increasing the number of profitable activities through product innovation. Mueller et al. (2012) divided firms into startup and growth phases and found that while both phases are characterized by fragmented activities, growth-phase firms spend more time on information exchange and less time on analytical and conceptual activities. They also suggest that startup phase entrepreneurs pursue exploration activities more, although most of the activities in both phases relate to exploitation. This sequential approach to entrepreneurial activities dates back at least to Utterback and Abernathy (1975) and Abernathy and Utterback (1978), who suggested that innovations go through *three* phases—fluid, transitional, and specific, during which most emphasis should be, respectively, on product performance, process changes, and incremental innovation in both.

Finally, we note the work of Jiang and Liu (2019), who present a game-theoretic model to explore how managerial optimism influences competition and firm outcomes. Although not explicitly about entrepreneurship, the paper cites findings that entrepreneurs are often quite optimistic, unrealistically so at times. Their model yields a result, however, that firms with optimistic leaders will be better off than those with pessimistic leaders. Optimism pays off.

If we look beyond *POM* and the special issues mentioned above, we can find a significant body of work in OM that also touches on issues related to operations for entrepreneurs (see Table 2). As noted by Joglekar and Lévesque (2013), the bulk of the OM literature has focused on models that assume a degree of stability and maturity in a firm's marketing and operations functions that may not be realistically descriptive of many startup environments. However, many OM papers can be construed to address questions specific to startups.

2.2 | Entrepreneurial literature beyond OM

Beyond the OM literature, many scholars have studied aspects of the evolutionary path of entrepreneurial firms—how startups emerge, what helps them grow, and how can they sustain their businesses and evolve into large and successful organizations. Table 3 identifies some of this literature. The papers and books listed are either foundational or were found via a search on the Web of Science and then selected for their relatively high citation counts. We have grouped these papers into categories by research agenda, for example, designing startups, entrepreneurship strategy, organizations and environments, individuals and networks, and organizational development.

In summary, the set of papers that explicitly addresses operations for entrepreneurs is thin, particularly in the top-five OM journals, but across a much broader management literature, there are many papers that can be useful as building blocks for building a coherent view of operations for entrepreneurs.

3 | NAILING, SCALING, AND SAILING

Our framework and attempts at conceptualization evolved as we iterated between the field and the classroom. As noted, we were motivated in part by a desire to develop a course for MBAs and executives. The papers referenced above offer a rich menu from which to choose topics and content, but challenges remained as to what to select and how to organize concepts and tools.

As noted above, we began by interviewing a broad range of active entrepreneurs, retired entrepreneurs, and executive education participants with the intent to write cases about any interesting company stories we found. Given the earlier reported dearth of knowledge at the interface of operations and entrepreneurship, we felt this was an important component of our exploration. Based on our interviews and cases (described in more detail in Section 4), we evolved the following components of a framework that we have used for teaching operations for entrepreneurs.

3.1 | Nailing

For many startups, the "nail it" stage is frenetic and exploratory, with many iterations of trial and error. With limited resources, young firms race to prototype and establish a value proposition that works simultaneously for all the members across its value chain—customers, employees, suppliers, distributors, investors, and so forth. Founders face a myriad of decisions about how to pursue their ideas, with whom to work, and how to secure and expend the scarce resources typically available to them. At this stage, early entrepreneurial intentions, initial resource endowments, decision-making judgment, and relationships play especially important roles. A founding team must find the right mix of people that can work together, along with a well-chosen array of distributors, suppliers, and investors, to establish a viable value proposition, business model, and value chain. "Cash is oxygen," we were told, and most entrepreneurs felt significant pressures to avoid running out.

Numerous popular authors offer guidelines to early-stage entrepreneurs. Draw your business model canvas (Osterwalder & Pigneur, 2010). Iterate rapidly but incrementally (Ries, 2011). Identify your beachhead market and your minimum viable product (Aulet, 2013). Stay focused,

TABLE 2 Entrepreneurial literature in OM

Topic/findings/frameworks	Literature
Managing uncertainty and risks	
Reduction of process and information time in agile supply chains	(Mason-Jones & Towill, 1999)
Trial-and-error learning and parallel pursuit of alternatives	(Sommer et al., 2009)
Managing risks along the value chain	(Girotra & Netessine, 2011)
Path dependency based on the maturity of capabilities	
Design scope and task interdependencies in supplier–manufacturer relationships	(Sobrero & Roberts, 2001)
Inventory policies in startup companies	(Archibald et al., 2002)
Model of the innovation process: recognition of opportunity, idea formulation, problem-solving, prototype solution, commercial development, and technology utilization and/or diffusion	(Roberts, 2007)
Trade-offs	
Production and investment decisions to reduce the risk of bankruptcy	(Tanrısever et al., 2012)
Operational capabilities (short-term) versus dynamic capabilities (long-term)	(Rahmandad, 2012)
Timing for allocation of resources	
Capacity expansion and production decisions pre-IPO (Initial Public Offering)	(Babich & Sobel, 2004)
New product development and supply chain management	(Loch & Terwiesch, 2009)
Capacity investment in startups under competition	(Swinney et al., 2011)
New hiring and investment in process improvement	(Yoo, Corbett, & Roels, 2016; Yoo, Roels, & Corbett, 2016)

keep learning, and be prepared to pivot. Finding one's way requires mastering all the business model canvas components required, with a disciplined (Aulet, 2013), lean (Ries, 2011) effort. The path is not easy and many fail along the way.

Metaphorically, nailing a value proposition across a complex value network is an unpredictable journey through a thick, unmapped jungle to a possibly ill-defined destination, typically requiring a team of multi-skilled risk-takers with an exploratory mindset and cognitive readiness to deal with unexpected challenges at every turn. Founders may find themselves hacking through this dense jungle with very few resources—barely more than the proverbial machete, but with no roads, and accompanied only by a small, determined team of like-minded adventurers, innovators, and mission-driven problem solvers.

Time and again, we heard from entrepreneurs that in the prototyping stage, speed typically overrides quality, and a minimum viable product tested early in the marketplace will typically do more good than waiting for perfection. Rarely do startups immediately figure out a full value proposition, a sustainable revenue model, a reliable set of employees and suppliers, plus the right customer personae. Further, many firms take calculated risks to progress quickly.

> We have to be prepared to make mistakes, but to fix them quickly. We fly very close to the treetops, but have great confidence in our pilots. (Jim Dunlay, Tesla Vice President of Powertrain Engineering at the time of the interview, November 13, 2013)

In many cases, hiring is based less on precise requirements but rather on attitude, alignment, energy, capabilities, and cultural compatibility. People typically come first, job descriptions second.

> Scrappiness, hiring the best people in the world, allowing people to exercise their judgment in the face of uncertainty, and leading by example. (Jim Dunlay, Tesla Vice President of Powertrain Engineering at the time of the interview, November 13, 2013)

Clear communication among the team is crucial as a myriad of questions arise every day—questions that would not necessarily have been anticipated and may not have ready answers. Such young organizations often want their team members to feel confident and empowered to act independently, yet maintain communication and alignment to the mission. Rapid problem-solving benefits from a flat hierarchy, intense communication, immediate validation, and collaborative pivoting decisions when needed.

In this environment, capability building may be haphazard. If a hiring decision turns out to be successful, *voila*!, the firm's capabilities are enhanced. If a chosen employee or partner does not work out, the firm suffers a setback and must search anew. Because the path forward may be murky, it can be difficult to systematically build capabilities that will later be needed. A necessary pivot can wipe out months of effort and investment. Until the business model is nailed down, the capabilities required can be quite uncertain.

TABLE 3 Entrepreneurial literature beyond OM

Topic/findings/frameworks	Literature
Designing startups	
Three lenses: entrepreneurial, organizational, and ecological lenses	(Van de Ven et al., 1984)
Five stages: existence, survival, success, take-off, and resource maturity	(Churchill & Lewis, 1983)
Four perspectives: individuals, organizations, environment, process	(Gartner, 1985)
Five whys, lean startup	(Ries, 2011)
24 steps: disciplined entrepreneurship	(Aulet, 2013)
Entrepreneurship strategy	
Five forces analysis	(Porter, 1979)
Resource-based theory	(Chandler & Hanks, 1994; Grant, 1991; Peteraf, 1993; Wernerfelt, 1984)
Strategic factor market	(Barney, 1986; 1991)
Time compression diseconomies	(Dierickx & Cool, 1989)
Dynamic capabilities	(Teece et al., 1997)
Organizations and environments	
Planning activities and commitments	(Brinckmann et al., 2010; Carter et al., 1996; Delmar & Shane, 2003; Duchesneau & Gartner, 1990; Gruber, 2007; Karlsson & Honig, 2009; Matthews & Scott, 1995; Shane & Delmar, 2004)
Resource management	(Brush et al., 2001)
Role of financing, venture capital	(Cassar, 2004; Davila et al., 2003; Hellman & Puri, 2000; Jeng & Wells, 2000; King & Levine, 1993)
Role of human capital	(Bruderl et al., 1992; Cooper et al., 1997; Chandler, 1998)
Product development, experimentation	(Brown & Eisenhardt, 1995; Thomke, 1998)
Partnerships and alliances, corporate networks	(Cooper, 1985; Eisenhardt & Schoonhoven, 1996; Lechner et al., 2006; C. Lee et al., 2001; Uzzi, 1996)
Marketing strategy	(Knight, 2000)
Individuals and networks	
Personal characteristics of entrepreneurs	(Duchesneau & Gartner, 1990; Frese & Gielnik, 2014; Gielnik et al., 2020; Miller, 1983)
Personal communication and networks	(Allen, 1970; Eisenhardt & Schoonhoven, 1996; Hansen, 1995; Ostgaard & Birley, 1996; Shane & Stuart, 2002)
Entrepreneurial orientation	(Lumpkin & Dess, 1996; Rauch et al., 2009)
Organizational development	
Planning change	Model of planned change (unfreezing, changing, and freezing; Lewin, 1951) (Beckhard & Harris, 1987; Kotter, 1996)
Corporate culture	(Schein, 1999) Entrepreneurship and business culture (Casson, 1995); big hairy audacious goals (Collins & Porras, 1996)
Team collaboration	Group dynamics (forming, storming, norming, performing, and adjourning; Dass & Parker, 1999; Tuckman & Jensen, 1977)
Workforce motivation	Job characteristics theory (Hackman & Oldham, 1980); motivation-hygiene theory (Herzberg et al., 1959)

In our cases described in Section 4, several firms delayed thinking about operations until late in their nailing stage. MediTech built a supply chain based on the superior technical capabilities of its suppliers, but the logistics of distance, and the asymmetric power between the tiny startup and its giant suppliers, doomed them to run out of money before they could develop and debug a viable prototype. Tesla's Roadster development followed a similar path, and the company would likely have suffered a similar fate if not for the deep pockets and connections of its Chief Executive Officer (CEO). Banza, SkinnyGirl, and MoS all underinvested in strategic operations thinking early on and suffered various pains as a result. We have not come to believe that every startup must invest in operations capabilities from Day 1, but

we believe that every startup should invest in some strategic operations thinking from the start.

Some scholars (Roberts, 2007; Sobrero & Roberts, 2001) have observed the path dependence of the evolutionary journey of a new venture. Entrepreneurs need insight as to what capabilities they might need when, and they need to think through how early decisions might influence their later needs. In teaching about the nailing stage, one can dive deeply into traditional operations topics such as decision-making under uncertainty, the role of experimentation in organizational learning, and matching the rate of cash burn to the rate of progress to revenue, for example.[4]

3.2 | Scaling

The "scaling" stage comes once a company has proven some key aspects of its value proposition (e.g., product, technology, customers, pricing) and then must grow its market *in parallel* with its production and delivery capabilities. If nailing the business model is a trek through a dense jungle, then scaling a now-viable business model is a mountain climbing expedition with tools, teams, evolving repeatable processes, and task specialization—with much more visibility to the targeted peak on the horizon. The organization is not stable; however, it is constantly growing, adjusting, and systematizing its work to continue the ascent.

The organizational culture developed during nailing typically needs to adapt during scaling—sometimes dramatically. The "nail it" environment features the need for speed, iteration, risk-taking, tolerance for uncertainty, rapid problem-solving, and intense communications with a flat structure. In contrast, the "scale it" environment relies more on processes, discipline, standardization, and committees perhaps, with a more hierarchical structure. The people who thrived in the startup environment can feel smothered as scaling and discipline take over.

Operations tools can make a significant difference in the scaling stage. We have come to use the term "naked scaling" for situations where a firm that has successfully nailed its business model and value proposition, tries to scale that model in the absence of any tools. The results are often chaotic and seemingly quite suboptimal. Based on our case studies, we have developed a catalog of 10 tools for entrepreneurial scaling: (1) processification, (2) professionalization, (3) culturalization, (4) automation, (5) segmentation, (6) platformization, (7) collaboration, (8) capitalization, (9) replication, and (10) evaluation. For each of these, we list one or more of our cases (Section 4) to illustrate the need or application of the tool.

1. Processification: One definition for a process is: "an organized group of related activities [tasks] that work together [to create] value to the customer" (Hammer, 2001). Well-defined processes enable efficiency and repeatability while allowing delegation and decentralization. Many startups need to invent processes for their development and business needs as they go. The first time a process is undertaken, it might be called a "hack." The second time around, the steps and sequence might be a bit clearer. But before an organization starts scaling, its processes typically require knowledge, practice, customers, debugging, metrics, some predictability, and a process owner. Task standardization is a prerequisite to process definition, regularization, and reproducibility. Process discipline is a key component of processification. Lack of process adherence is functionally the absence of process. But freeze processes too soon, and the enterprise may lose needed flexibility (see automation below). Illustrative cases: ASB, Banza, MoS, Novaconfort, Renetech.
2. Professionalization: In the earliest stages of a startup's life, many founding teams consist primarily of generalists. The founder/CEO might run marketing, sales, Human Resources (HR), and investor relations. The founder/Chief Technical Officer (CTO) might run R&D, manufacturing, procurement, and supply chain management. The founder/CFO might run accounting, finance, and Information Technology (IT). Typically, such founders do not bring deep expertise to each of these functional domains, but by necessity, most firms need to operate this way in the earliest stages. As the firm begins to achieve some success, it will start onboarding more specialized employees with "professional grade" skills. Newly hired functional professionals bring much-needed "best practices" to their domains. However, one challenge with such professionals is that their first inclination is often to try to reproduce in the nascent firm exactly the functions and systems they had in their previous organizations, independent of the particular culture and challenges of their new employers. Thus, newly hired professionals bring much-needed skills and knowledge, but ought not to be "left alone" by the founders who will need to "acculturate" the new staff members, regardless of how much domain expertise they have. Illustrative cases: ASB, Metropoli, Micrometal, MoS, Novaconfort, SkinnyGirl, Tesla.
3. Culturalization: One adage has it that "culture is what happens when the boss is not watching." Furthermore, entropy is a natural phenomenon in virtually all organizations, so a culture that is not constantly communicated is liable to fragment over time. A strong, positive, continually reinforced culture can serve as the glue that keeps an organization on track once it has outgrown its small team huddled in a single room with face-to-face communication. Building and maintaining a culture that supports the organization's goals is critical to efficient scaling. During rapid scaling, however, the sheer number of employees and partners can create significant challenges to acculturate every new joiner as well as maintain the integrity of the culture amongst the organization's veterans. In many cases, cultural reinforcement for keeping the organization focused on the mission and values must remain the job of the top leadership team. Say it every day if you mean it. Illustrative cases: ASB, Venture for America (VFA).

4. Automation: In the nailing stage, when so many activities are experiments that will be adjusted on the next iteration, processes are mostly manual. The flexibility to adjust repeatedly is the essence of the nailing journey. Once processification is well underway, however, manually repeating processes *ad nauseum* rarely helps quality, productivity, or morale. Computers and robots are very good at the repeatability of well-defined tasks so that automating physical and information processes is desirable and usually necessary for any degree of high-volume scaling. Of course, where labor is cheap and programming skills are dear, automation is likely to progress more slowly, but even in low labor cost regions, a great deal of effort is often invested in the automation once serious scaling commences. However, automating processes often causes a reduction in flexibility and can therefore raise the cost of later experimentation. Famous adage: Installing an Enterprise Resource Planning (ERP) system is like pouring a layer of concrete over your organizational processes. Do not do it too early. Illustrative cases: ASB, Renetech.
5. Segmentation: Early in the nailing stage, entrepreneurs are often encouraged to develop their "minimum viable product" for their "beachhead market," and by necessity, a single market segment is typically targeted (Aulet, 2013). If that target is well chosen, the "total addressable market" will enable the firm to begin generating revenue and trigger the growth process. However, in many businesses, successful firms will saturate their beachhead markets and must then explore how to drive growth into adjacent or different market segments. Such segmentation almost always will accompany the scaling stage and require additional and more fragmented efforts in marketing, sales, product development, finance, and operations. If processification is well underway, some of the developed processes will need to give way to specialized subprocesses. If automation commenced too early, costly rework of automated processes may be required to accommodate new market segments with different needs. Segmentation almost always adds complexity and cost to the operations functions that support the products and services that are slotted for the multiplicity of segments. Thus, segmentation is critical for scaling but will challenge the operations function to expand its breadth of activities. Illustrative cases: Angularity, ASB, Beijing Genomics Institute (BGI), Micrometal, SkinnyGirl.
6. Platformization: Some business models are amenable to utilizing a platform to exploit cross economies of scale from multiple customer segments or constituent groups as described by Parker, Alstyne and Choudary (2016) or Evans and Schmalensee (2016). However, the Internet age has witnessed remarkable scale economies enjoyed by some companies that have exploited this business model form (e.g., Facebook, Google, Alibaba, TenCent). Sometimes a good platform can outcompete an excellent product, so scaling with a platform provides a great opportunity when the business model can accommodate such a structure. Illustrative cases: ASB, VFA.
7. Collaboration: Very few firms can "do it all" by themselves. Most startups collaborate with suppliers, channels, technology, and distribution partners as noted in several papers listed above. Especially when a firm is small, partnering can be challenging, because a small startup may have little leverage with a large supplier or distributor. A successful young firm that has already started scaling has potentially much more leverage to develop valuable relationships with attractive partners. However, collaborative relationships typically require some manner of sharing the value chain pie. Thus, a collaborator is often both a value-adding partner and a potential competitor for a share of the total profits available (see, e.g., Fine, 1998; Y. Li et al., 2011). Illustrative cases: ASB, MediTech, SkinnyGirl.
8. Capitalization: For most startups capital investment is critical. A great deal of attention is typically paid to how startups can attract and negotiate for initial capital investment as noted in the literature review above. However, the capital requirements for significant scaling (factories, warehouses, personnel, infrastructure—sometimes across multiple global locations) can often dwarf what was needed for the initial startup, depending on the business. In such cases, founders are often faced with the dilemma (Wasserman, 2013) of needing to give up significant control if they want access to the necessary capital to exploit growth opportunities. Illustrative cases: Metropoli, MoS, Novaconfort, Tesla, Unity.
9. Replication: For many business models, scaling requires replication and reproducibility. Once a process has been refined, it may need to be replicated in many locations and settings, sometimes identically, and sometimes with modifications for localized needs for a different market segment. Organizations need to document and train and measure the capabilities and outcomes of replication efforts. Illustrative cases: Unity Homes, VFA.
10. Evaluation: Even if founders have a clear vision for their future, internal alignment often requires systems to set milestones and identify potential problems. Metrics enable organizations to manage the performance of newly professionalized teams and the effectiveness of processes. Evaluation is also critical for demonstrating responsible use of investor funds. However, the imposition of narrowly defined metrics can stifle the innovative spirit that brought the firm its initial success, so Key Performance Indicators (KPI's) and the like must be used with caution. Illustrative cases: ASB, Renetech.

We do not claim that these are all the scaling tools that an entrepreneurial firm might need as it grows, nor would we call all of these OM tools per se. Rather, they represent capabilities that we observed as relevant for scaling. The case examples in Section 4 describe some of the organizations where we observed these tools to be used or needed. Section 5 describes how this set of tools might be useful for scholarly research.

3.3 | Sailing

At this point in the life cycle, the firm may be still growing, but slowly—perhaps no faster than the rate of growth of the surrounding economy. The days of double-digit growth are probably long past. Classically, OM in mature organizations often focuses on maintaining system stability and pursuing incremental, continuous improvements in quality and productivity, broadly defined. As noted by Joglekar and Lévesque (2013), a large body of OM literature is devoted to models and analysis for optimizing operations for organizations in a steady state. The "sail it" environment is often ready-made for optimization and data analytics. Such tools are well known to *POM* readers and will not be recounted here.

Culturally, the risk-takers may be long gone. The founding team may have been replaced by risk-averse caretakers, specialists, and bureaucrats, each in their own silo, each waiting to be told what to do. Problems are referred (if at all) to the appropriate department or to the "lean six-sigma black belts," who may all be housed in an internal consulting group. The battle now is against complacency. Instead of embracing the dynamics of change, many employees will resist it.

Perhaps this portrait is extreme, but, as noted by Christensen (1997), maturity and stability can be a dangerous state for a well-established firm. In contrast to the steep slope of scaling, our sailing analogy implies a level environment but not a flat one. Sailing ships can encounter monstrous storms and waves, so must be always on their guard. Complacency and resistance to change can be early warning signs of decline. Jeff Bezos (founder of Amazon.com) is said the have stated on numerous occasions: "It is always Day 1 at Amazon. Day 2 is stasis. Followed by irrelevance. Followed by excruciating, painful decline. Followed by death" (Bezos, 1999).

In our executive programs in innovation, the modal participant has been a middle-aged, middle, or senior manager who wants to drive innovation into his/her mature organization but finds the culture is not well-suited to support innovative change. Renewal and transformation, that is, the driving of intrapreneurial change, can be extremely difficult. Many of these managers seek to establish or re-establish the jungle exploration culture and spirit in their organizations. However, if the sailing firm is populated with people who received well-established processes from others, they may be lost when asked to explore a new jungle and invent new processes as needed. Process invention is a very different skill from process adherence (ASB case).

4 | CASE EXAMPLES FOR FRAMEWORK ILLUSTRATION

We chose 14 of our cases to present here briefly. They are quite heterogeneous and were selected because they illustrate phenomena that resonated with our students. Many of them also illustrate well the framework and the scaling tools listed above. They span numerous industries, geographies, technologies, customer types, and value propositions.

4.1 | Brief synopses of our cases

Angularity (disguised name) was founded in 2000 in Asia by a team of high-capability, young engineering graduates that developed expertise in the design and development of manufacturing process technology equipment for components and products for the electronics industry. Following its launch, the company repeatedly experienced challenges and disruptions to its markets, but each time used its deep manufacturing and technological capabilities to pivot to new products and new markets. For example, the company launched as a provider of manufacturing equipment for certain electronics components and products, which led to several years of significant market success. However, an economic downturn led to an extreme collapse of the equipment market.[5] But the firm pivoted to enter the market for electronics components and products rather than for the manufacturing equipment—essentially choosing to go into direct competition with some of its customers. Their superior manufacturing knowledge enabled them to become the low-cost producer in these end-product markets. Across several later pivots, the firm's technical capabilities enabled them to repeatedly enter new markets, first for manufacturing equipment, and later for the end products. The company's successful repeated pivots, in the context of fast-moving, technology-intensive markets, seemed to be due to its ***deep manufacturing and technical capabilities*** rather than to its connection to particular customers, markets, or products.

Banza, shorthand for garbanzo pasta, was founded in 2013 to provide a healthy, tasty pasta that was easy to cook and gluten-free. The founders had no experience in the food industry but started the project from their home kitchen and ran many experiments trying to find a viable recipe. The company landed on a national reality television (TV) cooking show, *Restaurant Startup*, and despite a rocky start, it caught the attention of one of the judges who ended up investing in the company and became one of their first distributors, stocking the shelves of the trendy restaurant Eataly with the new product. The TV show brought Banza instant exposure and other orders followed.

When the young team began to scale production, their factory could not replicate their home kitchen recipe success and the startup lost many orders. As the team burned through their seed-round money, efforts shifted from promotion to production. The founding team "lived in the factory" as they frantically tried to perfect a scalable, reproducible pasta recipe. The initial Banza manufacturing process included over 50 variables that had to be constantly monitored. These intense efforts paid off, and Banza expanded from two stores to over 10,000 in the United States alone and garnered significant media attention. Early tailwinds in marketing helped

the firm, but ***unpreparedness for production scaling almost killed it***.

BGI was founded in Beijing in 1999 (as Beijing Genomics Institute) with a mission to master the technologies of genomics—decoding the DNA of plants and animals to benefit agriculture and human healthcare. BGI's two founders were exceptional and passionate scientists, and the early years of their company's life were devoted to seeking research grants for technical academic research and scientific capability building, not searching for markets and customers. Over time, their superior knowledge and capabilities enabled them to create products and markets for genomic sequencing and data. As a market leader, BGI employed ***segmentation*** to exploit multiple revenue-generating product lines including research, genomic sequencing for others, education, human health care, agriculture, and genomic data cloud services. However, after a great initial success, essentially creating and dominating these marketplaces, BGI subsequently faced severe competition in gene sequencing from upstarts focused on cost minimization, harvesting from the "fields" that were initially "plowed" by BGI.

MediTech (disguised name and industry) developed sophisticated technology to improve brain imaging before and during cranial surgery by heightening image resolution through the exploitation of technological advances in imaging, plus adding in algorithmic innovation and computational horsepower to interpret the images. Presenting their improved images with an appealing user interface, MediTech's solution had the potential to markedly improve cranial surgery outcomes. MediTech hired top-flight engineers who were tasked with achieving the highest possible performance for its system. As a result, the engineering team selected suppliers with technologically superior capabilities and components. These suppliers, intended as ***collaboration*** partners, were mostly large and well-established players in their industries.

However, collectively, the geography and size of the chosen supply chain created a logistical and business nightmare for small-lot prototype production and assembly. Not only were the transport lead times across the supply chain painfully long, but MediTech also lacked bargaining power to get fast turnaround times on prototype and component production from their chosen suppliers. Consequently, the prototype development and manufacturing cycles were dramatically elongated and the company did not have enough cash to endure the resulting delays, resulting in selling the company to a competitor. The net result was that ***early supply chain designs***, implemented by engineers solely focused on the technological performance of the sourced components, were a key factor in preventing the company from meeting critical targets set by its capital suppliers.

MicroMetal (disguised name) was an Asia-based company, founded in the late 1990s, focused on ultra-high precision metal machining. The company manufactured top quality, technologically complex, high precision, machined metal parts for a demanding set of clients, and assembled subsystems for those same clients. Despite its strong customer relationships achieved over time, MicroMetal's early activities focused on achieving and perfecting its manufacturing processes while postponing the development of markets or customers. MicroMetal was founded by a seasoned entrepreneur/investor who had prior experience in the metal machining business. That founder hired a CEO and a CTO and instructed them: "First achieve excellence in machining precision, then the customers will come." With the resulting strong emphasis on perfecting its capabilities, MicroMetal's state-of-the-art technologies and know-how eventually grew to serve leading companies in various industries. The company exploited ***segmentation*** to develop markets in machine tool, heavy-duty machines, commercial printing, aerospace, semiconductors, and manufacturing equipment industries. As the company grew, the CEO and CTO gradually deployed ***professionalization*** by adding experts in marketing, sales, manufacturing, finance, and human resources.

Metropoli (disguised name) is a family-owned business in India with a long history of traditional manufacturing and export of leather wallets, handbags, and other accessories as a contract manufacturer for fashion brands. Within global markets, Metropoli leveraged low labor costs in India to establish itself as a reliable, affordable provider of manufacturing services for (primarily European) brand name, high-end leather goods companies. Early reliance on channel partners for design concepts, market intelligence, and end-customer channels enabled Metropoli management to focus on operational excellence and high quality, but they were also exposed to the ***processification*** and ***professionalization*** of their value chain partners in design and marketing to high-end consumer brands. That exposure, and profits from their role as a contract manufacturer, enabled internally generated ***capitalization*** to purchase and license some high-end brands and expand downstream into the design and marketing of these (licensed) branded items, capturing a much larger fraction of the value in its value chain.

MoS was founded in 2010 at MIT by a team of engineers, designers, and material scientists, with the mission to invent a line of men's business apparel that was classy, yet comfortable, and durable in the face of extreme usage conditions. The team combined clever marketing of "MIT meets Fashion" (e.g., images of James Bond's need for extreme-performance tuxedos for his inevitable fight scenes) with advanced materials and innovative product design. Their first two product concepts raised 10 times their funding goal on Kickstarter. However, the very successful ***capitalization*** and sales campaigns ran ahead of operational capabilities. The company promised an expanded line of shirts, socks, undershirts, pants, and so forth, in volume, to their retail store customers. This ***segmentation*** sprint provides an example of "naked scaling," where their marketing and sales ran ahead of disciplined ***processification*** and ***professionalization*** in operations and supply chain management. They had to retrench and revise their plans as they built stronger operations capabilities, but their strong market position gave them the ability to maintain a positive image as a consumer brand as they built proper scaling capabilities.

Novaconfort was founded in 2005 as a small family-owned construction company based in Cluj Napoca, Romania. The founders, with no experience in the construction business, started by bootstrapping a small renovation contract, in which they exploited contractors with well-developed ***professionalization*** capabilities to help them with ***processification*** within their own small organization as they developed knowledge of the business and a network of experts. Despite their initial lack of experience in the industry, the small company ambitiously took on ever larger projects over time. The founders initially outsourced the most complex steps and jobs in each process but paid careful attention to the work done and documented all the learning, to the point where they became autonomous from outside experts. After the 2008 crisis in the real estate market, the company pivoted beyond construction and went into development and the rental business, remaining one of the few surviving companies of that size. Post crisis, Novaconfort continued to grow profitably, yet ran into scaling constraints due to a reluctance to expand ***capitalization*** and senior management beyond the family owners.

Renetech (disguised company and industry) was founded in 2003 as a professional services firm specialized in consulting and technology solutions for small- and medium-size companies facing challenges with legal compliance in the face of ever-changing global, regional, and local regulations in the energy industry. Renetech's initial hires were all seasoned experts from the consulting and energy industries, and by 2018 employed over 150 people worldwide in offices across four continents. Due to the deep experience of the founder and his early hires, success in obtaining clients and installing high-quality technology solutions was straightforward for the lean staff that formed the early Renetech Solutions team. However, as volume and complexity increased, fresh college graduates were hired and had to be trained to a Renetech standard. Renetech realized late that had not given forethought to ***processification*** needed for standardization and training, to improvement efforts with ***automation*** of many processes to manage their systems, and to ***evaluation*** capabilities to track metrics to measure success.

SkinnyGirl Cocktails was founded in 2009 by Bethenny Frankel, a television personality who hit upon a concept for a premixed low-calorie cocktail drink marketed exclusively to women, a segment previously ignored by the major spirits companies. In very short order, SkinnyGirl became the fastest growing spirits brand in the United States, but the founder's initial ***collaboration*** partner for fulfillment struggled to develop operational and supply chain capabilities to keep up with the market demands. Ultimately, due to this inability to rapidly scale its production and distribution alongside its exploding demand, the startup sold itself to a large beverage company for a value seemingly below the net present value of its future cash flows. Subsequently, the larger firm was able to fulfill the order backlog but was unable to maintain the popularity of the brand. Although ***ex-post***, one could argue that the founder got a profitable exit for her startup, the case illustrates how an ***inability to scale operations in sync with market demand*** can impair the ability of a founder to maintain and capture the value created by an initially successful business concept.

The **Tesla Roadster** was Tesla's first car sold to the public. The company designed an initial supply chain that spanned three continents and resulted in very long prototyping cycles. In that initial model, the design and engineering of the key electronics and battery modules were performed in California, along with the final vehicle test and tuning. The manufacturing and supply chain team lacked ***professionals*** from the automotive industry, and with a focus on low labor costs outsourced the manufacture of key modules to multiple sites in Asia. Further, due to capability requirements, vehicle assembly was located in Europe. The footprint of this outsourcing model yielded very long design-manufacture-test cycles—from California to Asia to Europe and back to California. Such long debugging cycles, especially for a first-of-its-kind product, were not sustainable, and the company went through a major re-***capitalization*** and a radical organizational change to restructure and redesign its operations toward more a more insourced and geographically compact manufacturing footprint, which enabled it to then debug and deliver the Roadster vehicles. The initial concept of minimizing costs by outsourcing manufacturing to low-cost geographies was supplanted by the insight that supply chain speed can often save more money than low-cost labor.

The extreme operations pivot that Tesla was forced to undergo under duress, is often not possible for a company that does not have backers with deep pockets. The lesson that Tesla drew from the Roadster experience was how ***short supply chains can increase development speed***, which encouraged it to invest in a large, much more integrated facility (in Fremont California) for its next product generation, the Model S.

Unity Homes was founded by Tedd Benson in 2012 as a subsidiary of Bensonwood Homes, which had been a leader in designing and building high-end, timber-frame homes in the United States since the 1970s. Bensonwood invested heavily in learning Japanese and European manufacturing and homebuilding methods and invested in automation and human capital over the long term rather than hiring much cheaper day labor for house construction that would be shed at every downturn. Further, the company's continual push for higher quality, durability, and precision led it to invest in digital design and Computer-Aided Design and Manufacturing (CAD/CAM) capabilities for manufacturing highly engineered, complex home components—wall panels, roof structures, and floor structures—in their enclosed factory in New Hampshire. On-site construction of homes became a single-week exercise of final assembly with these panels rather than a months-long process of cutting, fabricating, framing, and installing thousands of components on the job site while exposed to the weather. The resulting homes had very high energy conservation capabilities and generated dramatically fewer defects and less waste. In an industry rife with defects, rework, and delays, Bensonwood came close to the zero-waste, zero-defects, zero-delay production

performance envisioned by the developers of the famed Toyota Production System.

Unity Homes was conceived to offer lower-priced homes but with a similar value proposition with regard to quality and energy efficiency. Unity homes were custom designed on a modular platform but offered less variety, less complexity, and smaller footprints than the typical Bensonwood home. Unity initially produced its panels in the Bensonwood factory, but that facility was not optimized for lower costs or lower variety required for the mid-tier market. In 2018, Unity opened a second factory in New Hampshire, designed for higher volume, lower variety, and lower cost, and had plans for ***replication*** of this factory design in different locations across the United States. The desire to maintain family control and expand through internally generated cash only slowed the growth as compared with what might be possible with a broader ***capitalization*** strategy.

VFA deployed a ***platformization*** strategy to create a business and management internship "fellows" program to match high-capability US millennials with startup companies that might not otherwise have ready access to such talent. Inspired in part by Teach for America, VFA aimed to recruit the best and brightest from the top universities, with a ***culturalization*** strategy to instill common innovation and entrepreneurship values throughout their network. VFA targeted small, entrepreneurial ventures in "second tier" entrepreneurial US cities (i.e., outside places like Silicon Valley, Boston, etc.) and deployed its elite troops into those firms, providing these startups with first-class, albeit raw talent, and providing its recruits with a worm's eye, hands-on experience in building a business. The first cities selected, Detroit, New Orleans, and Providence, had existing entrepreneurial ecosystems in place but had a high need for exceptional talent. VFA then scaled their model with a ***replication*** strategy, copying the initial model for many other cities. The startups paid salaries to the fellows, but much of the organization's overhead was covered by benefactors, whose donations represented charitable contributions for the sake of driving an industrial renaissance in some of America's bygone business centers.

The resulting platform business model required a careful balance of the needs of all these stakeholders: entrepreneurial employers, fellows, donors, and civic leaders. The initial reactions to the model were strongly positive. VFA had a formula that worked. Having successfully nailed the model, VFA then faced the challenge of scaling the model from dozens to thousands of fellows, while managing its growing alumni and partner network.

The ASB was founded in 2015, in Kuala Lumpur, as a greenfield ***collaboration*** between the MIT Sloan School and Bank Negara Malaysia. The ASB launched with a mission to become a "premier" business school in Asia and initially staffed its courses primarily with MIT Sloan faculty and curriculum, using generous scholarships in the early years to attract high-caliber students drawn from more than three-dozen countries from across six continents.

ASB's ***platformization*** strategy was to leverage its Bank Negara funding and its MIT affiliation to attract high-caliber faculty, students, and corporate partners, exploiting positive cross-externalities across these groups. ASB's ***culturalization*** strategy was to blend key cultural features of MIT (egalitarian, meritocratic, entrepreneurial) in a very different environment from Cambridge, Massachusetts, and with a collection of students, faculty, and staff who had grown up with a very diverse set of cultural and educational values and norms. As a result, attempts at ***professionalization*** of numerous staff jobs led to challenges of (1) needing significant ***acculturation for*** some new hires who had deep experience in their fields but did not have the context for a very different organization from their previous job(s), or (2) trying to build professional skills for people who were intellectually and culturally aligned but lacked experience in the areas they were hired to staff. The first job of virtually every new hire in the early years was to figure out what his/her job should be. Not everyone could do that.

Processification proceeded at very different rates in different parts of the organization, with the admissions and action learning teams formalizing their processes quite early, whereas marketing, career development, and faculty review processes, for example, evolved more slowly. Each new element of market ***segmentation***, including new degreed programs or non-degreed executive education, for example, added new layers of operational complexity that strained the small organization and often required new subprocesses. ***Automation*** in the form of an industrial strength ERP system came too early to ASB and the resulting cost and human overhead were disproportionate to the need in the early stages of development. Measurement of progress in the early years was informal: Could ASB fill its first MBA class? Could ASB hire enough faculty, fill key staff positions, source enough student projects, and ultimately help graduates get job placements? With light oversight in the early years, ASB moved very quickly and flexibly, and its curriculum was noted in 2020 as being one of "The 10 Biggest B-School Innovations Of The Decade."[6] Over time, however, board oversight driven by the shareholder led to the imposition of many layers of ***evaluation*** controls and measures, which slowed decision-making and forced cultural change from a risk-taking, jungle-trekker mentality toward a much more bureaucratic orientation driven by Standard Operating Procedures (SOPs) and fear of "audit findings" from SOP non-compliance.

5 | DISCUSSION, CONCLUSION, AND FUTURE RESEARCH

We hypothesize that entrepreneurship success can be enhanced by understanding the evolutionary journey that many firms traverse and by having tools and frameworks to guide firms through that journey. Some researchers (e.g., Joglekar & Lévesque, 2013; Kickul et al., 2011) have observed that the OM scholarly literature has not paid much attention to the contributions that OM might make to entrepreneurial practice. This state of affairs strikes us as an opportunity for the OM field to add additional value to management curricula and economic development and growth broadly.

Our initial efforts to exploit that opportunity have been field-based and ethnographic, with the intent to develop knowledge and frameworks that are actionable by practitioners. The journey of an entrepreneur is inherently dynamic. The entrepreneur attempts to build an organization and a viable business along a path where the challenges can change with each passing day but with some predictability with regard to the nature of the challenges to be faced along this path. Based on our fieldwork and teaching experiments in MBA and executive education settings, we believe that providing guidance to entrepreneurs—on what to expect along this path, what tools might come in handy, and what pitfalls to be aware of—can be of significant help to new ventures. We note that our conjectures have been explored informally to date and without the kind of data that might test these hypotheses with empirical rigor. Thus, we present this work as focusing on hypothesis generation and hope that it can be useful to catalyze additional work.

For example, we have found it compelling for students and practitioners to divide the entrepreneurial journey into three stages—nailing, scaling, and sailing—each quite distinct from the other with regard to challenges faced, tools required, and organizational cultures. Other scholars have used four stages or five or even more to describe the entrepreneurial journey. We have also proposed 10 scaling tools for managing the growth stage: (1) processification, (2) professionalization, (3) culturalization, (4) automation, (5) segmentation, (6) platformization, (7) collaboration, (8) capitalization, (9) replication, and (10) evaluation. We have observed each of these in various forms of deployment, and we have seen some dysfunction in cases where organizational cognizance of such tools was absent. But, the value of such tools and the completeness of this list might be subjected to more formal and rigorous analysis. Finally, for the sailing stage, we have observed people from mature firms seeking to be more innovative and entrepreneurial, and we are struck by the frustrations of such people as they struggle to nudge or hammer their organizations toward transformative change. More systematic guidance would be very welcome in this segment.

The limitations of our work also include our small and highly heterogeneous set of cases. Future research might be able to confirm, refute, or extend our findings by looking at a broader set of firms over longer time periods. We outlined a framework qualitatively, showing the complex landscape of tools and objectives available to entrepreneurs, but this framework is merely a hypothesis based on our limited sample. Building rigorous theory and empirical studies to affirm or deny these hypotheses remains to be done. Synthesizing practical policies for managers of complex systems often requires well-defined models that can capture complex interactions and time dependencies.

We conclude by inviting our OM colleagues into the jungle. We believe that a great deal of richness can emerge from greater engagement by the OM community in pursuing research in entrepreneurial operations. We cited above the work of Jiang and Liu (2019) who noted that entrepreneurs are often unrealistically optimistic. However, they present a model that shows how optimism nevertheless pays off. We think of many of our fellow scholars as academic entrepreneurs. Optimistically, we plunge into the unexplored jungles of knowledge domains, seeking new insights and perhaps a few truths. Happy hunting.

ACKNOWLEDGMENTS

The authors are grateful for comments and suggestions from faculty colleagues Bill Aulet, Bill Fischer, Michael Frese, and Nitin Joglekar; from dozens of our students who contributed to our case studies and our understanding of the phenomena discussed here; to the people and organizations who offered the stories of their entrepreneurial journeys; and to colleagues, executive education participants, and seminar attendees at the MIT Sloan School of Management (MIT, USA), the International Institute for Management Development (IMD, Switzerland), the Asia School of Business (ASB, Malaysia), and the Indian School of Business (ISB, India). Finally, we are particularly grateful for the supportive and very helpful comments from Chris Tang, as editor of this special issue of *POM*. Remaining shortcomings, of course, reside with the authors.

ENDNOTES

[1] Looking through the available curriculum information online for the top-ranked MBA programs in entrepreneurship https://www.usnews.com/best-graduate-schools/top-business-schools/entrepreneurship-rankings, we could not find courses in operations for entrepreneurs. In some programs, operations was not even listed as available or recommended for master's degrees focused on entrepreneurship.

[2] These cases will be released in a (much) longer manuscript.

[3] "According to the *Oxford Dictionary of Word Origins*, [the phrase 'nailed it' is] probably from the Roman poet Horace, who used a Latin phrased meaning 'nail it'. Sculptors might finish their work to perfection by scraping the work with their finger nail. And carpenters might check their joints using their finger nails. 'Nail it' still has the meaning of to perfection (successfully, etc.)" (available from https://www.quora.com/Where-does-the-phrase-nailed-it-come-from).

[4] Our MediTech case provides a numerical calculation exercise for this.

[5] This equipment market collapse was a classic example of the bullwhip effect in capital equipment markets. For a discussion of this phenomenon, see, for example, Anderson et al. (2009).

[6] See https://poetsandquants.com/2020/08/12/the-10-biggest-b-school-innovations-of-the-decade/2/.

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How to cite this article: Fine, C. H., Padurean, L., & Naumov, S. (2022). Operations for entrepreneurs: Can Operations Management make a difference in entrepreneurial theory and practice? *Production and Operations Management*, *31,* 4599–4615. https://doi.org/10.1111/poms.13851