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Rethinking the Design Principles of Support Systems for Deep Tech Ventures

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Abstract

Starting on the premise that the creation of deep tech ventures is a complex and multi-faceted process, we explore in this review essay important principles to consider when designing support systems to incubate or accelerate deep tech ventures. While many contemporary entrepreneurial support systems cater specifically to the creation of digital start-ups, we know little about the mechanisms that affect important outcomes like investor readiness and attractiveness in the context of deep-tech ventures, i.e. ventures that commercialize early-stage technological innovations and scientific breakthroughs. We summarize the current insight into key learning activities in such ventures and their relation to the lean startup-inspired model of support programs, which currently dominate entrepreneurial ecosystems. Building on recent empirical findings on typical learning activities in deep tech ventures and outcomes patterns, we derive two important design principles that will need to be considered when structuring venture support systems. Contrary to the dominant lean start accelerator model, we suggest that deep tech acceleration and incubation programs will want to consider a loose-coupling in two dimensions: (1) technology from customer problems, in order to build broader application portfolios, and (2) time from outcome milestones, i.e. allow for variation in pace. These insights offer an important starting point for the practice of designing venture support systems, fitted to the specific knowledge context of an entrepreneurial project.

Keywords

Accelerators • Deep tech ventures • Incubation • Lean startup • Science-based entrepreneurship • Technology commercialization

Introduction

Venture support systems in form of incubation and acceleration programs have become the dominant players in entrepreneurial ecosystems around the globe [1-3]. Many of these programs follow the same underlying patterns and processes, designed originally to accelerate entrepreneurial learning in digital ventures through relying on scientific entrepreneurship methods [1,4-6]. Popularized as lean start-up in the wider literature [7,8], this method builds on fast iterative cycles around business experimentation with the aim to identify market needs and desires before making substantial financial commitments to building products, services, and venture organizations. In so doing, lean start-up design principles orient the outcomes of typical support programs toward validated product ideas, accelerated product-market-fit, and ultimately scalable business models. This, however, targets specific types of idea-driven ventures, not necessarily optimized for helping deep tech entrepreneurs to get off the ground, and thus calling into question the effectiveness of acceleration programs [9]. Based on recent research into the typical development patterns of science-based and deep tech ventures [10-12], and our recent forays into better understanding the learning trajectories in these ventures [13,14], we are outlining in this essay two important design principles that support programs will need to consider when structuring the support of deep tech ventures.

Learning Trajectories and Patterns in Deep Tech Ventures

In contrast to digital startups, deep tech ventures are often constrained in their ability to engage in market experiments because of their higher development cost coupled with long cycle times [15-17]. Deep tech ventures are ventures with the purpose to commercialize early-stage technologies, which are typically technologies with low maturity on the technology readiness scale developed originally by NASA [18,19]. This scale has been in wide use in private and public technology contexts to aid important technology management decisions [20]. Deep tech ventures often begin their commercial explorations early on and thus may enter entrepreneurial support systems with TRL levels of two or three [13,14], long before they have even established prototypes that are fully functioning in commercial environments. Subsequently, such ventures still need to engage in substantial technology and application experimentation, more so than necessarily market and business model experimentation [21,22]. At the same time, deep tech ventures nonetheless also need to engage in market scoping [23], in particular the related activities of market research and analysis [24] in search for the most promising market application [25]. None of these starting conditions is well represented in the dominant lean startup model of venture development used across many support programs.

Against this backdrop, in a recent line of research [13] examined the boundaries of deep tech venture acceleration and important design requirements to support the effective development of those ventures. Based on a comparative multiple case study of 8 ventures in the Europe-based acceleration and venture training program Climate-KIC (CKIC) the research finds that the more successful deep tech ventures engage in a parallel market learning path of exploring several different promising market applications at the same time, rather than following a sequential learning approach. The parallel learning approach allowed the more successful ventures to create a portfolio of options and generate more business connections. Parallel experimentation also allowed for faster elimination of options that were technically or market-wise unattractive, and it enabled those ventures to reach important venture milestones faster than their counterparts who experimented in a serial fashion. The parallel approach worked in particular through stimulating the development of a product-market portfolio, which overall increased the venture's investment attractiveness and allowed the parallel experimenters to outperform their peers in the acceleration program. This effect was, however, more pronounced for ventures with early-stage technologies, i.e. technologies with low technology readiness scores. In terms of individual-level priors that influenced the choice for parallel vs. serial experimentation, the entrepreneurs' market knowledge appeared important. Prior knowledge of markets and customer problems reduced both the participants' willingness to explore multiple options and to experiment in parallel fashion [13]. In line with the cognitive entrenchment perspective [25,26], participants with prior market knowledge appeared more entrenched in their original idea, which prevented them to leverage additional opportunities over the program's run time.

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The above results have extended in important ways prior insights into how entrepreneurs navigate the early stages in deep tech ventures. They allow us also to critically rethink current support programs and derive two important design principles for programs tailored to deep tech ventures. The dashed-border box in Figure 1. Summarizes at high levels the core findings [13], based on which we subsequently derive here two core design principles that support programs will want to consider as we discuss in more detail below.

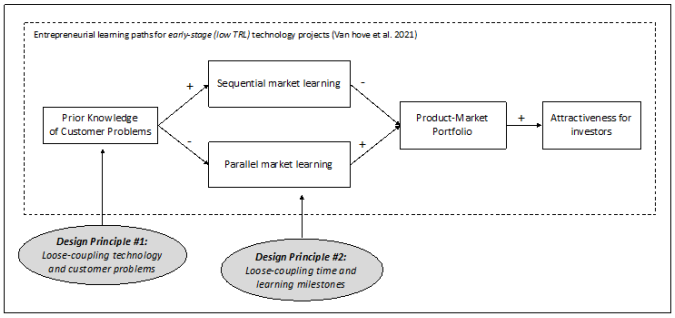

Figure 1. Two key design principles for deep tech venture programs.

Rethinking the Design Principles of Support Programs for Deep Tech Ventures

The common accelerator design principles of product focus and fast cycles of business model experimentation do not typically focus on these particular conditions and needs of technology-market linking as an important prior of high-tech ventures [27,28]. In their focus on product-market-fit that uses lean startup principles as a variance-reducing mechanism [35] their typical design systematically defocuses from the success factors found in the CKIC sample as outlined above. Against this backdrop and the extended review of our collective knowledge about the particularities of deep tech venture development, incubation and acceleration programs will need to rethink in particular their approaches to application variance (see design principle #1) and to time-based milestones (design principle #2).

Design principle #1: Loose-coupling technology and customer problems

Prior research has highlighted that early-stage technology ventures benefit from accepting market ambiguity [23] when it comes to linking technologies to markets. The insight that parallel experimentation is the more effective experimentation approach in this case, not only for business model development [29] but also when identifying applications is important. It is this parallel experimentation with applications that helps implement mindsets geared toward a market ambiguity acceptance [23] This is important and should be reflected in the design of incubation and acceleration processes for deep tech ventures. Contrary to the variance-reducing focus of lean startup principles, support programs for deep tech ventures will need to evaluate carefully the key performance criteria based on which these ventures are most likely to unlock follow-on funding. In deep tech ventures, an early commercial viability assessment may rest more on a variety of application options that leverage the still inherent technological uncertainty. Subsequently, programs should consider incorporating practices and processes that allow for the creation of a viable application portfolio, i.e. multiple 'product-market-fit' instances.

Due to the aforementioned cognitive entrenchment risk, programs will require to have their tenants engage in purposeful decoupling of technology and application, and insight that resonates with the literature on successful resource leveraging [30] and has been discussed previously as important element in the early training of academic entrepreneurs [24,36]. These works offer interesting insights into tools that may systematically aid such decoupling process, which then will enable a more systematic identification of a whole application portfolio and thus purposefully introduce options for variance, which should be effective in dealing with the market ambiguity surrounding these ventures.

Design principle #2: Loose-coupling time and learning milestones

Recent research in entrepreneurship has also proposed that time should be taken more seriously [31]. This corresponds to a feature which requires more pronounced emphasis in the described analysis of the CKIC acceleration program [13]. Contrary to the typical time-constrained design of lean startup inspired support programs [6] there was a unique flexibility of the CKIC program that allowed deep tech ventures time-flexibility to reach their milestones. Instead of imposing the same corset of time-milestone onto all program tenants, the CKIC process allowed the participating entrepreneurs to spend longer to reach important learning milestones, i.e. adapt the "graduation" time to the needs of their program. That means, while the initiation and chronology of tasks [31] may be an integral and important fixed element of a support program, the pace of when ventures reach learning milestones and complete certain tasks may be flexibly adapted based on technology development and the often more complex application experimentation processes [14,21].

A time-based flexibility may reflect to some extent also recent insight into how entrepreneurs construct and optimize business models in novel markets [32], which has shown the importance of time for pause and reflection in making important venture strategy decisions. In fact, combining thinking and doing loops appear in particular important in technology ventures [33]. Since the strategy formation in deep tech ventures is of significant complexity along more than just business model criteria [10,21,22], the typical "pressure-cooker" environment of a standard venture accelerator may be ill-fitted for deep tech support programs. More research will be required into understanding the importance of pace but a brief survey of contemporary technology support programs [13,14] suggests time spans of 12-18 months to allow the learning process in deep tech ventures to unfold such that important gate-keeping decisions can be made.

Conclusion

The notions of accelerators and other entrepreneurial support programs as 'high throughput' tools that follow a 'one size fits all' approach require a careful evaluation against the different types of technology ventures. Recent research distinguishes in particular the knowledge context of new ventures and highlights systematic differences between ventures based on scientific discoveries, unmet user need, and mission-oriented grand challenges [34] Traditionally, support programs, in particular venture incubation and accelerators are designed with a one-size-fits-all approach, resting in particular on principles of time constraint and the implementation of lean startup principles [6]. In this essay, we reviewed recent insights on empir ical acceleration patterns in deep tech ventures, which highlight that vent ure learning processes in these types of ventures differ from the learning user-need based ventures. A result from this insight is that venture support programs will need to adapt to the type of venture to be supported, notably its type of knowledge context. We derive that support programs will want to look in particular at two linkages that typical programs foster: (1) the tight linkage between market problem and technology, and (2) the tight linkage between time and venture milestones. We posit here that both principles will need to be carefully considered and possibly relaxed in favor of a more loose-coupled approach, in order to effectively support the development of deep tech ventures.

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