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STarmac: an environment for the stimulation and development of entrepreneurial projects in academic institutions

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Abstract:

In this article, the authors present STarmac, a pre-incubator developed by the Swiss Applied Science University of Canton Vaud (HEIG-VD) which aims to support young founders in the development of innovative business ideas by providing them with the tools to manage market and technology risk. The article describes the STarmac pre-incubator and its components, and outlines a process for stimulating and supporting entrepreneurship for university spin-offs. The authors introduce metrics for the assessment of STarmac's performance, centred on team development, to enable continuous improvement and provide better support to participants. They conducted two studies, one qualitative on the requirements of the participants for pre-incubation and one quantitative on the impact of the supporting programme to develop entrepreneurial skills.

While still preliminary, the results from these studies confirm the authors' hypotheses on the key success factors for effective pre-incubation in the context of university spin-offs.

Keywords:

Start-up, entrepreneurship, innovation, incubators, accelerators, spin-offs

University spin-offs (Oake, 1995) are companies whose products are based on research carried out in the university's laboratories and institutes. Projects are usually spawned from final-year student projects, PhD theses and research performed by faculty and research staff. Spin-off development requires training and coaching because project founders do not have all the necessary skills to build and run a business (Steffensen et al., 1999). In some cases, the necessary training and coaching are guaranteed by the university itself. In other cases, they are provided by public or private institutions such as incubators or accelerators. According to the stage of development, this kind of support can take various forms: in most cases, universities take care of technology transfer and delegate business development support to external institutions (Pérez Pérez and Martinez Sanchez, 2003).

There are three key phases in supporting the creation of a business (Dichter et al., 2003):

1. *Pre-incubation:* idea generation, conceptualization, business model definition and validation, initial business plan. In this phase, as pointed out by Voisey et al. (2013), pre-incubation support is intended to fill the gaps between higher education institutions and business incubators by providing tools to manage the risks usually associated with early-stage ventures and offering support to founders in the form of specific training, coaching and infrastructure.
2. *Incubation:* company incorporation, access to funding, set-up of partnership, go-to-market strategy, growth. Unlike pre-incubators, incubators help start-ups to access finance and to develop an effective partner network. Lewis et al. (2011) set out best practices for incubators and propose a set of tools for measuring start-up incubation

performance (see http://www.edaincubatortool.org/). Based on a number of variables, the performance of incubators correlates with entrepreneurial success. The findings from the study by Lewis et al. suggest that business incubation positively influences entrepreneurial success.

3. *Post-incubation:* scaling, industrialization, exit strategy. Also known as acceleration (Voisey et al, 2013), post-incubation focuses on growth, in terms of both market penetration and capacity building.

In this paper, our focus is on the pre-incubation of university spin-offs (Steffensen et al., 1999). We are interested in assessing the performance of pre-incubation by maximizing a set of indicators (metrics) that are relevant and that can help in benchmarking our efforts with respect to similar initiatives – the goal being to derive best practices and continuous improvement in our performance. We aim to show that the performance not only of the incubator, but also of the pre-incubation process can be considered a key factor in entrepreneurial success. The literature on the impact of pre-incubation is well summarized by Soetanto and Jack (2016), although framed within a different terminology ('university-based incubation'). While Soetanto and Jack provide a clear definition of pre-incubation support for spin-off development, they do not provide direct metrics for measuring the impact of pre-incubation efforts with regard to specific aspects of that development.

We considered the methodology proposed by European Commission for the benchmarking of business incubators (EC, 2002) with the intention of adapting it to the specific case of pre-incubators. However, this benchmarking methodology focuses mostly

on measuring internal factors such as the ‘efficiency’, ‘utility’ and ‘sustainability’ of the incubator, or its ‘effectiveness’ (e.g. the survival rate – the number/percentage of start-ups still trading after 3 years) and correlating them with economic indicators, such the wealth generated and the jobs created. In the long term, our goal is to provide figures for these indicators, especially the economic ones.

In this paper, we focus only on indicators that correlate with the improvement of team quality. As for retained indicators, we base our set on the conceptual model proposed by Mandel and Noyes (2016) and shown in Figure 1. These indicators relate to the assessment of individual and team skills. We found agreement in similar initiatives concerning the importance of developing such a skillset. As this paper discusses part of an ongoing research project, we consider here only those metrics related to individual and team skills. However, our future goal is to measure the full set of indicators, which include those related to economic impact as proposed by the EC (Centre for Strategy and Evaluation Services, 2002).

Figure 1 about here

In the sections that follow we introduce the STarmac processes for supporting the business development of university spin-offs, and we provide a framework for assessing the impact and performance of university pre-incubators. We also present two studies we conducted which informed the design of this benchmarking framework.

STarmac university pre-incubator

STarmac is a university pre-incubator (Kirby, 2004) intended to promote the emergence of entrepreneurial projects among the academic community by providing an environment

that stimulates innovation and entrepreneurship from the ground up. In other words, STarmac aims to increase the number of business ideas and avoids filtering them at the outset. Instead, we support the founders in testing their ideas in the market, first assessing the business opportunities rather than focusing exclusively on technology development. Being a multidisciplinary school, we encourage the creation of multidisciplinary teams and let the market, not the technology, drive innovation.

STarmac is both a *physical place* where university students and staff can work and meet, and a set of *support services* organized into a 'journey' towards the creation and development of new ventures. Its main goals are:

- to provide a safe environment in which participants can overcome their fears and develop their business ideas by testing them in the market, following the 'Lean Startup' approach (Ries, 2011);
- to foster the creation of interdisciplinary teams (Reuveni and Vashdi, 2015) with the right balance of technology and business development expertise (Mian et al., 2016); and
- to provide a means of liaison with the local entrepreneurial ecosystem (Pettersen et al., 2016) as well as a due diligence process for potential investors to assess the level of risk and the expected return on investment (Norton and Moore, 2006).

When a founder or a founding team joins STarmac, an initial assessment is undertaken to understand the stage of the project's development. In most of the cases, projects are brought by engineering students or researchers, who may have developed the technology

but who have not considered the elements of business development. Occasionally, projects are brought by business students, and we aim to increase the number of business students involved in entrepreneurship by proposing to them classes in which they can develop their business ideas. This goal is extremely relevant for STarmac, as the pre-incubator is part of a multidisciplinary applied science university where engineering and business students and faculty are supposed to collaborate. Moreover, founders with more of a more business background are keen to develop market-pull rather than technology-push innovation. The STarmac process highlights the need to validate market assumptions before proceeding further with technology development. In other words, STarmac is a 'Lean Startup' pre-incubator (Ries, 2011).

We have identified 4 entry points for our programme:

- *Business ideas.* Based on founders' intuitions, business opportunities are proposed without any strong concern about technical feasibility or economic viability. Usually, ideas come from classes, but not always. Sometimes, even first- and second-year students contact us for feedback on their business ideas.
- *Business concept.* This phase represents the first step of validation of the idea. With a blend of training and coaching, founders engage in 'customer discovery' (Blank and Dorf, 2012). At the end of this phase, we expect market opportunities to be clearly identified. The programme relies heavily on collecting primary data from potential clients: teams need to perform at least 30 interviews during a term. Some projects end at this stage because the initial assumption about market demand has been shown to be erroneous. Moreover, some founders are not able to

pivot and adapt their initial strategy to the outcomes of a reality-check. As an additional outcome of this programme, the founders have defined their initial (not yet validated) business model.

- *Business validation.* Founders who have been able to identify a market opportunity can now start to validate their business model assumptions. During another term (4 months), founding teams are pushed beyond their comfort zone and are asked to tackle the market by selling their value proposition. Based on Steve Blank's Customer Validation method (Blank and Dorf, 2012), founders have to test their Minimum Viable Product (MVP) directly in the market. It is a fast-paced process, in which we ask the teams to iterate rapidly, emphasizing the 'minimalism' of MVP – that is, the minimum effort required to validate an assumption. Very often, MVPs are considered as prototypes or proofs-of-concept to show that the solution 'works'. We stress that MVPs are tools for validation, and that technical feasibility is rarely the riskiest assumption to validate first (Blank, 2006).
- *Startup-Innogrant.* This phase involves both coaching and financial support. Selected projects are incubated for one year so that they can reach the necessary maturity to apply successfully for external incubation or acceleration programmes. The main goal of this programme is to prepare the project for scaling. There may be some assumptions left from the business validation phase, and the team should be able to acquire the necessary traction to become of interest to investors (Weinberg and Mares, 2014).

As previously noted, STarmac also provides a suitable infrastructure for the emergence of entrepreneurial projects. Other university (pre-)incubators have been described in the literature, such as those started in Brazil (Stala et al., 2016), and STarmac has strong similarities with these initiatives. Its architecture is shown in Figure 2. STarmac offers: an information and orientation Help Desk for entrepreneurship and innovation; a co-working space (HUB); a rich programme of stimulation events and opportunities to liaise with the local entrepreneurial ecosystem; and individual coaching. In order to bring the new projects to the right level of maturity, we have created a three-step process, as shown in Figure 3.

Figures 2 and 3 about here

Business model design and validation

A business model can be defined as an architecture for creating new value for targeted customer segments in a viable and sustainable way. Business model design (Osterwalder et al., 2010) is about linking together the components of the architecture in a coherent, effective and efficient way:

- *Coherence* is related to the interdependence of components; e.g., linked value streams, compliance with regulations and constraints, validated assumptions.

- *Effectiveness* has to do with impact and value creation. In other words, it is about pain relief and gain creation for the targeted customers and/or stakeholders.
- *Efficiency* is about optimizing the resources needed for value/impact creation.

Although there is a logical structure, it is hard to reduce these three different aspects to discrete, independent components. Most of the time, in the case of multi-stakeholder business models, the global optimum is hardly achievable, and trade-offs are the norm. Moreover, as business models are designed before their deployment, their elements are based on assumptions.

Business models need to be validated before they are implemented (Ganguly and Euchner, 2018) to reduce the risk of failure due to high uncertainty in assessing stakeholders' precise requirements. Markets are volatile and frame conditions can be unstable and uncertain. Therefore, the design method must include reliable ways to validate the model empirically – for instance, by simulating real conditions or with small-scale deployments.

The validation methodology, adapted from the Customer Development approach (Blank and Dorf, 2012) and Ries's Lean Startup method (Ries, 2011) for the design of business models, is illustrated in Figure 4.

Figure 4 about here

Business model design should not end on paper. Building a business model architecture is only the first step of what may be a long series of iterations in adapting the

assumptions to the reality. The reality-check is often a hurdle that engineers try to avoid, but it is extremely important for the creation of a successful product.

We have outlined a business model validation methodology which stems from the Lean Startup and Customer Development methods adapted for specific domains and socio-cultural contexts. We noticed, indeed, that the effectiveness of the validation method depends on the type of risk, market or technological, and that we needed to find a trade-off between pure metric-based validation and pure technology development. The three fundamental factors in value creation – desirability, feasibility and viability – cannot be tackled independently. Although we believe that desirability is the most fundamental factor, we also believe that feasibility and viability must inform what kind of desires will be fulfilled for the targeted customers and to what extent they will be fulfilled.

For this purpose, an assessment of the type of risk is essential. We believe that for a product risk ranges between the two extremes of 'pure technical' and 'pure market' risk. We see very low chances of success for those products that feature both high technical and high market risk. In other words, if a solution to a problem is very hard to achieve, we expect that problem to be a compelling one (i.e., low market/adoption risk). This is almost always the case for drugs and health-related products. For the other extreme, where market risk is very high (i.e., the switching cost is very high), off-the-shelf technology should be more than enough to implement the solution, as the main focus will be on understanding what exactly are the neglected features that will fulfil an unsatisfied need for the targeted customer segment or stakeholder. We have crafted the

process depicted in Figure 5, which will eventually lead to the maturity level needed for scaling up the business.

Figure 5 about here

Business model validation is central to the STarmac approach because it encourages founders and their team to focus on market demand. In particular, STarmac is part of a science university in which research is applied rather than fundamental (Kleger, 2016). This means that we expect shorter go-to-market timeframes for products that fill existing market gaps. Very often, the projects hosted in STarmac incorporate a mix of business model innovation and integration of technology developed at neighbouring universities.

Research study

Currently STarmac hosts a dozen projects and involves a core team of 5 people plus several adjunct and voluntary staff members. It is a newly created structure and we have only recently started collecting data. However, we already have interesting and promising results, which we present in this paper. We provide here summaries of two studies: one qualitative, in which we collected information about other similar local initiatives, and the other quantitative, in which we assessed the improvement of selected indicators when support was provided to founding teams. To our knowledge, there are few studies on pre-incubation related to ours: among them, we highlight a longitudinal study over 10 years conducted in Wales (Voisey et al., 2013) and an assessment of the impact of pre-incubation in Turkey (Kepenek and Eser, 2008). These studies are not directly

comparable to ours since there is as yet no common evaluation framework. This paper furthers the adoption of a common set of metrics so that best practices can be shared and compared.

Qualitative study

In order to obtain a deeper understanding of the current context and the different stakeholders' perspectives, we organized our qualitative study into 3 parts:

1. In the winter of 2017, we interviewed 4 directors of other pre-incubators in the French-speaking region of Switzerland. Those 4 pre-incubation programmes were selected because their structure and organization were different from one another and from STarmac (some are entrepreneurship-oriented education sessions incorporated into higher business education programmes; others are incorporated into the academic structures but remain independent from the education programmes and are designed to gather together students and employees who want to be entrepreneurs). At the same time, all have similar visions and offer the same range of services and, moreover, are part of the same political, educational and social ecosystem in the French-speaking region of Switzerland. The goal of this part of the study was to confirm that our initial hypotheses and concerns were shared by the other pre-incubators.
2. In the spring and summer of 2017, we interviewed 4 directors of post-incubation organizations to capture insights into the requirements for the ideal pre-incubator from the perspective of the receiving party. These post-incubation structures were

selected because of their willingness to participate in the innovation ecosystem in Switzerland and their reputation in the community. Furthermore, they are considered by STarmac as future potential hosts for teams and projects and as a step forward in the transition process from idea to business.

3. Also in the spring and summer of 2017, we interviewed 2 directors of local support agencies for economic development in order to assess key success factors for new business creation. These public agencies are important in the local innovation ecosystem because of their capability to develop and monitor public funding programmes to support entrepreneurs in their journey from idea to business, generating added value for the area and jobs.

Pre-incubators in Switzerland

There are various university pre-incubators in Switzerland, but their roles and offerings vary substantially. Some are more focused on technology transfer from research labs and offer very little support while others, like STarmac, are more concerned with the support of founders in business creation. As noted above, we surveyed pre-incubators whose missions were similar to that of STarmac. The following key points emerged from the qualitative study of pre-incubators:

1. The services offered are basically the same. No substantial difference in the types of services was detected.
2. Market validation emerges as the most important skill to be learned. Other skills are: networking, flexibility, adaptation, overcoming the fear of the reality-check, interaction with other people, pitching.

3. Some identify the role of the pre-incubator as stimulating entrepreneurship and creating an awareness among students of the different career opportunities and lifestyle it offers.
4. The number of entrepreneurial student projects is too small.
5. There is a tendency to ‘sweeten’ the support to avoid scaring potential entrepreneurs. The pre-incubators do not work at full capacity.
6. There is low interaction between pre-incubators. Because of the low demand, there is a tendency to isolate teams that might be ‘stolen’ by other pre-incubators.
7. Having teams at different stages of development in the same place is very helpful. More mature teams can advise newcomers and accelerate their development.
8. The performance of the pre-incubators is rarely measured. When it is measured, the most common metrics are qualitative and unclear, such as ‘added value created’. There is rarely a link to economic development metrics, such as the number of jobs created. Metrics related to individual and team skills development are also considered important.

Pre-incubation programmes can be considered as pointers to the entrepreneur’s way of life; as such, their shared goal is to foster entrepreneurship among students and many actions can be considered as pointers (for example, a TV show, an entrepreneur pitching in front of kids at school, innovation-oriented lessons during college or high school, start-up camps, hackathons, taking students to Silicon Valley during high school or private programmes). The people we met all shared the same vision but were developing different strategies to

achieve it, with different levels of structure and processes. For the remainder of our study, we thus regarded all initiatives aiming to sensitize students as pre-incubation actions.

Post-incubation organizations

The goal of the qualitative survey of post-incubation organizations was to assess their requirements, as these organizations would hopefully receive the teams that began their projects in the pre-incubators. Post-incubation organizations are often based on private–public partnerships and are sometimes associated with an investment fund.

Table 1 summarizes the key points emerging from the interviews with the 4 directors of post-incubation organizations. The main weakness of currently incubated startups is the lack of soft skills, which are hard to develop during higher education programmes and are linked to the personality of team leaders or team members (i.e., no validation mindset, weak networking skills, difficulties with public speaking and pitching). None of the weaknesses identified was linked to technical skills.

Table 1 about here

None of the items in the ‘What to avoid’ column in Table 1 applies to STarmac, as STarmac (a) does not provide academic training or theoretical lessons as this is the role of the education programme; (b) helps entrepreneurs to validate rapidly and to pause the project until interviews have been held; (c) helps entrepreneurs to develop their own development structure by providing support through coaching; and (d) organizes networking events and encourages entrepreneurs to meet specialists.

According to insights from the pre- and post-incubator interviews, we can characterize STarmac as:

- a very structured and sensitizing pre-incubation initiative, as it develops processes, sequences, coaching, co-working space, events and methodologies, with facilities and resources; and
- a pre-incubation structure which complies with the requirements of post-incubation structures.

Start-up support institutions

We met with the directors of 2 support institutions of the Vaud canton of French-speaking Switzerland. The first of these was the Chamber of Commerce for the canton (see http://www.innovaud.ch/), which provides financial help to start-ups in the form of grants (FIT Innogrant). The second, SPEco (see https://www.vd.ch/index.php?id=9184), provides loans and several other services such as intellectual property information, participation in trade shows, market feasibility studies, compliance and certification support, etc. Table 2 summarizes the key insights gained from these support institutions, focusing on the goals of both pre- and post-incubation, as well as a definition of start-up. What emerges from this qualitative survey is that institutional support bodies for entrepreneurship recognize that incubators and pre-incubators play different roles and are ready to support pre-incubation because incubation can be more effective if it is preceded

by work to manage risk, and because more good businesses are more likely to emerge from a larger number of validated ideas.

Table 2 about here

In conclusion, pre-incubation is perceived by both post-incubation and support organizations as an opportunity to stimulate entrepreneurship in the university and they favor the preliminary development of business ideas so that a 'natural' selection is made by the market and not by committees or juries.

Quantitative study

The goal of the quantitative part of our study was to understand the evolution of students' self-perception of indicators within the categories of Mandel and Noyes's conceptual model (Mandel and Noyes, 2016) before, during and after pre-incubation programmes. The questions can be categorized according to the conceptual model and they are shown in Table 3.

First, we performed a longitudinal study over 3 days of a student start-up competition (hackathon) co-organized by STarmac and other partner universities. The participants were engineering students. We collected data three times (during two days of the event) from a sample of 90 people. Our initial hypothesis was that our selected indicators would improve over time because of training and coaching. We asked 8 teams to answer 12 questions (on a scale ranging from 0 to 5). We can summarize the key results as follows:

- The teams progressed in business model validation.
- The teams lost confidence in the innovative power of their ideas.
- Their confidence in their assessments of market size and type remained stable.

- The urgency of pivoting increased slightly over time.
- The participants felt they had improved their knowledge of the market.
- While still high, their opinion about the importance of and interdisciplinary team decreased slightly.
- They generally observed the emergence of a team leader.
- Their feeling of having acquired new skills increased.
- Their awareness of the impact of coaching increased only at the end of the process.
- The teams felt that they could keep focusing (stable high evaluation).
- The teams felt that they were increasingly pushed beyond their comfort zone.

Secondly, we performed a longitudinal study over a term (12 weeks) with 3 data collection points (every 4 weeks) as part of the Business Concept programme. Important elements from the analysis of the data collected were:

- There was an average increase of 9.738% in the self-evaluation of all items during the whole event. The increase was less pronounced for the last data point (during the last 4 weeks), but was, nevertheless, 4.586%. One conclusion that can be reached is that self-improvement was strongly felt at the beginning of the hackathon.
- The self-evaluation item that recorded the highest increase was item 4.1 (Table 3), at 13.892%. This was followed by item 4.3 with an increase of 13.008%. Both these items are related to the impact of coaching in making progress with the project.

- The item with the highest increase in the last month of the program was item 3.2, with an increase of 8.929%, while the above-mentioned item 4.1, related to the impact of coaching, increased on average from 8.138% to 8.174%.
- Item 4.3, related to the impact of coaching on challenging the founders' point of view, scored consistently across the 3 data point collections. Their ability to pivot is supported by coaching.

Thirdly, we performed a longitudinal study over a term (12 weeks) with 3 data collection points (every 4 weeks) as part of the Business Validation programme. The results of the analysis of the data collected were as follows:

- Similarly, there was a substantial average increase of 10.681% in self-evaluation for all items across the 3 data point collections, although this was slightly lower than in the Business Concept programme. The increase was less pronounced for the last data point (during the last 4 weeks), at 1.099%. A similar conclusion can be drawn for this programme as for the Business Concept programme.
- The self-evaluation item with the highest increase was item 3.1 ('Do you consider your business model validated?'), at 34.535 %. Participants were not initially convinced that their product was ready for the market, but their confidence increased dramatically in the last month. We can infer that founders acquire more self-confidence in their ability to respond to market demand while progressing in their project.

- The item with the highest increase in the last month of the program was item 1.3 with an increase of 8.333%, while the above-mentioned items 4.1 and 4.3, related to the impact of coaching, show a 1-point decrease during the same period. We can infer that, towards the end of the program, the founders feel that teamwork is more important for validation than coaching support.
- The items in the third category, related to the perception of market validation and market opportunities, show a progression of about 11% during the last month, although the increase occurs only during the first 2 months, staying the same in the third month. This usually coincides with the need to pivot in certain projects.

With our population of fewer than 30 people we used the Microsoft Excel VAR.P.N function to compute variances to conduct a two-tailed test (z-test) with a 5% equality hypothesis. We consider population as independent, assuming that people do not remember their responses in the previous survey. As shown in Tables 4 and Table 5, we rejected the equality hypothesis when values were between –1.96 and 1.96*, considering then a statistical difference shown as an impact of the programme on participants' beliefs.

Conclusions

In this paper we have presented the STarmac pre-incubator with its essential components. We have also proposed a framework for assessing the impact of STarmac on five categories related to individual and team skills. The results of our investigation into measuring the performance and impact of STarmac provide us with useful insights that will inform the future development of the project. We can summarize what we have learned from the studies as follows.

First, we observed a strong interest in the role of pre-incubation in the local entrepreneurial ecosystem. Very often, founders join incubators and accelerators prematurely, before they have carried out an initial validation of the market. Moreover, if awarded grants or funding, they might gain the false impression that their business model is validated. We keep repeating that investors are not customers, because they can be impressed by technology while overlooking the real market opportunity.

Pre-incubators need to provide the right balance between training and support. Some founders may lack business skills, while others may lack an entrepreneurial mindset. None of the interviewees mentioned that local start-up founders lacked technical skills. Therefore, the pre-incubator should focus on business development skills rather than on boosting already excellent technical skills. Other than market analysis skills, networking, teamwork and resilience seem to be the most lacking.

From the quantitative study, we conclude that pre-incubation programmes similar to that we have proposed are able to improve the self-confidence of founders, who feel better equipped to deal with entrepreneurial challenges. The role of coaching is important, but the ability to build strong teams emerges as a key success factor, together with the ability to understand market needs and recognize business opportunities.

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Table 1. Summary of qualitative study of post-incubation organizations.

	Goals of pre-incubation	Weaknesses of currently incubated startups	Desired services of pre-incubation	What to avoid in pre-incubation
FonGit (Geneva)	Educate future entrepreneurs. Provide office space, exchange and meeting opportunities with market actors, mentors and like-minded people. Events, hackathons.	Lacking validation mindset. Slow pace in business development. Weak networking skills.	Provide support for business model validation. Provide entry points to network (customers and partners).	Theoretical/academic training.
MassChallenge (Lausanne)	Develop teamwork skills. Expose to different components of the entrepreneurship value chain. Become aware of the social context.	Learn how to pitch. Find relevant information quickly. Clearly state project's goals and vision.	Scenario management. Push founders to perform reality checks with stakeholders in the value chain. Design business models.	Designing business models without validating them. Keeping incubated projects secret.
Y Start (Yverdon)	Organize validation of the project's market value. Help founders to complete the team with necessary skilled members.	Focus on business plans rather than business models. Preference for working alone rather than with a team. Overlooking marketing efforts. Weak pitching skills.	Training in basic and advanced entrepreneurial skills. Networking events. Sharing of experiences.	Avoid rigid structures as every project is different.
KickStart (Zurich)	Gather motivated people around projects. Help in meeting potential customers. Support for building and validating MVPs. Support for dealing with unexpected outcomes and pivoting. Provide basic entrepreneurial skillset.	Never met potential customers. Lack of dynamism in teamwork and real leadership. Lack of a clear roadmap. Lack of awareness of required resources for project development.	Flexible work space for individual and teamwork. Provide access to domain experts, coaching, and mentors. Provide access to early-stage funding. Organize demo days, events and meetings. Provide a framework for making progress with the roadmap.	Just a co-working space without a vibrant community.

Table 2. Institutions supporting start-ups in the canton of Vaud.

	Goals of incubation	**Goals of pre-incubation**	**Characteristics of start-up**
Chamber of commerce of Canton Vaud (CVCI)	Accelerate business development. Optimize processes for ideas execution. Test the team in real situations. Generate revenues and jobs.	Train to manage risk. Stimulate creativity. Gather like-minded people. Develop business network. Learn to pitch.	Technology-intensive (R&D). Intellectual property. High-growth potential (exponential). A new venture.
Service for the support of economic development (SPECo)	Contribute to the consolidation of new businesses. Accelerate start-up development. Increase number of start-ups.	Financial support for idea development and testing. An office and working space in a university. Support and coaching. Stimulation for entrepreneurship and innovation.	Not based on the number of years of existence. Technology-intensive. Provider of technology solutions. Intellectual property management. With a long development timeframe. Losing money during first years. Unidentified markets.

Table 3. Survey questions categorized according to Mandel and Noyes's (2016) model.

1. Relationship with entrepreneurial team	**2. Reflecting on success and failure**	**3. Proactiveness in exploring and defining business opportunities**	**4. Engaging with entrepreneurs as mentors**	**5. Social complexity in negotiating relationships with customers and suppliers**
1.1 Do you think that an interdisciplinary team brings some sort of competitive advantage? 1.2 Do you feel that a leader emerged in the team? 1.3 Do you feel you are bringing value to the team?	2.1 Do you think that your product/service is innovative? 2.2 Do you think you need to pivot? 2.3 Do you feel you are acquiring new skills related to the development of your business? 2.4 Do you feel you are focusing correctly on the jobs to be done?	3.1 Do you consider your business model validated? 3.2 How comfortable are you with the viability (size, potential, accessibility) of the selected market segment(s)? 3.3 How do you estimate the potential of your product to become global (low–high)?	4.1 Do you feel that coaching is carried out properly and that you (and your team) are benefiting from it? 4.2 Do you feel that your assumptions and beliefs are challenged, and you are forced to leave your comfort zone? 4.3 Are you able to incorporate the advice offered by the coach and reconsider your own perspective?	5.1 Do you think you have discovered new knowledge about the sector/domain/industry for your product/service?

Table 4. Averages and variances from the surveys.

	I am self-confident about becoming an entrepreneur	I can bring value to the team I join	I think coaching helps to advance the project	I am capable of learning from the coach's feedback and challenge my point of view if necessary	I know the target market and its business opportunities	I am sure of the impact of my project on the target market
	Item 1	**Item 2**	**Item 3**	**Item 4**	**Item 5**	**Item 6**
Average March	6.3797	7.2308	7.1772	7.2025	6.3671	6.2785
Variance March	5.5014	5.5878	4.7028	4.6172	5.2703	6.1756
N March	79	79	79	79	79	79
Average May	6.8488	7.6163	8.1744	8.1395	6.9767	6.8605
Variance May	5.1981	4.0504	3.1207	2.6084	3.1390	3.8177
N May	86	86	86	86	86	86
Average June	7.2125	8.0875	8.1375	8.2000	7.6000	7.3250
Variance June	4.3423	3.5548	3.7686	3.5350	3.1650	4.0444
N June	80	80	80	80	80	80

Table 5. z-scores.

z-test						
March–May	–1.301	–1.123	–3.222	–3.145	–1.898	–1.662
May–June	–1.074	–1.558	0.128	–0.222	–2.260	–1.508
March–June	–2.366	–2.525	–2.941	–3.114	–3.782	–2.917

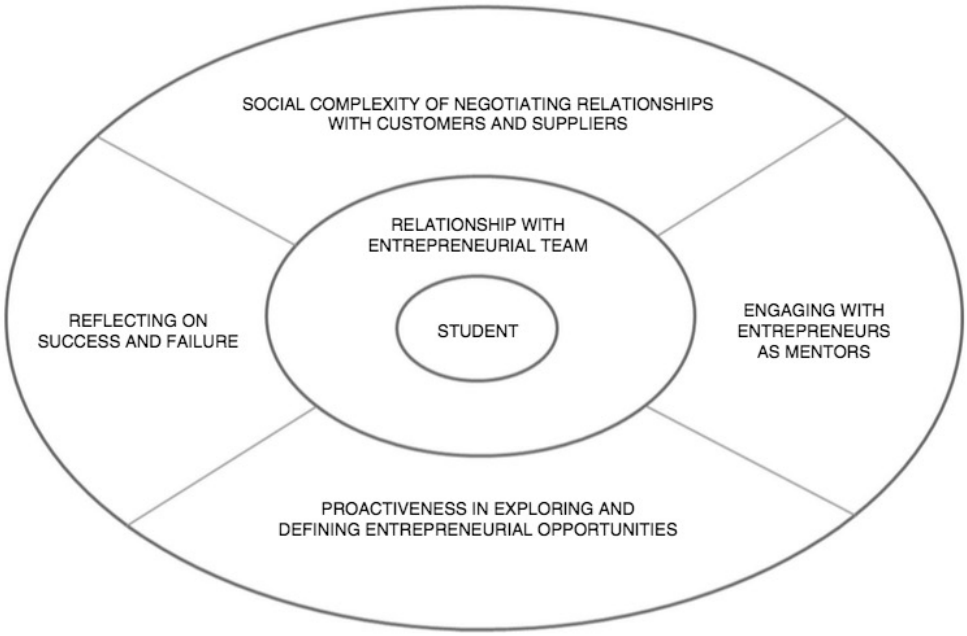

Figure 1. Conceptual model of entrepreneurial entrepreneurship education.

Source: Mandel and Noyes (2016).

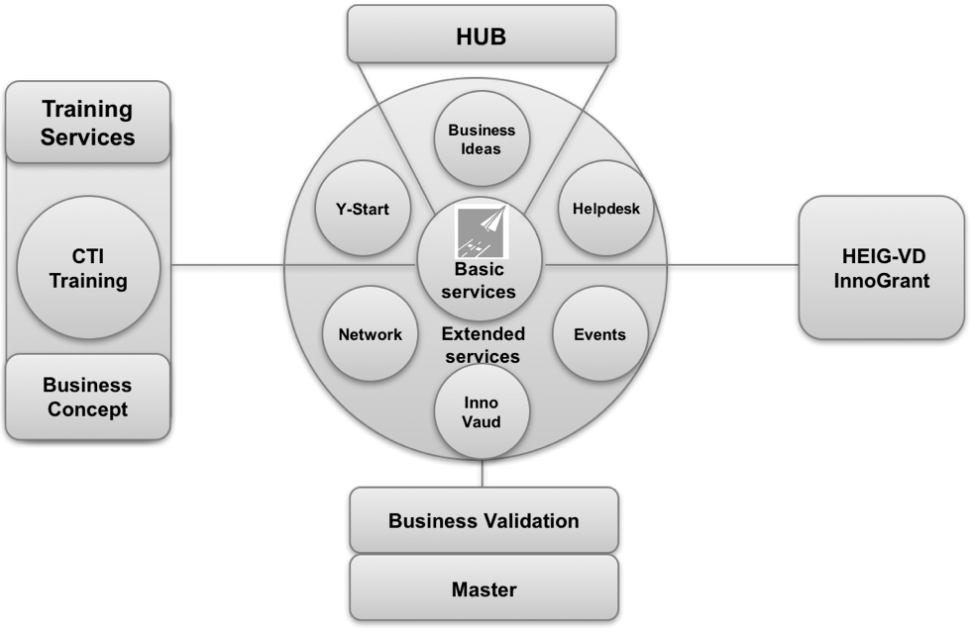

Figure 2. STarmac architecture.

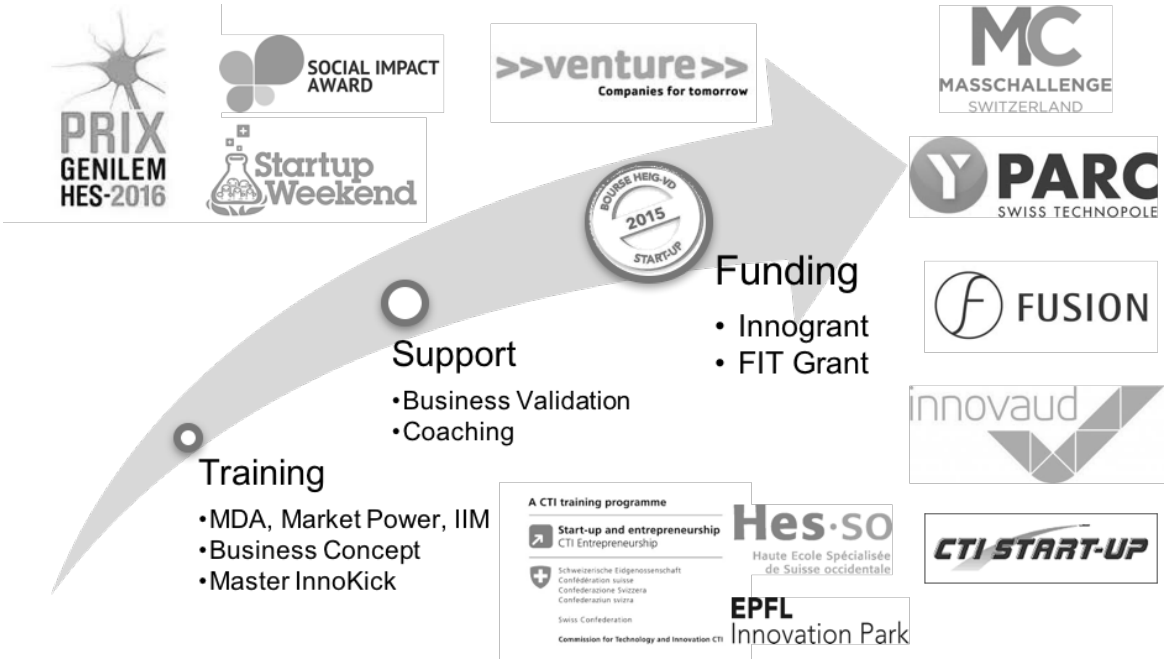

Figure 3. The STarmac process for supporting university spin-offs.

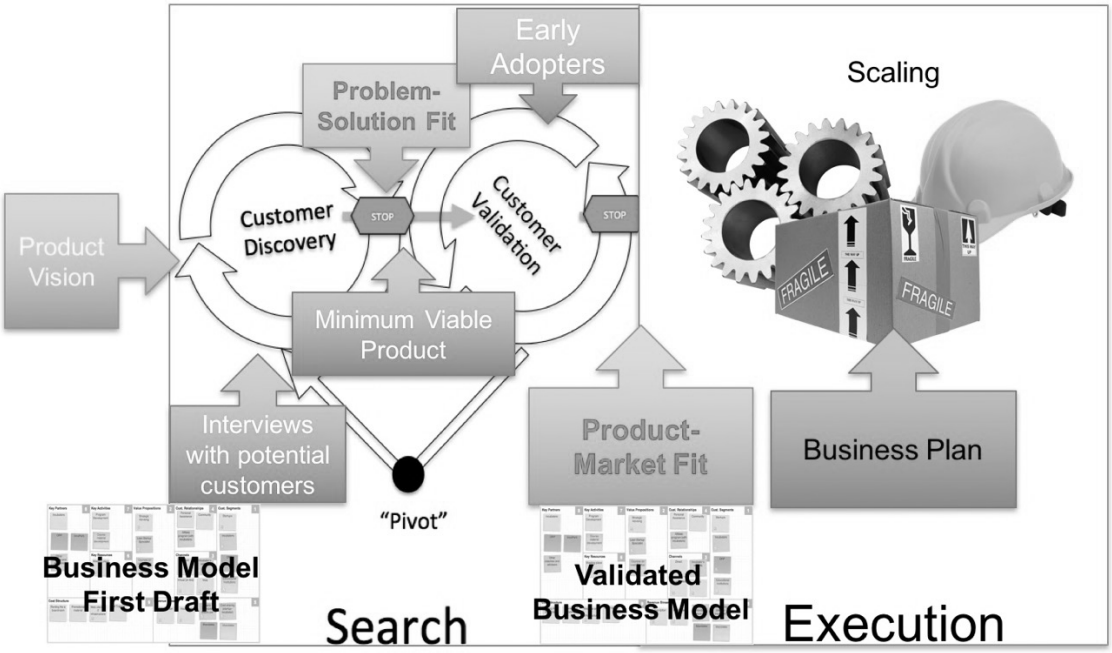

Figure 4. Customer development methodology.

Source: Adapted from Blank and Dorf (2012).

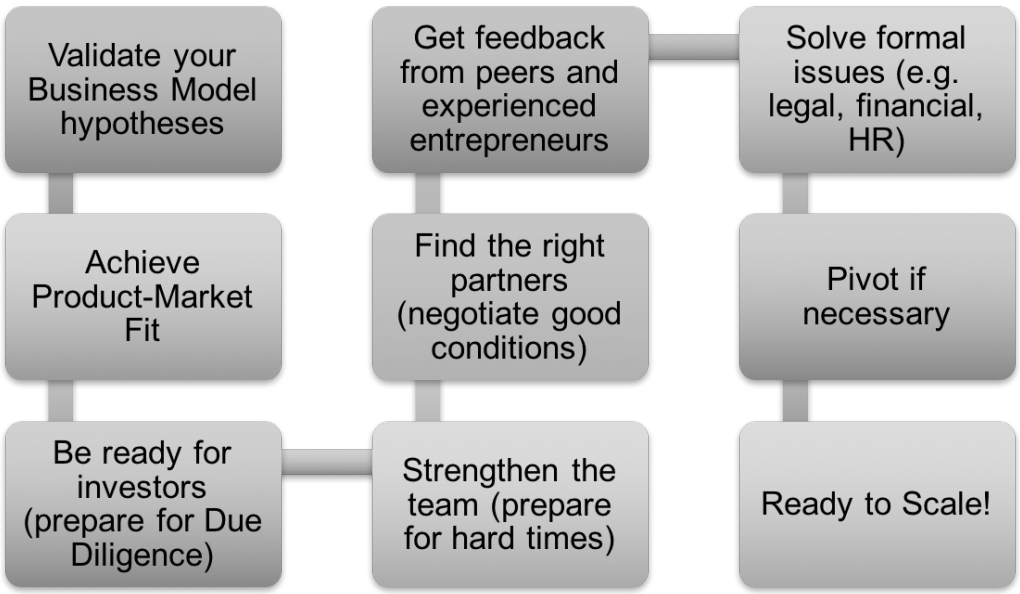

Figure 5. The STarmac business model validation process.