International Journal of Innovation and Economic Development
ISSN 1849-7020 (Print)
ISSN 1849-7551 (Online)

URL: http://dx.doi.org/10.18775/ijied.1849-7551-7020.2015.31.2006
DOI: 10.18775/ijied.1849-7551-7020.2015.31.2006

Volume 3
Issue 1
April, 2017
Pages 99-112

Development Trajectory of an Innovation Based Environmental Technology Start-Up

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Abstract: This research paper focuses on the growth models of new business ventures and their applicability to a specific type of start-up, environmental technology–based growth company via a case study. Start-ups companies are a focal point of interest of this decade. Start-ups develop products and services in conditions of market and technological uncertainty and competitive volatility. Due to their crucial role in the net job creation there is a growing need and interest to understand, model and develop start-ups. One industry of high interest in regards of start-up activity is that of environmental technology business, as it is addressing needs for solving problems related to such global issues as pollution, waste management and need for renewable energy sources. However, there is a very limited amount of prior research focusing specifically to start-up companies in this field. E.g. the growth stage models of start-up companies do not take in account the time dimensions caused by capital and regulatory demands that differentiate the development pace and stages of development of an environmental technology start-up from its peers in other industries. On the other hand, general research of environmental technology businesses often lacks the entrepreneurial and start-up focus, bundling efforts of new ventures in the field together with major projects by established companies. The aim of this paper is to provide a framework that helps understanding the growth process of new ventures in the aforementioned industry.

In this case study, the authors assessed the suitability of models of growth dimensions, sources and obstacles proposed by earlier research and literature to a case company: a start-up company providing environmental technology for global business-to-business markets. Via qualitative, interview-based data collection among the company stakeholder and external business experts and analysis of the obtained qualitative data the authors were able to draw conclusions regarding compatibility of the case to the earlier models of new venture growth. The results obtained shows that despite the common features between the case company´s growth trajectory and models proposed by earlier research, none of the stage models offers a full match. Based on the findings the authors propose a new, partly cyclical model of start-up growth for further elaboration.

Keywords: Environment, Entrepreneurship, Sustainability, Innovation, Growth, Start-up

1. INTRODUCTION

The growing and crucial role of the start-up companies in the net job creation (e.g. by Kaufmann Foundation, 2010) proposes their development deserves special attention. As Aulet and Murray (2012) put it: “Not all jobs are created equal”. Some innovation-driven enterprises address global markets from early on offering goods and services based on substantial innovation and grow fast. Environmental technology business is one area where such potential exists.

Business growth is rarely linear and contains variations in pace and discontinuities, due to changes in the dynamic operating environment (e.g. Ries, 2009; Mohr et al., 2011). Prior research has identified stages and enablers of growth and crises in growth (Dodge et a., 1994, Kazanjian, 1988). Crises have an important role in growth (Scott and Bruce, 1987).

This research contributes to the knowledge of start-up development and environmental technology entrepreneurship by answering the questions:

1. How do prior-art models of growth suit true start-ups, specifically in environmental business?
2. How are dimensions, sources and challenges of growth in an environmental technology start-up interpreted and prioritized?
3. How do the roles and capabilities of entrepreneur(s) change as company evolves?

Case study method in business studies suits to studying something new and important in order to recognize factors affecting its behaviour (Ghauri & Grønhaug 2005; Eriksson & Kovalainen 2008.). The development phase and characteristics of the case company matched to the quest of knowledge. The primary data collection happened qualitatively by interviewing. Due to a request by the case company they are referred as “company X”. X has a few years of history, but key innovations were developed over longer time. The solutions focus on turning waste into energy. The company employs 10+ people and has sales agents internationally.

In Chapter 2 the authors review prior-art research to define the relevant concepts and models. Chapter 3 describes the methodological approach and the research implementation. In Chapter 4 the authors present the findings and propose a conceptual model of start-up development that can be used in future research. Last chapter 5 reflects the research process and the usability of results and points out direction for further research.

2. LITERATURE REVIEW

2.1 Defining start-up

This research aims at understanding the pattern and dimensions of growth for a start-up in environmental technology business. The core definition of a “start-up” is not unanimously coined. For Carter, et al. (1996) nascent entrepreneurs were “individuals identified as taking steps to found a new business”. So, a start-up could even be a pre-phase of a company. Birley and Westhead (1994) used start-up as a synonym for “a new independent business”. Common is the concept of novelty that refers to short history as a company.

Gruber and Henkel (2006) cross-use the terms of “new venture” and “start-up” but link these companies to such phenomena as scarce resources and high risk but also to freedom in the business planning. Freedom also means ambiguity of the viable solutions and processes.

Blank (2010) saw a start-up being fundamentally different to an established company: “A start-up is an organization formed to search for a repeatable and scalable business model”, pretty similarly Ries (2011) stated that “a start-up is a human organization designed create a new product or service under conditions of extreme uncertainty”. Scalability is a must for survival and profitability for high technology start-ups.

In the high technology entrepreneurship that includes environmental technology business addressing issues like global warming, environmental damage caused by urban waste etc. the market needs are of a global nature and offer growth potential beyond local markets. The start-up companies aiming at rapid internationalization are labelled “infant multinationals” (Lindqvist, 1991) or “born globals” (Knight, 1996). This description also suits to company X.

The concept used by the authors for this paper is as follows: A start-up is a company with new solution(s) and with an urge and opportunity to grow in many dimensions, but also with high risks involved".

2.2 Dimensions and stages of growth

Linking the growth to sales revenue or size of the organisation is a common concept. However, Wickham (2006; Figure 1) stated there are various dimensions of growth.

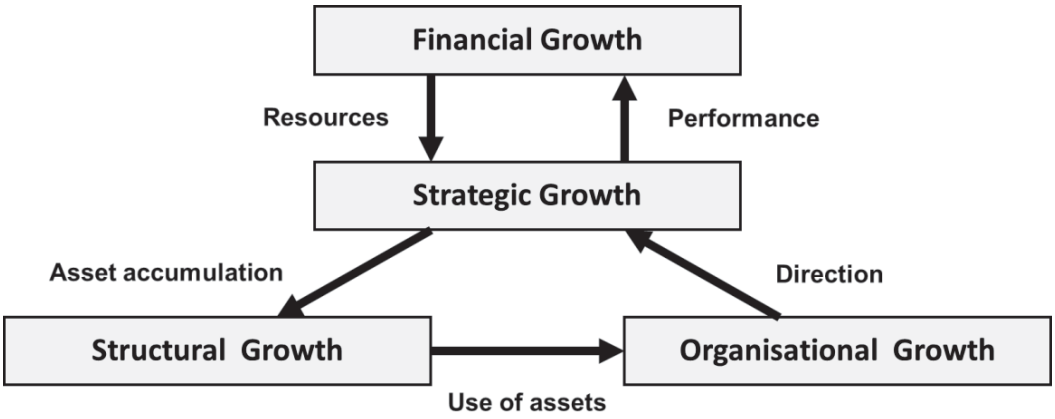

Figure 1: Understanding the nature of growth (Wickham, 2006)

Wickham´s model does not propose any sequential order of the dimensions, but rather underlines their interrelatedness.

Numerous scholars have stressed the important role of discontinuities and crises in the development. Some use terms like "developmental problems" (Kazanjian, 1988) or 'developmental hurdles' (Parks, 1977) instead of "crises". Dodge et. al. (1994) state that there is a consensus of different problems occurring at during different stages of growth and they are of sequential nature. According to Scott and Bruce (1987), the "crisis" stages are more likely to cause the organization to fail than other phases of development, if development obstacles cannot be solved.

The crises and hurdles are not only negative to the development of a start-up company and entrepreneur(s). In these points the entrepreneurs can learn new ways of thinking and acting. According to Greiner (1972) "…these periods of tension provide the pressure, ideas and awareness that afford a platform for change and practices" Greiner´s model (Figure 2) shows the sources of growth through the stages of growth and likely sources of crises.

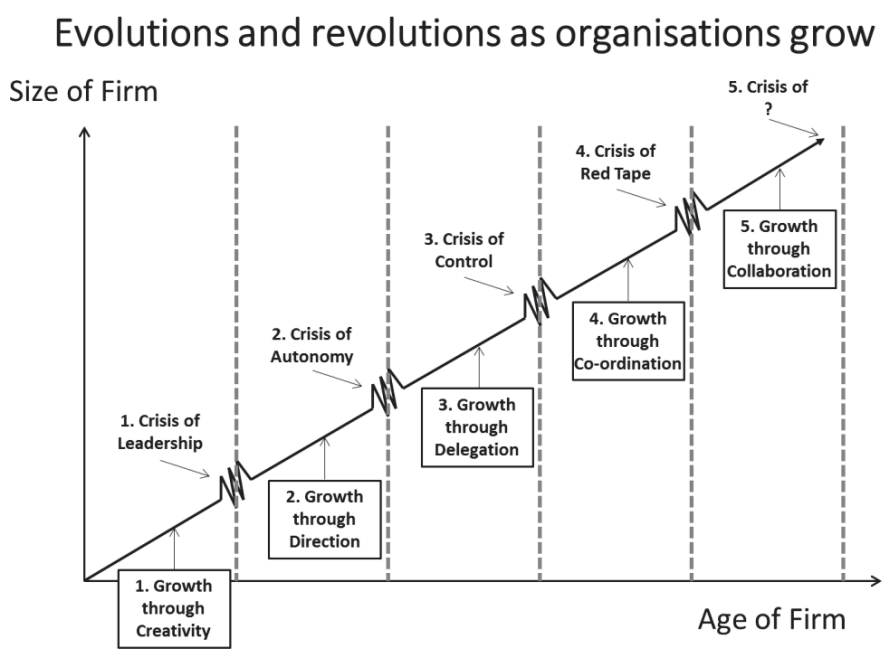

Figure 2: Sources of growth and crises in a growth trajectory of a firm (based on Greiner, 1972)

A new model was introduced in the Start-up Genome Report (Marmer et al, 2011a). The researchers state that at start they saw "describing the repeating patterns of startups an impossible task or even a disgraceful reduction of the artistry of entrepreneurship to numbers and graphs" but have gained understanding of success and failure factors over growth stages. The project started with basic assumptions held by many earlier researchers:

1. Start-ups evolve through stages of development. Stages can be measured with specific milestones and thresholds.
2. There are different types of start-ups. Each type evolves through the stages differently.
3. Learning is a fundamental to progress for start-ups. More learning increases chances of success.

With Point 2 above Marmer et al. mean different types of internet start-ups, so it is industry-specific. Points 1 and 3 provide wider applicability. The 4 stages identified – "Marmer stages" -are: Discovery, Validation, Efficiency, Scaling. As conclusion, it is stated that:

1. The Marmer Stages correlate with traditional indicators of progress.
2. The startups that don't move through the stages in order show less progress.

In their research Marmer et al. observed a specific phenomenon of Premature Scaling (Marmer et al. 2011b) – with high correlation with a failure of a start-up. Opposite to "growth obstacle" it can be called "wrongly directed growth" that consumes the resources of the company. In their data originating of 200+ internet-based business Marmer et. al. found that 70% of start-ups they studied scaled prematurely.

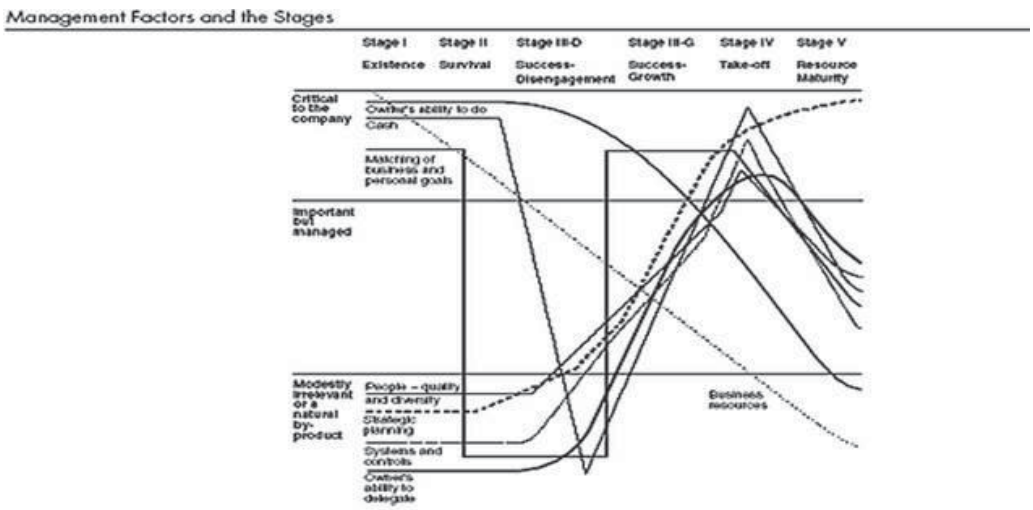

Figure 3: The Management factors through stages of development by Churchill & Lewis (1983)

In this study three management factors were selected to the discussion with the interviewees; "People, Planning and Systems", as expressed in the Figure 4 below.

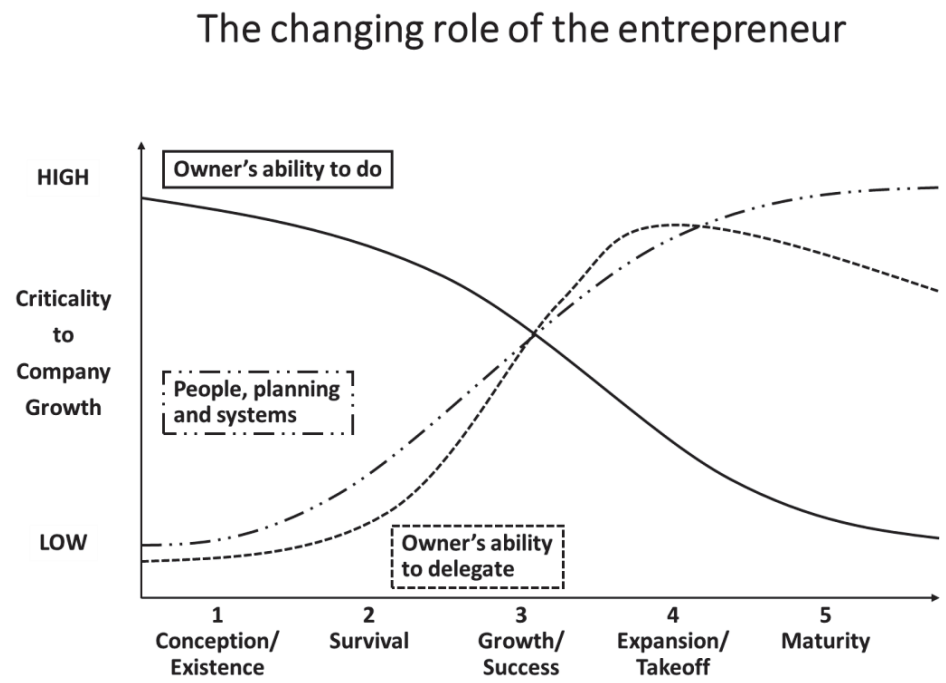

Figure 4: Change of managerial factors over time (adapted from Churchill & Lewis, 1983)

The concepts like value enhancement and risks involved are mentioned in numerous models of venture development. Michael J. Skok sees the Increasing of the value and Reduction of the risk as key targets for start-up management. He linked some key events or artefacts that lead to success in these two targets (Figures 5 and 6).

A start-up is typically managed and mostly owned by the original innovator(s), so it is not viable to separate the development of the company from the development of the entrepreneur. Models of small business growth characterize the way the small organizations develop and influence, and are influenced by, the owner managers. The roles of the entrepreneur and

critical capabilities or "management factors" for company success change over time. These dynamics were summarized by Churchill and Lewis (1983), presented below in Figure 3.

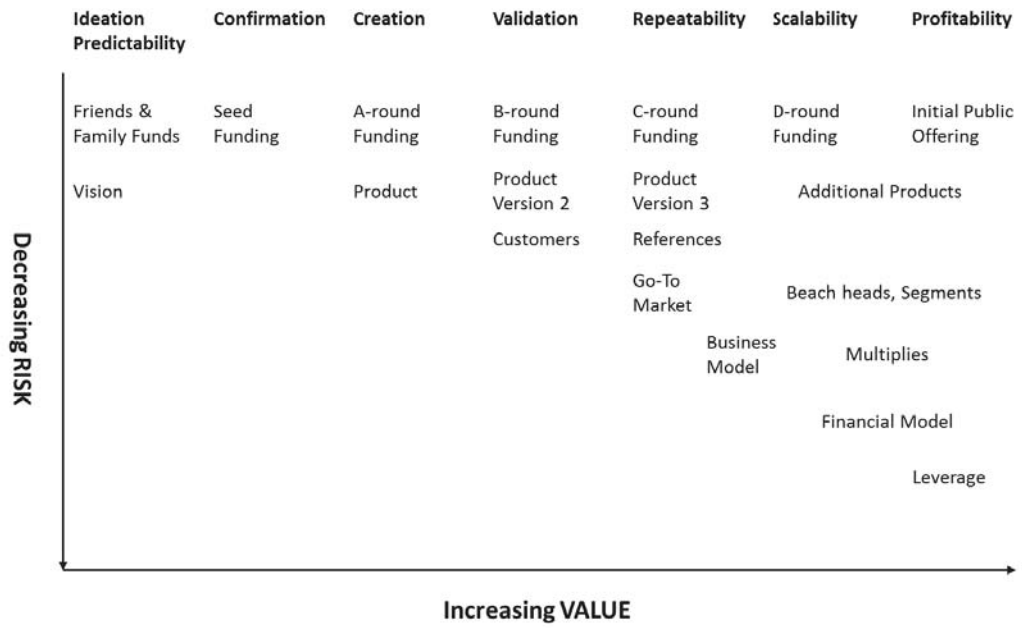

Figure 5: Key artefacts and events in Risk/Value framework in development stages (Skok, 2014)

2.3 Nature of environmental entrepreneurship

Despite some common patterns in start-up development across industries, all areas of business are not alike. Environmental entrepreneurship as its own area of research inside entrepreneurship emerged already in 1990s. Terms like "environmental entrepreneur" "green entrepreneur", "eco-entrepreneur" and the derivation of the last one "ecopreneur" were introduced by Bennett (1991), Berle (1991) and Blue (1990).

Schaper (2010) made an attempt to set some boundaries to the field. He identified features common to all ecopreneurial activity. Firstly, ecopreneurs are engaged in business ventures with risk, unpredictability of outcomes and omnipresence of a possibility of failure. In short, they are entrepreneurial. Even though these features are common to all type of (at least innovation-driven) ventures, it sets ecopreneur ship apart from some other kinds of environmental business, such as large infrastructure projects funded publicly and supplied by established companies. Secondly, ecopreneurs perform activities that in case of successful implementation have a positive effect on the environment and sustainability. Thirdly, intentionality is more common to ecopreneurs than entrepreneurs in general. For some business ventures the altruistic goals are more important than financial return. However, the financial targets also have to be achieved to survive and to reach the non-financial goals.

3. METHODOLOGY

The research approach in this study is inductive; collecting primary data of the object of study, recognizing a pattern and critically reviewing the identified against conceptual and process models of prior research and proposing improvements to them. In inductive approach, the models and concepts identified in the literature review can affect but not decide or limit what the researchers may find during the primary data collection process (Malhotra&Birks, 2005). The method of single case study focusing on company X was defendable, since the case study

method suits to instances with aim of understanding new and evolving phenomenon (Eisenhardt, 1989; Yin, 2003).

Qualitative research was chosen to develop a complex, holistic picture of the target and conduct the study in a natural setting (Creswell, 1998). Semi-structured interviews were the method of data collection. The researchers had pre-planned themes to ensure the interviewer could cover the essential topics that have emerged from the literature review and guide the interviews so that they allow summaries and comparisons. The informants were informed of the key themes – but not exact questions– when agreeing the time and place for the interviews.

Choice of informants plays a vital role in terms of data quality and affects the ability of the researchers to draw conclusions. Altogether 4 respondents from within the company were interviewed and in order to have a wider and more neutral view to X, 3 external experts were added to the informant pool. The final pool consisted of (abbreviations for individual informants used later in results-section) following types of informants as listed below:

Profile of respondents:

1. In-house resources in company X
- Founder-Owner-Manager – later in this paper referred as FOM - the person behind the core innovations of X, acts as CEO and is the biggest shareholder in X
- Owner-Manager – OM - works in business development, experience in environmental/energy business also from a large corporation, has an equity stake in X
- Sales & Marketing Personnel - 2 informants; SMP_1, SMP_2 – work in the commercial activities of X in different markets areas, no equity stakes in X

2. External Experts
- External Industry Expert – EIE – an expert in energy and environmental technology business.
- Business Development Expert – BDE – an experienced start-up business coach and board member in start-ups
- Venture Capital Expert – VCE – over 15 years of experience in VC and private equity investments

In order to avoid bias of having different interviewers the joint semi-structured frame was created in advance and in the interviewing situation the frameworks of earlier research were shown on a conceptual level to spark and steer the discussion. All interviews were recorded, transcribed and shared between the two authors who analysed the data independently, after which the individual conclusions by the two authors were fused for a joint view. All interviews were time-wise done within 3 weeks, so both the contextual factors were the same for all interviewees.

4. FINDINGS, DISCUSSION AND CONCLUSION

4.1 The research findings

In this chapter, the main findings of the research are presented as one-by-one answers to the research questions posed. In the last chapter authors propose a new model of growth process that seem to match the case in question and asking for support by additional research.

4.2 How do prior-art models of growth suit true start-ups, specifically in environmental business?

As a reflection of results vs. earlier models of venture growth it can be stated that the sequential order of dimensions in Wickham model can be pictured from the research data: A strategic choice of the first generation of solutions to be completed needs to be done. Then

the funding to secure real-life implementation needs to be arranged. Minimum organization needed to accomplish the needed tasks is put together. Structural and organizational dimensions of growth combine the internal and external resources: The controls of the mission-critical parts are kept in the hands of the company but complementary capabilities are extracted from the partner network.

The 4 first stages of the model by Marmer et al. were all partly referred to, but it was obvious that the events did not follow the sequential order. The case study left an impression that in reality a start-up has simultaneous and parallel growth processes going on. The Greiner model -based discussion with Crises- periods did not succeed in bringing up relevant information. The sources of growth from the model by Greiner, however, were an easier concept to work on: "Customers are currently most important element for company growth" (OM).

Last, the value creation and risk reduction model by Skok as well as the Churchill and Lewis' model of changing capabilities across stages of start-up development were conceptually close to experienced reality, and conclusions of the research could be placed to those frameworks. The Churchill and Lewis' model created some tension between the views of the internal and external interviewees (see chapter 4.1.3.).

Despite the avoidance of the usage of expressions like "environmental technology" or "cleantech" in the spontaneous company profiling, the special characteristics of the business segment became clear.

1. The unavoidable role of regulatory framework, or frameworks, when the company acts in multiple markets and many solution areas. The role of regulations and other interventions by governments and other public authorities serve both as business enablers as well as factors limiting the growth process.

2. An ecopreneurial company has long lasting and tight connections to the customers that the aforementioned customer intimacy is part of. "You need have customer side for speakers for promoting your technology" (EIE).

3. The clock speed in ecopreneur ship differs from many other fields. The long development time of regulations (that affects the decision-making ability of the firms, suppliers and customers alike) was mentioned earlier as a source of slow clock speed. Other factors are related to the depth and volume of R&D before sales can be done. "Unit cost is pretty high when you are environmental and energy business. You need a real-life demonstration, which is working … then pilot1, pilot2, ½ scaled unit and full scaled unit" (EIE).

4. The specific nature of the financial dynamics in this industry. The capital injections would be needed early on, long before the sales revenue start to act as a source of financial resource but "If we go in as an investor early on, the risks are humongous but so are the potential rewards. If later, the company value has gone up already, so the risk is lower but so is the potential multiple to your investment" (VCE).

4.3 How are dimensions, sources and challenges of growth in an environmental technology start-up interpreted and prioritized?

Despite the finding presented in the chapter 4.1.1, where a clear order of the growth dimensions emerged from the data, separating the dimensions from each other seemed artificial to the interviewees. The different fields of the growth were interlinked, and the current order of priorities was highly dependent on the financial status of the company. A single capital injection would have changed both the order and speed in which steps in different areas of growth are taken.

Despite the fact that strategic decisions and strategic growth were seen as the key foundation for all other areas of growth across the respondent pool, the views on what makes "growth" in strategic terms differed a lot. For some growth in strategic dimension obviously was synonymous to widening of the offering, whereas to some it was more of narrowing and focusing. As an example, to enhance the value of the company to its owners and customers, the innovativeness acts in controversial manners. To attract different type of customers and fulfil multiple needs, strategic choice of having one solution only was regarded as a risky option. "To me having different solutions for different end-uses gives more options to customers to choose from" (SMP2). On the other hand, limited resources should be well addressed to limited directions, as there is a need for efficiency from early on. Investors prefer a clear focus: "In early stage the way you should have a fairly limited portfolio. You better be somewhat single-minded. But all products and services have a life-cycle, so the portfolio needs to grow and renew over time. However, the portfolio growth should not kick in before break-even" (VCE).

One way to impact the business portfolio and also the structure of the revenue streams without harming the efficiency of technology production is to move from product supplies to product-service-system (PSS) that allows the company to fund its development organically: "By adding services like operating the plants on behalf of the customers is a future way of improving the constant cash flow. The margins are different to tech supplies but so is the predictability. And the purchase threshold for services is lower than that of buying hardware - the latter one has a life-cycle of 30 years" (FOM). Having that said, the growth models should avoid labelling the firms studied to Product or Service companies, but rather see how those two basic business types are combined into one offering.

One additional difficulty to adopt Wickham's model was the networked way modern companies operate. Talking of growth only within company boundaries felt short-sighted: "Ecosystem is needed for real size unit: sustainable production, sustainable fuel supply security, logistics, maintenance … you cannot do it yourself" (EIE). In Western manufacturing companies the trend of outsourcing the manufacturing and thus reducing the tied-in capital has been a prevailing trend. Based on the case study, outsourcing without holding a leading role in the business network in fact grows the risk. "Own manufacturing is not a red flag to an investor, if that is needed to control the entire process in its critical parts" (VCE). The views of the internal and external interviewees matched in this respect. "Own manufacturing is a strategic choice. I want to reduce the risk by having a clear and firm view on what is happening, I know and can promise the delivery times we can do. This may change over time, but at this point we do want to have a tight grip on the process" (FOM). The usage of subcontractors and many of them may seem a good risk-aversion policy but it may contain a strain to company resources: "The wider the network, the higher risk of quality issues and delays. And truly managing a supply chain of networked companies is rare and demanding skill" (VCE).

As can be seen in Figure 6 (below), the external experts put more emphasis on the process and systems management from early on than in-house informants. That gives support to Start-Up Genome Report findings that if processes are not efficient and the scaling up occurs Premature Scaling is a true danger. One important remark underlined that the processes should not be seen from only engineering angle "There must be a sales process from early on, who sells and how. If I do not get that I cannot invest" (VCE). The decline of the need to master processes and systems (by external experts) should be looked at in conjunction with their views of the changing role of the entrepreneur (see Chapter 4.3.)

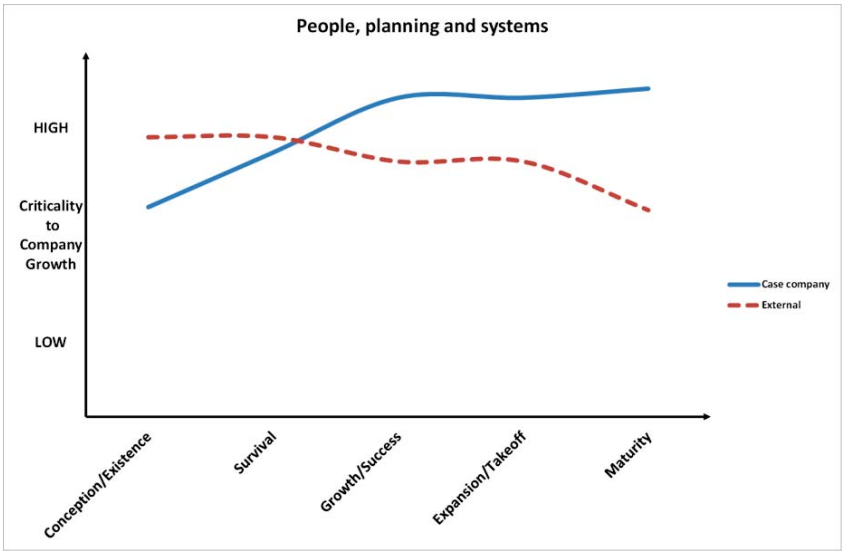

Figure 6: The changing criticality of skills in process, people and systems management following the model by Churchill and Lewis – averages of the graphs drawn by informants in the interview sessions

4.4 How do the roles and capabilities of entrepreneur(s) change as company evolves?

Figures 7 and 8 below show how the interviewees – internal vs. external – saw the role of the entrepreneur(s) to develop across development stages. There were some surprising findings between the 2 groups as well as when compared to model by Churchill and Lewis.

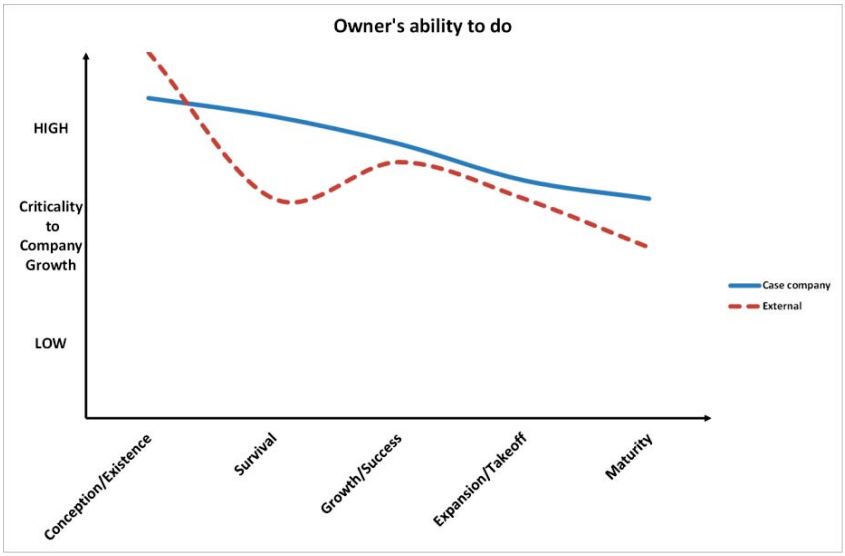

Figure 7: The changing role of the entrepreneur across the development stages (1) – following model by Churchill and Lewis – averages of the graphs drawn by informants in the interview sessions

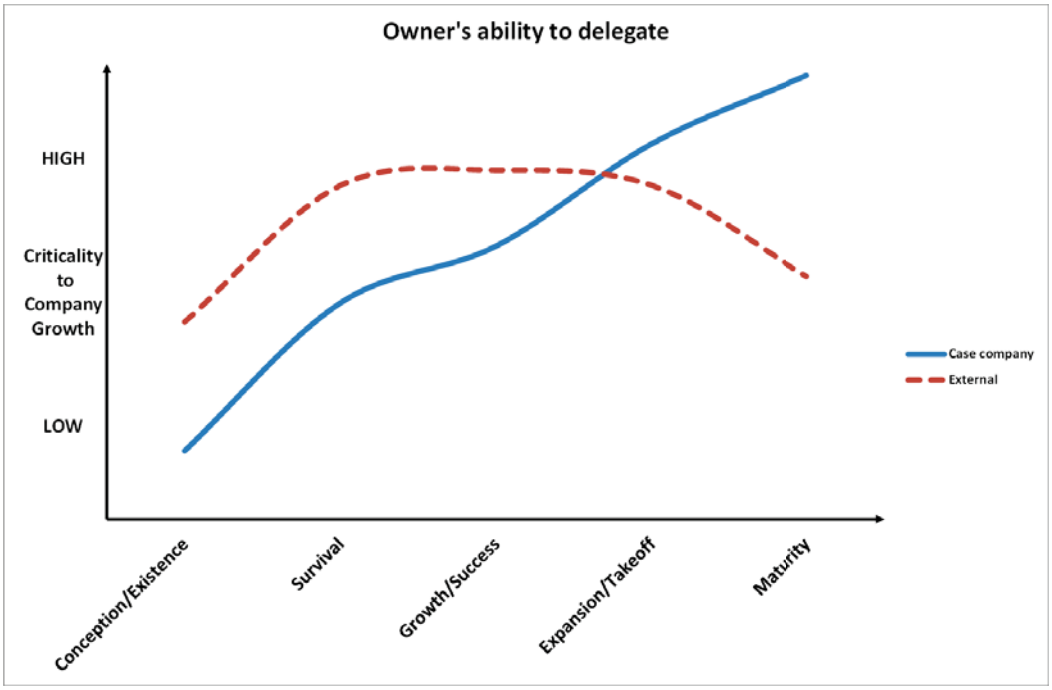

Figure 8: The changing role of the entrepreneur across the development stages (2) – following model by Churchill and Lewis – averages of the graphs drawn by informants in the interview sessions

The external experts made a clear point that delegation ability has to start early on and owners' own ability to do starts diminishing also early on. The need to delegate is also a concern of entrepreneurs in the case company: "It's a dilemma that too much is in our hands and we don't have enough time to handle everything … we really in the process how to delegate and to whom, it's the huge challenge for us" (OM). Ability to delegate is also as a part of process management capability and it also touches the network partners of the company: "To delegate is to co-operate" (BDE).

The true challenge for the skills and identity of the entrepreneurs seems to arrive when the company reaches some level of maturity. Managing that type of company is different to start-up management. New skills and angles to look at the company must be found – in addition to funding rounds there should be management upgrading rounds: "Management and funding should update many times in growth company … management and funding are the sources of crises. Aspiration to company growth is of high criticality to company growth" (BDE). If the aspiration is lost, company can start to stagnate. On the other hand, the both an entrepreneurial entrepreneur wanted to keep some parts of the start-up mentality in the company: "I want to see this as an eternal start-up but the term can perhaps not be used for a very long time" (FOM). "I don't want to be in mature company, I want to develop" (OM). Their views got also supported by the VCE "Thing to keep as long as possible from start-up is the entrepreneurship spirit, but it must be combined with growth in leadership skills" and BDE: "renewal is needed in growth company … is it synonym for continuous start-up".

4.5 A proposal for a start-up growth model

To sum up the findings, we propose that linear or at least sequentially constructed model of company growth could be replaced with a more cyclical model (Figure 9) highlighting the research finding that an innovation-driven enterprise needs to simultaneously run processes leading to scalable and optimized processes ("growth loop") and keep on start-up spirited

search of novel ideas ("start-up loop"). The emphasized criticality of funding and sales revenue must be a key part of models for environmental technology start-ups.

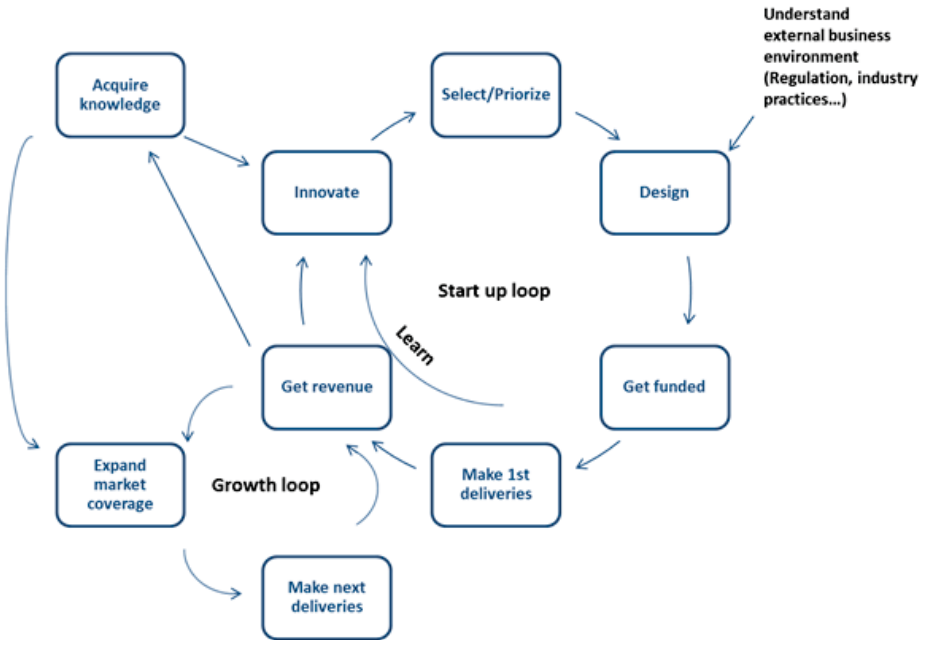

Figure 9: The cyclical two-loop model of start-up development in environmental technology business (by the authors of the paper)

4.6 Discussions

A single case has limitations in the extent in which the research findings can be generalized, and the extent in which the case got studied needs consideration. In what comes to the latter issue, the authors were able to see a repetition in viewpoints as the interviewing process continued, so the saturation point was reached. The combination of internal and external views to the case provided multiple and complementary insights. The case company operates from Finland but on global markets. The societal context in e.g. in corporate taxation, public R&D support etc. is thus somewhat specific. "Finland has good infrastructure, education and quality culture. We have the means to grow in this business." (SMP_1). A start-up company from another country would have slightly differing enablers and obstacles for growth.

The company studied belongs to the cohort of "born globals". "Demand for cleantech solutions is absolute" (SMP_2), i.e. the need for solutions for waste treatment and green energy solutions is global, and also contextual factors such as regulations are applied in wider areas than in a single country. "Regulations, laws and directives in a way bring structure, they guide your operations" (SMP_1). Also, the competition is of global nature, as reminded by the Business Development Expert (BDE) interviewed: "company X is operating in a traded cluster … it means global business". So, certain learnings from the Finnish case can be generalized to wider context.

To further understand the specific challenges and opportunities for environmental start-ups, additional research via multiple case studies would add to the existing knowledge. Studying closer the way the cyclical process consisting of two different but interconnected loops proposed by the authors is managed by the practitioners is needed. Studying the applicability of the model to in multiple societal and market contexts would help scholars and practitioners to understand and guide start-ups development.

4.7 Conclusions

Based on the research findings it can be concluded that rather than searching for a correct and best fitting model of growth for a single start-up venture it is more viable to study various models and identify the most relevant elements of these models to the case in question as well as economic, technological and societal context. Industries and companies in them have specific features that make finding q universal model for company growth a mission unlikely to be accomplished.

The research findings and the new model of start-up growth in environmental technology business developed by the authors give support to the view presented by Levie and Lichtenstein (2010): Stage-based models are convenient to use in their clarity and sequential order of actions but reflect poorly the new venture reality, that is full of flexibility. learning and even restarting processes i.e. continuous movement between dynamic states of a company. Some newer models such as the findings of Marmer et al. in the project Start-Up Genome report acknowledge this importance of pivoting, finding new directions by returning back to earlier phases when the development gets stuck due to internal reasons or market feedback.

In addition, it is not enough for companies to recognize the developmental phase they are in but also to develop and implement strategies to tackle the challenges viable to the industrial context they live in and taking in account the resources of the company, its entrepreneurs and value network.

Future research on the development path of new ventures should thus adopt the networked view, and study the development of the organizationally separate but operationally cooperating and interactive networks, the stakeholders in which can be in different phases of development, but their common initiatives/projects live a growth pattern partly independent of the network partners' trajectory.

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