Paper to be presented at the DRUID Academy Conference 2017 at University of Southern Denmark, Odense, Denmark on January 18-20, 2017

Business incubation models and the start-up life cycle - Conceptualising the fit between incubation design and a start-up's development stage

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Abstract

Paul Sterzenbach, Doctoral Researcher (2016 - 2019) Manchester Institute of Innovation Research, Alliance Manchester Business School, The University of Manchester paul.sterzenbach@postgrad.manchester.ac.uk The incubator landscape in Europe is currently characterised by its heterogeneity in various dimensions, shaping a large variety of different incubation models and designs. Growing numbers of new incubation designs such as sector-specialised incubators (SBI), or the rather new form of accelerators are examples for this development, underpinning its significance. This heterogeneity is mirrored by various different groups of start-ups with diverse sectoral focuses and stages of development, resulting in most different needs. The heterogeneity on both sides, incubators and start-ups, possibly creates a misfit of start-up needs and provided support through incubation, potentially leading to a mismatch of expectations between both sides and thus reduced incubator performance. This conceptual paper, therefore, sheds light on the relationship between the incubation model design and the life cycle of start-ups. The existing literature provides limited evidence about the varying impact of different incubation designs, for instance, SBIs or accelerators, and their tenant composition. Authors such as Hansen et al. (2000), Tötterman & Sten (2005), von Zedtwitz & Grimaldi (2006), McAdam & Marlow (2007), and Schwartz & Hornych (2008, 2010) deal with different incubation models, as well as sector specialisation and its impact on incubated start-ups but have so far neglected the dimension of the stage of the life cycle a start-up finds itself in. A critical, comprehensive discussion about the suitability of different incubation models for different growth stages can hardly be found. Some studies have used very simplified assumptions, claiming a linear increase of benefits of incubation in correlation with start-ups' life cycle development (McAdam & McAdam, 2008). However, this paper argues that start-ups benefit in various ways from different incubation models during different life cycle stages, not necessarily in a linear fashion. Incubation designs thus might differ in their suitability for different start-up stages, as they satisfy varying stage-related needs, also dependent on the ability of the start-ups' effective resource usage. This paper suggests a conceptualisation of the relationship of incubation models, particularly of the tenant composition, with different start-up life cycle stages. It enables to understand possible implications of this relationship that might crucially influence the impact of incubation on start-ups' performance. The paper starts with a systematic literature review which reveals the major contributions, as well as the most important research gaps. From this viewpoint, it develops different propositions thereafter that provide more insight into the relationship between incubation models and start-up

life cycle. It aims to close a so far neglected gap in the literature to provide a starting point for a shift in incubation policy and implementation. This approach leads to a development and conceptualisation of one key and three synthesising propositions. First, it is proposed that SBIs might be more suitable for later stage start-ups with advanced business model validation, while diversified programmes are more suitable for early-stage start-ups. Most diverse needs, such as flexibility in the dimension of creativity or a required strong sectoral focus and support among others, mainly foster this proposition. Furthermore, SBIs may narrow down potential business models and markets, restricting the pivoting of incubated start-ups. Increased sector-specialization of incubators might also impede cross-fertilization of incubated early-stage start-ups. And finally, later-stage start-ups in SBIs might need more personalised investment deals, which are aligned with their individual development stage. In connecting the start-up life cycle and its development stages with different designs of incubation, this paper provides a distinct conceptualisation for future research areas, potentially influencing various stakeholders of start-up incubation.

Jelcodes:M13,M13

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December 2016

Preliminary version – please do not cite or circulate.

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Paper to be presented at the DRUID Academy Conference 2017 – Odense, Denmark

1. Introduction

The incubator landscape, worldwide and in Europe, is currently characterised by its large variety of incubation designs in various dimensions. These designs are mostly based on a few key incubation models but nevertheless create a large heterogeneity, through individualisation and adaptation to most diverse specificities of regions and types of start-ups. Growing numbers of sector-specialized incubators (SBIs), accelerators, or virtual incubators are examples of the emergence and diffusion of new incubation designs. This development underpins the importance of analysing and evaluating incubation designs and their suitability for different groups of start-ups.

The heterogeneity of the incubator landscape is mirrored by the large heterogeneity of different groups of start-ups in the dimensions of sectoral or industrial focus, as well as stages of development. Those diverse sectors and development stages result in many different needs of start-ups on which incubators' support aims to focus. The heterogeneity of start-up needs, as well as incubation designs, or in other words different forms of support, possibly creates a mismatch of expectations and goals on both sides, provided support and needs. Indeed, this might constitute one of the most important issues faced by start-up incubation. The fit between incubator designs and provided support with different groups of start-ups and their specific needs seems to be one of the keys for achieving increased incubator performance and subsequently successful start-up development. This paper aims to shed light on one dimension of this recent issue in concentrating on the relationship between the incubation model design and the stage-related needs of start-ups.

The existing literature only provides limited evidence on the impact of different incubation designs on incubators' performance. Studies mostly focus on isolated design characteristics, rather than applying a comprehensive viewpoint. Moreover, the component of the incubators' tenant composition and the way in which sector-specialisation or diversification might impact the development of incubated start-ups has only been subject to a limited amount of studies. Authors such as Hansen et al. (2000), Tötterman & Sten (2005), von Zedtwitz & Grimaldi (2006), McAdam & Marlow (2007), and Schwartz & Hornych (2008, 2010) have started analysing this design component but, nevertheless, this question leaves space for more future in-depth studies. The dimension of the start-up life cycle and the potential impact of the individual development stage of a start-up on the suitability and performance of different incubator designs has so far been neglected. A comprehensive discussion about the suitability of different incubation designs for different growth and development stages of start-ups is still rare. Some studies have used very simplified assumptions, claiming a linear increase of benefits of incubation in correlation with the further development of startups' life cycle (McAdam & McAdam, 2008) but yet have not considered and distinguished the impact of individual design components. However, this paper argues that start-ups benefit in various ways from different incubation designs during their individual life cycle stages, not necessarily in a linear fashion. Incubation models and their various designs of components differ in their suitability for different start-up life cycle stages in embodying a diverse set

of support functions. Moreover, the startups' ability of effective resource usage during different life cycle stages influences the fit between stage-related needs and provided support through incubation. The diverse needs of start-ups have to be seen in relationship to the development stages and the start-ups' ability of effective resource usage. This paper, therefore, argues that incubation aims to satisfy various needs which are related to the startups' development stages, as well as to their correlating ability of effective resource usage. In conceptualising the relationship between different incubation models and start-up life cycle stages, it elucidates a new and so far neglected angle of business incubation research. This might provide a starting point for a possible shift in incubation policy and implementation and its impact on start-up performance, potentially influencing various stakeholders such as policy makers, venture capitalists, incubators' management, and entrepreneurs.

Before conceptualising the relationships explained, as well as the concluding propositions, the next section resorts to a literature review to illuminate and discuss the existing studies on elements shaping incubation models, impacts of incubation, and life cycle specific challenges of start-ups. First, it shall illustrate the neglecting of life cycle theory in incubation research. Secondly, it aims to develop a comprehensive synopsis of incubation design elements. Finally, it develops a connection of selected design elements with life cycle specific challenges of start-up growth. As this paper is purely conceptual, it does not utilise an empirical methodology, but rather derives its propositions and outcomes from existing research to prepare this new angle of incubation research for future empirical studies.

2. Theoretical Derivation

To highlight the research gap in the area of business incubation and to connect it with available research on the start-up life cycle at the end of this section, this derivation applies a narrowing funnel of different elements, framing the area of concern. To conceptualise incubator design, it starts with a review and categorisation of influencing design elements, which shape the key organisational categories of incubators. The top-level definitions of the two organisational categories of "science parks" and "accelerators" then allow to identify the characteristics of some of the influencing design elements. A selection of those elements is used in the final conceptual development for a connection with the start-up life cycle and its different stages of development. The study does not consider different types of start-ups and their various specificities in the dimensions of industry or region, but rather aims to stay on an overarching stage level. The second step of the research funnel presents the most important studies on the impact of incubation on start-up performance, and more specifically, on the impact of incubator composition and possible other elements that might be related to the start-up life cycle. The subsequent introduction of key references of start-up life cycle research, as well as of stage-related challenges and needs, represents the third stage of this funnel. Finally, the relationship between the incubation designs and the stage-related challenges is derived, resulting in conceptual propositions.

2.1. Elements shaping incubation designs

The design of business incubators is based on several different design elements and their diverse peculiarities and adaptations. Regardless of the categorising definition of the term "incubator" that will be explained later, this paper uses it as an umbrella term for the variety of possible different categories and models, as it has been largely done in previous studies (e.g. Aernoud, 2004; Bollingtoft & Ulhoi, 2005; Pauwels et al., 2015; van Weele et al., 2016). The widely used categories of science parks, business incubators, and accelerators that will be defined in the following, all encapsulate the different influencing design elements of incubation, but of course significantly differ in their characteristics.

To justify the later selection of design elements in the final conceptualisation, this section attempts to develop a comprehensive model (table 1), embodying all elements which influence incubation design, as well as the peculiarities of those design elements shaping the respective incubator categories. Before deriving the design elements from the literature, three different environments or layers can be identified, setting the elements into different contexts of influence. First, the macro environment constitutes the regional context of incubation, which influences both the availability of resources and the forces and impacts of stakeholder groups (actors). The meso environment represents the organisational setting in which the incubator is embedded. This layer incorporates external organisational influences on the incubator. Thirdly, the micro environment constitutes the elements shaping the actual incubation process (McAdam et al., 2016). It also includes the main functions of incubation or in other words the elements of support which aim to respond to the start-ups' needs. In this development both macro and meso environments have been combined to one category of elements, as a clear allocation requires a more detailed view and analysis of possible sub-elements. In this interconnected system of incubation, actors of the quadruple helix stakeholder model (government, universities, industry, end users) and their interactions shape and influence the design elements in all three environments (McAdam et al., 2016) in most varying ways.

The derivation of influencing design elements depicted in table 1 is twofold, echoing the division into "structural & organisational" and "procedural" elements. Consequently, it is based on, firstly, studies identifying and analysing the different functions of incubation; secondly, the defining elements of different categories of incubation. As explained, the micro environment embodying the procedural design elements, represents the incubation process itself, as well as functions of incubation. Various authors in the existing literature have identified shaping design elements on a procedural level, mostly applying a value added or functional perspective. Campbell et al.'s (1985) attempt has been the basis for various authors that followed, in defining four essential values added by the incubator: "The diagnosis of business needs", "The selection and monitoring of needed business services", "Access to capital" and "Access to networks". Based on various former studies (e.g. Allen & McCluskey, 1990; Westhead & Storey, 1994; Sternberg, 1997; European Commission, 2002) and on an integration of the four values mentioned, Schwartz (2013) subsumes the main functions of support of incubation depicted

in figure 1. The rather new category of accelerators enables to add another element of direct support: Financial investment. Accelerators and possibly also other categories of incubators frequently provide a fixed upfront investment, often equity-based, to their incubatees (Miller & Bound, 2011; Pauwels et al., 2016). This element constitutes an additional form of tangible support alongside the provision of shared office space and other facilities.

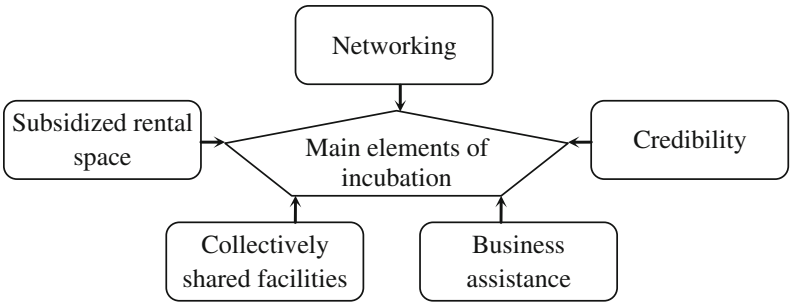

Figure 1: The basic elements of incubation (Schwartz, 2013)

Besides the direct functions of support explained, other procedural elements can be identified which are not directly related to the values added, but still constitute distinguishing factors, possibly influencing the support functions, and thus incubators' performance. Especially the intangible support functions of Credibility/Legitimacy, Business assistance, and Networking are shaped and influenced by those additional procedural elements. The recent trend of sector-specialized incubation (SBIs) exemplifies the design element of "incubator composition" (Aerts et al., 2007; Mian et al., 2016) in raising various possible questions regarding its influence on the mentioned intangible support functions. Derived from the definitions of categories of incubators, the design elements of "degree of formalization", "length of incubation", and "application & selection process", first, might influence the intangible support functions as well, and secondly, enable to distinguish between the partly contrasting categories of science parks and accelerators.

The macro and meso environments illuminate the regional and organisational context of incubation, containing the structural and organisational design elements. Similar to the procedural elements which might influence the support functions, as outlined above, those functions might also be influenced by structural and organisational design elements. It illustrates the possible external influences of these elements on the design and shaping of procedural support functions of incubation. Moreover, it paradigmatically represents the interconnectedness of all design elements (McAdam et al., 2016). As macro and meso environments are not the focus of this study, a more detailed analysis of impacts and functions of their elements shall not be done here.

The inclusion of all elements of incubation, structural, organisational, and procedural, and their peculiarities enables the identification of some fundamental categories of incubators. Those give rise to a variety of customizations and adaptations along the design elements depicted in table 1, and thus shape the mentioned heterogeneity of the incubator landscape. This heterogeneity is mirrored by the variety of attempts in the literature, aiming to identify and categorise different incubation models along different

dimensions. Barbero et al.'s (2012) summary of incubator classifications provides a comprehensive overview of the variations available. As those different classifications are based on different dimensions, such as strategic objectives, main shareholders, or peculiarities of design elements, not all are suitable for the purpose of this study. This conceptualisation shall connect incubation design elements with the start-up life cycle, and therefore uses the most common categorisation available that is indeed mainly based on design elements.

To explain the basic distinguishing elements of science parks, business incubators, and accelerators, which represent the categorisation used, it is helpful to utilise Allen & McCluskey's (1990) business incubator continuum. This is based on Brooks' (1986) work, developing two basic models of incubation. While the continuum is originally dealing with the objectives of incubation (i.e. theoretical rationale), it also inherently incorporates the elements of incubation on a functional level of support (i.e. offering). On the one end of the range the "economic growth incubator" mainly focuses on business support and networking, while on the other end the "real estate incubator" focuses on the provision of office space and shared services. This first approach is mirrored in Allen & McCluskey's (1990) advancement by concentrating on the incubators' value-added, as well as in the historical development of incubation. In the 1980s, the first generation of incubators mainly focused on benefits from economies of scale in sharing office space and other facilities (Bruneel et al., 2012; van der Weele et al. 2016). Over the time, incubation developed towards the provision of intangible resources, with today's focus on the benefits of internal and external networks, external resources and increasing positive legitimacy (Hansen et al., 2000; Bollingtoft & Ulhoi, 2005, Bruneel et al., 2012; Mian et al., 2016; van der Weele, 2016). The historical development of offerings and theoretical rationales is presented in Bruneel et al.'s (2012) summary of value propositions (figure 2). Nevertheless, even though the historical development seems to be linear and to change theoretical rationales and offerings over time, this might lead to misjudgement of the categories used in this study. First, the development shows the change of focus in theoretical rationales of incubation and, thus, also the change of offerings but yet should not be seen as being excluding. All generations of incubators are still more or less available in today's heterogeneous incubation landscape. Secondly, as table 1 illustrates, the functional design elements are not necessarily being neglected by one or the other incubation model, but rather different models have different rationales and subsequently different focuses of offerings. As outlined in the following, the categorisation of science parks, business incubators, and accelerators, mirrors both Allen & McCluskey's (1990) business incubator continuum and the historical development described.

	First generation	Second generation	Third generation
Offering	Office space and shared resources	Coaching and training support	Access to technological, professional, and financial networks
Theoretical rationale	Economies of scale	Accelerating the learning curve	Access to external resources, knowledge, and legitimacy

Figure 2: Summary of the evolution of the incubator's value proposition (Bruneel et al., 2012)

At the level of procedural design elements, science parks mainly focus on the provision of office space and shared facilities, while accelerators concentrate on legitimacy, business assistance, and networking. The business incubator that can be ranged somewhere in between these two categories, aims towards the development of beneficial internal and external network structures, supporting coaching and mentoring. These functional priorities of support mirror the different objectives or theoretical rationales presented in the historical development. Science parks mainly aim to support their incubatees through economies of scale, while accelerators focus on enabling access to networks, knowledge, and legitimacy. This also explains one of the distinguishing objectives of business incubators and accelerators compared to science parks. The facilitation of new venture development and growth contrasts with that of science parks, which are not necessarily focused on early-stage companies (Hackett & Dilts, 2004). As this study only aims to conceptualise the design elements of incubation from a top-level perspective, the definition of the category of business incubators is not included at this point. Moreover, due to the heterogeneity of the incubator landscape, the purpose of a detailed and strict categorisation, as it has been attempted in some parts of the literature, might even be questionable.

Accelerators inherently embody the aim of new venture development, and moreover focus on enabling the validation of business models and a rapid development of early-stage start-ups. Short and highly structured designs of incubation, providing intangible resources often in the form of intensive coaching and interaction, are diametric to the tangible, often long-lasting support of science parks. In addition, the often equity-based pre-seed investments of accelerators, enabled by cultivating close connections with business angels or other investors, differ from the common focus on venture capital acquisition rounds after the actual programme. The sectoral focus of accelerators on technology, in particular IT start-ups, requires smaller early-stage investments than capital intensive sectors at similar stages of development. The facilitation of a follow-up pre-seed investment round after graduation of the accelerator constitutes one of the major stage-related priorities of this incubation model (Pauwels et al. 2016).

Actors	Environments	Influencing design elements	Peculiarities of design elements		
Interactions between stakeholder groups of the quadruple helix influence structural, organisational, and procedural elements of incubation.	Macro & Meso Environment (Structural & Organisational)		**Science Parks**		**Accelerators**
		• Regional factors (e.g. infrastructure; culture)	Variable focus		Variable focus
		• Integration into industrial cluster	Strong focus		Variable focus
		• Links to higher education institutes	Strong focus		Variable focus
		• Main incubator shareholders	Variable focus		Variable focus
		• Financial backing (e.g. for-profit vs. non-profit)	Variable focus		Variable focus
	Micro Environment (Procedural)	• Incubator composition (e.g. sector-special. vs. diversified)	Variable focus		Variable focus
		• Degree of formalization	Low		High
		• Length of incubation	Long		Short
		• Application & selection process	Limited/varies		Open/competitive
		• Role and background of incubation management	Variable focus		Variable focus
		• Functions of support:			
		o Shared office space and facilities	Strong focus		Variable focus
		o Financial investment	Variable forms		Equity-based, often fixed
		o Credibility/Legitimacy	Variable focus		Strong focus
		o Business assistance	Variable focus		Strong focus
		o Networking	Variable focus		Strong focus

Table 1: Model of influencing design elements and their peculiarities for Science Parks and Accelerators

(derived from Westhead & Storey, 1994; Chan & Lau, 2005; Schwartz, 2013; McAdam et al., 2016; Pauwels et al., 2016)

The table aims to encapsulate, merge and simplify the dimensions of actors, environments, influencing elements of incubation, and peculiarity of elements in the different categories of incubation. The definition of the peculiarities of influencing elements for the categories of science parks and accelerators are based on the commonly agreed definitions in the literature, using highly simplified scales. The simple distinction of "strong focus" and "variable focus" mirrors the heterogeneity of the incubator landscape and the top-level definitions available. By defining whether the incubation models particularly focus on the respective design element according to the definitions of the literature, or whether the peculiarity of the design element might vary in the particular model, it approaches the element's relative importance. For the design elements "degree of formalization", "length of incubation", "application & selection process", and "financial investment" different scales have been selected to ensure plausibility. Nevertheless, on a more detailed view different scales can be applied, which are specific to the individual element and possible sub-elements. As mentioned before, the category of business incubators has to be seen as somewhere in between science parks and accelerators. A definition of peculiarities of design elements for this category is not necessary and reasonable in this top-level view.

It becomes clear that science parks and accelerators are not necessarily opposing in every dimension (design element). Yet the general distinctions of both categories explained earlier clearly emerge in the table. The study only utilises some of the clearly distinguishable design elements to connect them with the life cycle stages and stage-related needs. For the sake of simplification, only some of the procedural elements of the micro environment are selected for this conceptualisation. Future studies might also employ other elements listed or possible sub-elements that need further theoretical development.

The classifications explained show that incubators already partly consider the start-up life cycle in targeting their objectives and support functions on the needs of different groups of start-ups. In fact, the spread of accelerators, as well as the growth of sector-specialized incubation exemplify this development (e.g. Aerts et al., 2007; InBIA, 2016; Mian et al., 2016). Start-up incubation has already begun to include the stage related needs of incubatees to some extent into the programme designs. Nevertheless, this development has only been poorly approached in the available studies on the impacts of incubation on start-up performance as laid out in the following section.

2.2. Impact of incubation and its design elements on start-ups' performance

As this literature review aims to elucidate the relationship between different incubation design elements and the so far neglected impact of the different development stages of start-ups' life cycle, it is also necessary to provide insights into studies which have dealt with the impact of incubation on the performance of start-ups. This first requires to shed light on the measures of this impact used in the

literature, as the selection and usage of plausible measures for implications of incubation have proved to be highly disputed and inconsistent. The heterogeneity of the incubator landscape leads to a dilemma of increasing complexity to measure and compare incubators' performance (Phan et al., 2005; Barbero et al., 2012; Theodorakopoulos et al., 2014).

The simplest measure for the performance of a group of start-ups is the survival rate after a certain time. Survivability is the minimum criterion of entrepreneurial success and constitutes one of the primary objectives of every incubator (Lalkaka, 1996; Tamasy, 2007; McAdam & Marlow, 2007; Schwartz, 2009). Although this measure is used as the indicator for performance in a selection of studies, it contains a variety of challenges analysed in Schwartz's (2013) study. The high complexity and interconnectivity of design elements, as demonstrated in the last section, impedes the understanding and measurement of incubator performance using only a single measure. One of the most obvious challenges is illuminated by Phan et al. (2005) who focus on the endogeneity problem of the survival rate, emerging from the objective of incubation that is to keep incubatees alive.

Nevertheless, other measures such as start-up growth and development, rate of innovativeness, or company linkages and collaborations are used (Hackett & Dilts, 2004; Schwartz, 2013), partly mirroring the design elements illuminated earlier. Technology adoption, access to subsidies and improvement of collaborations are additionally used by Colombo & Delmastro (2002) in a study about Italian technology incubators. The inclusion of R&D related measures (e.g. number of patents; research activity) also plays a role in some studies (Siegel et al., 2003). Barbero et al. (2012) provide a comprehensive overview of used measures. The selection of measures in the literature enables to hypothesise that measures are dependent on the category of incubator or the type of start-ups on which this incubator focuses (e.g. stages; sectors). Indeed, Bergek & Norman (2008) argue for an approach of selection which is dependent on the incubators' objectives. Barbero et al. (2012) underpin this in stating that the same measures should be used for the same categories of incubators regardless of possible sectoral specializations due to similar objectives. This corroborates the so far neglected importance of life cycle stages of incubatees for the selection of measures, as it similarly includes the different needs of start-ups.

The latter aspect is reflected by studies dealing with impacts of incubation on start-ups' performance measured with several factors. All of them have in common to completely neglect or only partly consider the dimension of life cycle stages and, moreover, not to incorporate the effects of isolated design elements. Rather, an overarching viewpoint, using combined-measure models, is often applied, only allowing very limited analyses of impacts of procedural design elements. In general, it is possible to categorise three different focuses of incubation impact research. The first focus is characterised by studies which analyse the survival rate of incubated start-ups compared with non-incubated start-ups. Schwartz's (2013) study provides a meta-analysis of available research in this category, as well as constitutes one of the largest samples, analysing 371 incubated start-ups and the same amount of non-incubated start-ups over a 10-year timespan. The second focus includes studies which analyse the impact

of incubation on intangible resource acquisition, targeting on the functional support elements of legitimacy, business assistance, or networking. For instance, Colombo & Delmastro (2002) use measures such as growth rate (i.e. revenue, number of employees), technology adoption, access to subsidies, and establishment of new collaborations in their study on Italian technology incubators. Löfsten & Lindelöf (2002) similarly focus on links with universities or sales and employment growth rates in their study about 9 different Swedish science parks. The third research focus targets the analysis of impacts of isolated design elements on start-up development or resource acquisition. This category includes recent developments such as the evaluation of sectoral specialization (incubator composition) and its impacts on the incubation process. Schwartz & Hornych's (2008, 2010) studies represent one of the most important contributions in comparing start-ups in sector-specialized and diversified incubators along the functional elements of support. Nevertheless, this part of incubation impact research only relies on a limited amount of studies. As this section aims to show how incubation impact research has neglected the dimension of the life cycle, it will not elaborate on the studies' results.

This overview shows that studies on the impacts of isolated design elements are still rare. The rather new third category has begun to analyse the effects of design elements such as sector specialization but requires further development. Instead, most studies take an overarching viewpoint in investigating the impacts of incubation on start-up development. Moreover, the inclusion and comparison of different incubation models and thus the peculiarities of design elements, has only been done in a limited amount of studies. It should constitute one of the next steps of this part of incubation research to include the dimension of life cycle stages that is derived in the next section, into the growing concentration of studies on impacts of design elements on incubation performance. Nevertheless, it shall be mentioned that possible interconnections and interdependencies of incubator design elements might impede those studies, also potentially influencing the consideration of life cycle stages.

2.3. The relationship between incubation designs and the start-up life cycle stages

The derivation and categorisation of both design elements and categories of incubation, as well as the insights into studies on the impact of incubation, have prepared the development of the relationship between design elements and life cycle stages. It is therefore necessary to depict and explain the underlying theory of life cycles and stage-related needs before deriving the final propositions.

First introduced by Alfred Chandler (1962), organisational life cycles aim to describe the development of organisations over time (Fisher et al., 2016) from birth to decline. Since then, a variety of life cycle models have been developed, focusing on different dimensions such as stage-related needs (e.g. Greiner, 1972; Kazanjian, 1988; Dodge & Robins, 1992; Churchill & Lewis, 2000). While the definitions of core challenges and thus the needs during the different stages, as well as the labels of stages vary sometimes, the essential natures of the stages tend to be similar across the literature. The

selection of one life cycle model for this study is therefore "*more semantic than substantive"* (Fisher et al., 2016). Nevertheless, the models differ in their contexts of development (Fisher et al., 2016), mostly in the dimension of sectoral concentration. The selection of the life cycle models used in this study is twofold. First, considering the different contexts of development, it is reasonable to choose a model that focuses on technology-based companies, as incubation largely targets this category with its various sub-sectors. Kazanjian's (1988) organisational life cycle model in fact relies on this context and is used in this study. Secondly, due to the variety of different life cycle models, it is necessary to choose a representative one that is widely used throughout the literature. Greiner's (1972) life cycle model can be seen as representative in defining evolution and revolution based growth (Beverland & Lockshin, 2001, McAdam & McAdam, 2008). Indeed, it is seen as one of the influential baseline models (Hanks et al., 1993). Both models not only present the life cycle stages but also define basic stage-related challenges and needs, necessary for this study. As this conceptualisation and incubation in general aims on start-ups rather than mature companies, only three of Kazanjian's (1988) four stages are used: conception, commercialization, and growth.

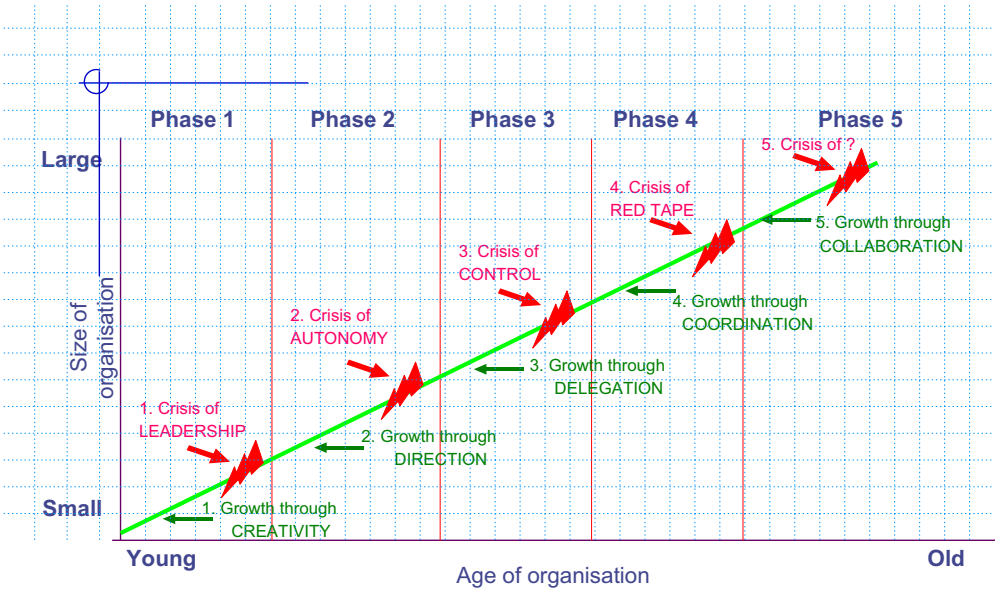

Figure 3: Characteristics of Greiner's growth model (Greiner, 1972)

The first stage – conception – is driven by creativity. Technology start-ups usually aim to develop a first working prototype and its underlying technology. Moreover, this stage focuses on validating a proof-of-concept for the first product in a specific market. Organizational structures and formality are usually very low to non-existent (Kazanjian, 1988). However, this stage is the foundation of entrepreneurship, creating the basis for a later formation of organisational structures. The degree of formalization and organisational structure is increasing from the conception stage to the growth stage (Hanks et al., 1993). The length of the conception stage can vary significantly, dependent on the development requirements of used technology (Fisher et al., 2016). The key challenges of development and validation of a first prototype or product mirror the start-ups' needs during this stage. The

establishment of first customer contacts, and assessment and definition of the target market are necessary to achieve successful validation and subsequently customer acceptance (Dodge & Robbins, 1992). Furthermore, this stage often requires the acquisition of initial financial resources to ensure survivability (Kazanjian, 1988). This clearly underpins the needed support in the dimensions of creativity, business knowledge, and networking to respond to the challenges explained.

The second stage – commercialization – constitutes the development of the technology and the prototype into a working product or service for a specific market (Kazanjian, 1988) after the prototype-market-fit has been validated in the first stage. This requires the identification of a product-market-fit (Ries, 2011), achieved by iterations, pivoting, or refining of product or service prototypes (Blank, 2013; Fisher, 2012). The definition of tasks in the organisation and first developments of organisational structures support this step (Kazajian, 1988). During this stage, growth is achieved through direction (Greiner, 1972). In contrast to the conception stage, this stage often requires less close network structures with universities or research institutions. Moreover, especially the commercialization in a high technology context, requires financial resources from business angel investors or venture capitalists (Fisher et al., 2016). Not only the required amount of investment might increase, but also the design of investment rounds and deals might significantly differ from requirements of possible pre-seed deals in the conception stage.

The third life cycle stage – growth – aims to develop the initial market success of the latter stage into exponential growth of the venture (Fisher et al., 2016). It is characterized by significantly increasing numbers of employees and customers (Jawahar & McLaughlin, 2001). Due to the further stabilisation of organisational structures, problems during this stage are mostly localized in the respective organisational functions which aim to build up efficient and effective task systems (Kazajian, 1988). Typical problems arising from extensive growth are: Stabilization of production and product reliability, extensive demand increase, cash flow maintenance, and formalization of organisational structures (Dodge & Robbins, 1992; Jawahar & McLaughlin, 2001). The required financial resources significantly increase compared to the commercialization stage and potentially develop into an initial public offering at the stock market (Martens et al., 2007). The stage persists until the ventures' growth rates catch up with or overtake market growth rates (Fisher et al., 2016).

To facilitate growth and long-term survival, incubators aim to provide resources and support for their incubatees during the life cycle stages elucidated. It is crucial to provide the right resources and support at the suitable stage of development to achieve these goals. Consequently, this challenge of incubation is dependent on the identification of needs of start-ups during their individual stage of development, and more importantly, on start-ups' ability of effective resource usage. Life cycle and growth effects correlate with the ability of small firms to effectively use resources, either internally available or externally provided. The peculiarity of effective usage of those which are externally provided is thus, among other factors, dependent on the life cycle stages of relative incubatees (Naffziger et al., 1994; Moy & Luk, 2003; McAdam & McAdam, 2008).

Only few studies have analysed the usage of provided resources at different life cycle stages in the incubation context so far. Bigliardi et al. (2006) analyse in a multiple case study the longitudinal performance of science parks and find varying usages of provided resources during the different stages of growth. McAdam & McAdam's (2008) results underpin this in exploring the longitudinal usage of resources in university science park incubators during different development stages. A positive relationship of increased usage of provided resources with the advancing maturity process could be identified. This is in line with other studies claiming a linear increase of resource usage in correlation with start-ups' life cycle development (McAdam & McAdam, 2008). However, this study argues that this correlation is not necessarily linear, but rather dependent on the fit of needs and provided support at the different life cycle stages. As demonstrated, start-ups' needs are dependent on and concern a variety of different areas and influencing factors. While regional and industrial specificities might play important roles in influencing the needs of incubated start-ups, this study does not particularly concentrate on the dimensions of region and industry, but rather aims to derive propositions that are possibly applicable to various groups of start-ups and their diverse needs.

The model depicted in figure 4 elucidates the general theoretical rationale of this study. Internally available resources of start-ups and incubator external resources not only influence the growth and development of start-ups as they are utilized, but also influence the design of elements of incubation as demonstrated. The support of start-up growth through resources provided by incubation is impacted by life cycle specific needs and the relative ability of effective resource usage. Those needs, explained in the previous paragraphs, are used in the following development of propositions as they are connected with the design elements.

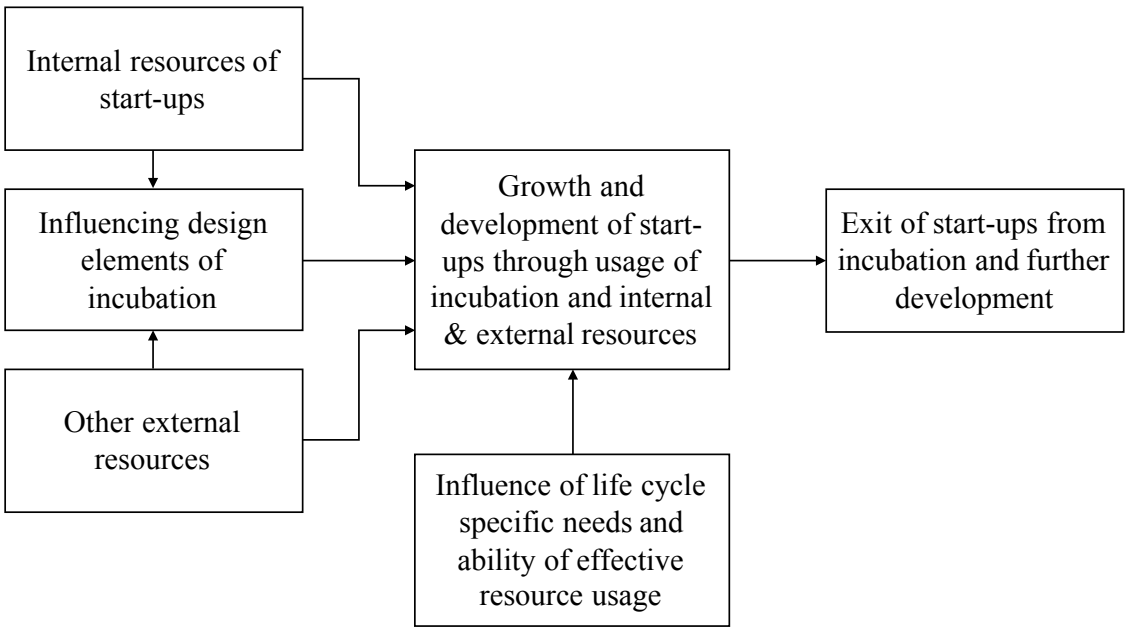

Figure 4: Relationship between resources, start-up growth, and life cycle (adapted from Löfsten & Lindelof, 2005; McAdam & McAdam, 2008)

3. Conceptual development of synthesising propositions

This conceptual development aims to connect the design elements of incubation and the provided support of incubators with the life cycle specific needs illuminated in the previous section. It provides a starting point for future in-depth analyses of the suitability of different incubation designs for different life cycle stages of start-ups. The design elements used in this conceptualisation are limited to the procedural level but exclude the functional support elements, as considering these would shift the perspective from top-level to very detailed. In the light of the recent growth of sector-specialized incubation, this development especially focuses on the element of incubator composition. The following figure 5 provides an overview of the elements included.

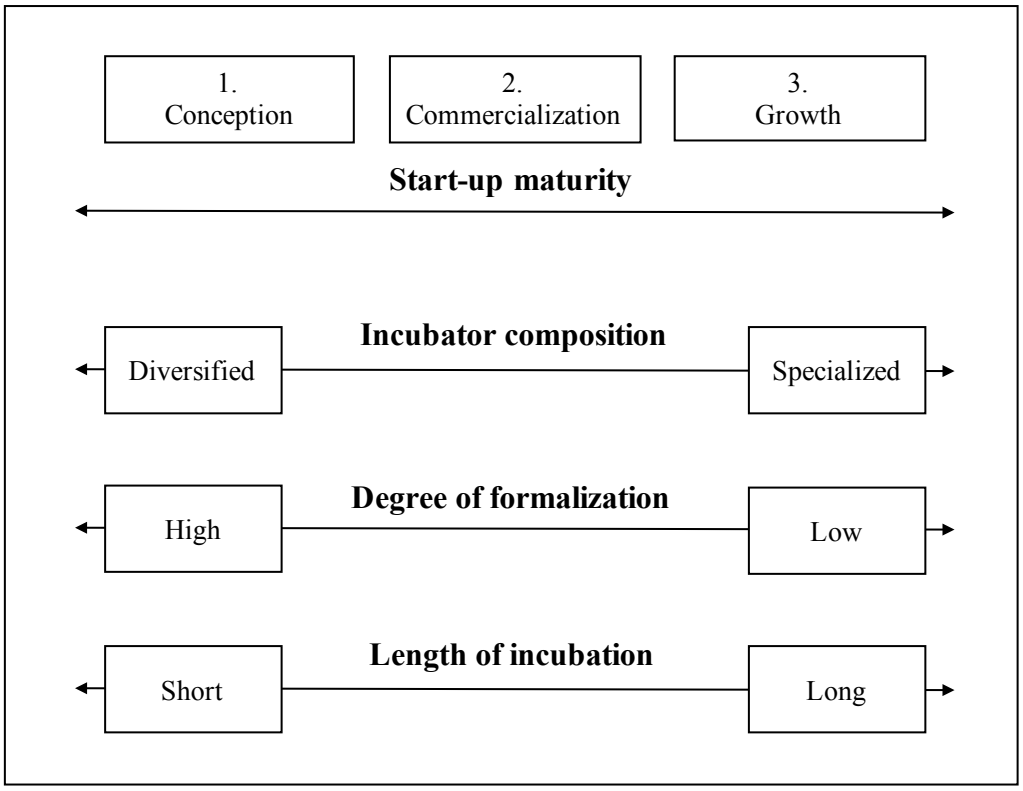

Figure 5: Relationship between start-up maturity and selected design elements of incubation

The conception stage largely relies on creativity as the major factor for growth (Greiner, 1972). It mirrors the primary challenges in this stage i.e. the development and validation of a suitable prototype and business model. In fact, Blank (2013) defines the term "start-up" as the search for a scalable business model. This development and searching process requires greatest flexibility in the dimensions of creativity and pivoting of value propositions, business models or markets. In contrast, start-ups with a validated product and business model who target the commercialisation in the second stage may require a stronger focus on their individual sector and its specificities, as the validation has largely been completed. This sectoral focus might concern elements such as knowledge, networks, and legitimacy, as well as the development of suitable organisational structures and the acquisition of suitable financial

investments. Therefore, it can be theoretically hypothesized that sector-specialized incubators are more likely to provide this sector-specific and personalized support due to their ability to concentrate on start-ups' needs in one sector or industry. On the contrary, diversified incubators provide greater flexibility and less specialized support, enabling creativity and pivoting. As a result, it is reasonable to infer that diversified incubators are more suitable for early stage start-ups (conception stage), while sector-specialized incubators are more suitable for later stage start-ups in their commercialization or growth stage.

Key proposition: *SBIs might be more suitable for later stage start-ups with advanced business model validation, while diversified programmes might be more suitable for early-stage start-ups.*

This key proposition enables to further develop synthesising propositions in the following. In the light of this first derivation, it is reasonable to further specify the challenge of creativity and pivoting of products, business models, or markets in the context of sector-specialized incubation for early stage start-ups. The process of the conception stage requires, according to Steve Blank's (2013) customer development approach, a continuous definition, testing and reiteration of hypotheses, to finally verify product and market validity for the start-up. In case the process provides negative results for the used hypotheses, pivoting of these hypotheses, or in other words of the product, business model, or market, is crucial. To achieve successful validation, greatest flexibility is necessary. As sector-specialized incubators often have a special interest in one sector or industry, they might restrict radical forms of pivoting in the dimensions outlined. Moreover, specialized and industry-focused know-how of the incubator management might impede creativity in guiding the conception stage into a specific direction. The possible industrial bias of major stakeholders of sector-specialized incubators might support these restrictions. SBIs are often embedded into regional industry clusters or have strong connections to one or more parent companies (i.e. semi-/corporate incubator), resulting in specific interests in one market or industry. It is therefore reasonable to hypothesize the following proposition:

1. *SBIs may narrow down potential products, business models or markets, restricting the pivoting of incubated start-ups.*

From the latter proposition, it becomes clear that creativity and the opportunity of pivoting are key enablers for early stage start-ups to reach the commercialization stage. The structure of incubatees in SBIs can be homogeneous in terms of markets, products, or knowledge bases. This can possibly lead to competition between incubatees resulting in a working climate characterised by various tensions (Tötterman & Sten, 2005). Moreover, incubated start-ups are often cautious about sharing information with their cohort (McAdam & Marlow, 2007). Schwartz & Hornych (2008) conclude that these issues might be more considerable with increased sector-specialization. As demonstrated earlier, knowledge

acquisition is one of the key needs during the first development stage, enabling creativity. Increased sector-specialization might lead to knowledge overlaps among incubatees. Due to similar knowledge bases, new knowledge of unfamiliar fields of business or technology might not be available, impeding mutual support and knowledge spillover. Unfruitful knowledge overlaps might hamper mutual support through collaboration. This paper therefore argues for less sector-specialized incubation to enable increased cross-fertilization of early stage start-ups.

2. *Increased sector-specialization of incubators might impede cross-fertilization of incubated early-stage start-ups.*

In contrast to possible negative implications of SBIs for early stage start-ups, later stage start-ups might benefit in various ways. As demonstrated, the requirements for financial investments change over the life cycle stages in the dimensions of amount and design. Later stage start-ups naturally require higher investments and a more personalized design of investments (Martens et al., 2007). Investment valuations in the conception stage are often vague, as credible multiples are not yet available. However, in the commercialization stage first (pre-)seed capital has already been acquired, enabling an individual and credible valuation of the start-ups' value. A decreasing valuation (down round) in the following investment round would not be accepted by the initial investors, underlining the necessity of personalized deals during this stage. Among the different categories of incubators, equity-based investments are considered as the more common models. The category of accelerators in particular, tends to choose a one-fits-all approach that provides the same deal for all incubatees. This certainly does not match the financial requirements of later stage start-ups in SBIs. A personalization of investment deals fitting the individual stage-related requirements of later stage start-ups is essential, leading to the following proposition.

3. *Later-stage start-ups in SBIs might need more personalised investment deals, which are aligned with their individual development stage.*

Besides the design element of "incubator composition", the elements of "degree of formalization" and "length of incubation" allow a connection with life cycle specific needs. Some structures of incubation models are highly formalized, while others provide individual customizations for their incubatees. Early stage start-ups usually have very low organisational formalization with non-existent organisational structures (Kazanjian, 1988). Over time the degree of formalization and organisational structure increases and constitutes one of the major challenges for start-ups (Hanks et al., 1993). Due to this challenge, the lacking internal organisational structure in early stages might benefit from higher degrees of external structures and formalization provided by the incubator. In contrast, later stage start-ups with more developed organisational structures might benefit from less formalized

programmes and higher degrees of individualization. In this case, incubators with higher degrees of formalization might even hinder the development of efficient and effective internal structures and thus of growth in later stages. Early stage start-ups need external structures to build up an internal organisation and to compensate inexperience, while later stage start-ups need adaptations of incubation structures on their already developed internal organisation and formalization.

Similarly, start-ups in different stages might require shorter or longer durations of incubation, potentially mirroring the duration of stages. The duration of the conception stage might theoretically vary significantly due to different requirements of technology or product development. Nevertheless, it is often characterized by a fast-paced environment, radical changes, and subsequently, changes in needs of support. In contrast, later stage start-ups in their commercialization or growth stages require longer durations of incubation, as sudden radical pivoting and changes in needs of support are unlikely. It is reasonable to hypothesize that early stage start-ups benefit from shorter lengths of incubation, while later stage start-ups benefit from longer ones. In fact, accelerators are usually time-limited, often lasting only a couple of months, while start-ups in science parks potentially benefit over several years (Pauwels et al., 2016).

Some of the relationships explained might lead to the assumption that accelerators are more suitable for early-stage start-ups and science parks for later stage start-ups. As a matter of fact, accelerators at least were initially designed for early stage start-ups. The heterogeneous incubator landscape does yet not fully mirror this simplification. Incubators which differ in the peculiarities of the highlighted design elements should consider including the relationships of design elements with the stages of start-ups' life cycles. Moreover, it might seem that every model of incubation currently existing could adjust the design elements conceptualised according to the different needs of life cycle stages. The theoretical derivation might lead to false interpretations. Although the peculiarities of some elements, such as the incubator composition, could be changed in every incubator, others such as the degree of formalization are not adjustable as their characteristics are essential for the respective incubation model. For instance, a very low degree of formalization in accelerators would contradict the very nature of this model, being highly formalized over a short period of time. As a result, this study shall only serve as a theoretical starting point for further developments and discussions in theory as well as in practice. It cannot attempt to examine every incubation design element in the light of start-up life cycle stages. Thus, a general statement on the suitability of different incubation models such as science parks or accelerators for the different stages of development is not possible.

4. Conclusion & Outlook

This conceptual study significantly contributes to the theoretical preparation of future studies in the wider area of incubation research. It attempts to fill the so far neglected theoretical gap of the start-up life cycle in relationship to different incubation designs. The development of a comprehensive and integrative model of incubation design elements and their peculiarities for the categories of science parks and accelerators prepares the theoretical connection with stage-related needs. This paper has argued that life cycle specific needs and the relative ability of effective resource usage influence the growth development and resource utilisation of incubated start-ups (figure 4). Moreover, it has developed three distinct propositions, building on the inference that sector-specialized incubators might be more suitable for later stage start-ups; and diversified incubators for early stage start-ups.

While this conceptualization primarily aims to contribute to theory building, it might also have implications for the implementation of start-up incubation. On the one hand, incubator shareholder and venture capitalists might benefit from the results in understanding and considering the impacts of start-up life cycle stages on their incubation designs. On the other hand, entrepreneurs and start-ups who aim to benefit from incubation might include the theoretical insights into their selection and decision process for targeting the suitable model and design for their specific needs.

The limitations of this study are twofold. First, it excludes industry and regional specificities from the conceptualization. This top-level perspective does not allow to include these dimensions. Nevertheless, they might be crucial influencing factors that potentially change the theoretical derivations. Future studies might focus on the suitability of incubation models for different industrial and regional specificities and an integration of those into the dimension of start-up life cycle stages. Secondly, due to the interconnectivity of design elements, the clear allocation of correlations might constitute a major problem. As demonstrated, design elements are interlinked, impeding the identification of correlations and relationships with the life cycle stages. This limitation constitutes one of the major problems in theory building.

Based on this conceptualization, future areas of research enable considering various angles and opportunities. To investigate the suitability of different incubation designs for different groups of start-ups (e.g. stages; industries), empirical studies are crucial. In the light of increasing numbers of sector-specialized incubation, the new research angle of incubator composition seems promising and needs further empirical studies. The propositions derived can serve as a starting point for this direction. Moreover, all studies require the inclusion of different stakeholder views – in particular, the start-up perspective – to achieve comprehensive and valid results. Finally, this study is only able to utilise a limited selection of design elements. Future studies should additionally include other elements and develop possible relationships with start-ups' stage-specific needs. This also requires to further identify and analyse incubation design elements and their impacts on start-up development.

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