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Investigating the growth paths of young technology-based firms: A process approach

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Abstract

Young technology-based firms are widely recognised as important drivers of economic renewal and growth. Many statistical studies have been carried out to ascertain the attributes of the more successful ventures. Most studies are based associations between measures of firms' growth and other firms' attributes, taken out of context. The internal developmental processes of these new ventures, viewed holistically, have not received attention in the research literature. Cross-sectional analyses of variance cannot reveal cumulative dynamic processes at work within firms, while case studies on new firms have lacked a generic conceptual framework capable of providing a systematic basis for comparison.

This report aims to complement findings from the dominant research approach by explicitly addressing new firms' internal development processes. To summarise unfolding growth experience over time in new firms, a quantitative analysis has been conducted on an exploratory basis. A new data set was created tracing over a period of eight years, the growth of a cohort of 136 German technology-based firms incorporated in 1991/9 . New compression techniques were devised that preserve information on internal change over time within firms. This analysis provides a quantitative background to an in-depth examination of 15 case studies undertaken to identify internal firm development processes. The analytic framework, inspired by the work of Penrose, provides a systematic way of comparing firms' growth experience. An exemplar is provided here together with an exposition of the conceptual framework.

It is shown that the typical growth paths of even a relatively successful cohort of survivor firms feature growth spurts, growth interruptions and temporary stagnation, evidence of which is concealed in standard studies of aggregate growth rates. The report explores the reasons for these patterns, using detailed case evidence. The 'new venture development framework' explains the prevalence of these growth patterns with reference to the entrepreneurs' evolving business concept and the firms' resource base and market opportunities. This pilot study shows that it is possible to understand and compare new firm growth by using contextual observations at the level of the firm. This provides rich material to inform support agencies and entrepreneurs facing growth problems of new firms in the field.

Keywords

Growth, entrepreneurship, process, resource-based theory, setbacks, problems

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1.0 Introduction

The experience of the recent investment cycle in technology ventures has raised many questions regarding enterprise and innovation in advanced economies. These include questions of research strategy. Much useful work has been done identifying typical success attributes of new firms [Storey 1994]. They provide insight into the kinds of factors that help new firms to achieve growth and internationalisation. But it is clear that a short-term, cross-sectional approach could not have provided insight into the dynamics that drove the changing fortunes of Internet ventures.¹ Indeed, an analysis of success attributes would have come up against many anomalies [Hugo and Garnsey 2001]. To appreciate the phenomenon, new venture emergence must be viewed in the context of environmental and sector dynamics unfolding over time [Schoonhoven and Romanelli 2001]. The firms themselves should be studied from a holistic perspective that cannot be captured by disembodied measures of association.

This document reports findings from a study on new venture emergence and growth which reflects the themes of context and process. The study aimed to conduct exploratory quantitative analysis on growth experience over time among new technology ventures and to develop a richer conceptualisation of the processes of growth giving rise to such paths.

We start by briefly discussing the need for a process approach which addresses a gap in the literature. We then depict the research approach employed here and document the results of the exploratory quantitative analysis on early firm growth paths. The next section discusses a framework for analysing and comparing new firm development from detailed case evidence. We apply this growth model to the experiences of a young technology-based firm in Germany (TPS Labs) as an exemplar to illustrate some of the dynamics of the framework in more detail before concluding with suggestions for future research.

2.0 Previous literature on new technology firm growth

Over the past 30 years, a large body of research has developed that seeks to characterise the new-technology based firm, viewed as a source of economic renewal. By exploring neglected opportunities and promoting discontinuous innovation, new technology-based ventures can operate as engines of economic growth [Almeida and Kogut 1997; Audretsch and Thurik

¹ The call for more historically aware, contextually sensitive and processual research is not new. Over 20 years ago, Kimberly made a similar point when he argued that “the generally moribund state of much current organizational theory and research is owing to the lack of appreciation for the role of history in, and the effects of context on, organizational life” (Kimberly 1980, p. 13).

2001; Phillips 1991; Anglo-German Foundation 1988; Arthur D Little 1977]. The transformative power of new firms is not limited to the West, but is equally evident in transitional economies where the transfer of resources from old to new enterprises is a source of growth [World Bank 2002, p. xviii]. Moreover, small firms are the providers of a significant proportion of jobs in advanced economies and the vehicles through which millions of individuals participate in the economy [Acs et al. 1998].

Approaches that seek to identify factors associated with the growth of new ventures have greatly enhanced our understanding of new firm success and have provided entrepreneurs with a yardstick with which to assess their own objectives and situation [cf. Storey 1994; Barkham et al. 1996]. Almus and Nerlinger [1999], for instance, use data on 580,000 firms in West Germany to identify the growth determinants of innovative firms founded between 1989 and 1996. They rightly stress the importance of start-up size, age and legal form. Specific factors associated with more rapid growth are limited liability legal status, tight links to external firms and the quality of human capital as demonstrated by the presence of technical degrees among the founders. In an in-depth study, Murray [1996] analysed six successful venture-capital (VC) backed firms to identify commonalities. Common themes which flowed from analysis of the multiple cases included the competence of the founder investee management team, the nature and behaviour of competitors, and the importance of patent protection. In a recent study, Burgel et al. show that new firms are more likely to achieve successful entry into international markets when they have qualified management teams with international experience and offer innovative but proven technology [Burgel et al. 2001, p. 67]. This research not only contributes to developing testable hypotheses but also provides entrepreneurs with valuable guidelines to keep in mind while starting and growing their ventures.

Research that attempts to identify processes that unfold within these new ventures over time can complement these studies. It has been noted that a comprehensive explanatory framework of early firm growth must “simultaneously explain the infrequency of the phenomenon and account for the major processes underlying growth” [O’Farrell and Hitchens 1988, p. 1380]. The complementarity of ‘cross-sectional’ and ‘longitudinal’ research is also recognised in the field of strategy with a view to developing a fuller theory of competitive advantage [Porter 1991]. Longitudinal research is often analysed in a cross sectional manner, however, losing critical information on the unfolding of processes over time [Delmar and Davidsson 1998]. As Pettigrew and colleagues have pointed out: “Dynamism has been difficult to study, and social

science has developed quite comfortably as an exercise in comparative statics” [Pettigrew et al. 2001, p. 697].

What is meant by the term 'growth process'? Van de Ven identified three uses of the term, the third of which corresponds to the meaning adopted in this study. Here, process is seen as “a sequence of events or activities that describes how things change over time, or that represents an underlying pattern of cognitive transitions by an entity in dealing with an issue” [Van de Ven 1992, p. 170]. This usage implies a historical developmental perspective that examines the sequences of incidents, activities and phases that unfold over the duration of an organisation’s existence. This accords well with Penrose’s definition of organisational growth “as a result of a *process* of development, akin to natural biological processes in which an interacting series of internal changes leads to increases in size accompanied by changes in the characteristics of the growing object” [Penrose 1995, p. 1]. Accordingly, for Penrose “size becomes a more or less incidental result of a continuous on-going or ‘unfolding’ process” [Penrose 1995, p. 1].

Applying a process perspective that looks at events that cumulatively change the characteristics of the new venture – including the cognition or mental models of the entrepreneurs – to the study of new venture emergence and growth, we can develop the following questions. (1) How are entrepreneurial ideas for a business transformed into a product or service of value? (2) What causes the business idea to emerge and change over time? (3) How do young firms respond to adversity, for instance how do they deal with a lack of resources needed to meet their objectives? (4) How do young firms co-evolve with their changing environment?

3.0 Our approach

Our investigation consisted of two parts. First, a database was assembled to explore the growth paths of a group of successful young technology-based firms in the first eight years of their lives. This pilot study provided background information on the incidence of various types of growth experience, insofar as these can be measured by growth indicators over time. We then conducted a series of comparative in-depth case studies to investigate in more depth the growth experience of young technology-based organisations and examine the internal dynamic processes associated with different kinds of growth paths.

3.1 The database analysis

Our challenge was to obtain a suitable data set for this analysis and to devise compression techniques that would not lose information on change over time in young firms. We aimed to create a data set providing consistent evidence on a national cohort of young technology-based firms. We contacted CREDITREFORM, a German creditor information agency comparable to Dun & Bradstreet in the United Kingdom. CREDITREFORM kindly agreed to provide data on a set of 20,603 firms incorporated in 1991/2. Our criteria for inclusion of firms in a suitable data set were that the firms:

- be clearly engaged in technology-based activity,
- have survived over eight years, and
- offer full eight-year survival records for analysis.

Only a minority of new firms survive over as long a period as 8 years. It has been established that the first eight years of new venture existence are characterised by mortality rates of up to 72% [Kirchhoff 1994, p. 154]. However, our aim was to follow the experience of those that did so in order to ascertain growth experience over time of firms with an exceptional survival record.

From the records, 283 firms were identified which were clearly technology-based and met the other criteria. This involved manual inspection of the activity description provided by the firms (free flow text) in the database. Firm-by-firm identification of technology-based activity was unavoidable because SIC codes are unreliable guides to firms' activity. Since not all 283 firms in the sample contained full employment and sales growth records for 1992-1999, we contacted the research institute ZEW Mannheim with a request to provide their data on this sample of firms. ZEW is specialised on the analysis of CREDITREFORM data [Almus, Engel and Prantl 2000]. Integration with ZEW records enabled us to identify 136 firms which met our demanding criteria of full records over eight years. Table I below shows the composition of this cohort of survivors by area of activity.

TABLE I – Distribution of high-technology firms founded in 1991/92 in data set, by sector of activity

Activity	Firms (%)
Software / hardware	39
Electronics components	19
Industrial machinery	15
Process control equipment	8
Medical technology	7
Environmental technology	7
Other	5
Total	100

(136 firms)

Key growth indicators show that this group of 136 firms may be characterised as a successful cohort of survivors. Total cohort employment grew by 47% from 1992 to 1999. In the same timeframe, total cohort sales grew from DM 357 million to DM 924 million, yielding an increase of 159% which exceeds cumulative inflation of 14.6% during the same period [Statistisches Bundesamt Deutschland 2002].² When these growth characteristics are viewed in the context of previous studies, the case for considering this group of firms a ‘successful cohort’ becomes even more compelling [Storey 1994]. The fact that the present cohort not only survived this critical phase but also managed to generate considerable growth on both measures underscores their success. Thus the group studied consisted of firms which might be most likely to have achieved sustained and steady growth.

3.2 The process analysis

The analysis of internal growth processes proceeded on the basis of an in-depth qualitative examination of individual firm's case histories [Eisenhardt 1989; Tesch 1990; Yin 1994]. In total, 15 firms in three technology sectors were examined: photovoltaics, electronic messaging and software. The research design was based on a strict ‘compare and contrast’ logic. We developed within-firm comparisons to see how individual ventures changed over time and between-firm comparisons to see which events gave rise to diverging developments, such as specific strategy choices. This approach resulted in a conceptual framework that was applied to different sectors in order to strengthen external validity. The process of data analysis was one of conceptual elaboration and enrichment, which is characterised by the utilisation of initial concepts to structure and guide an inquiry without letting these concepts constrain the

emergence of new insight. Indeed, contradicting and puzzling evidence was explicitly sought out in order to challenge and extend the initial framework based on Penrose [1995] and Garnsey [1998].

Garnsey [1998] extended Penrose's theory to the study of new venture growth. Garnsey focused on problem solving activities in the early life of the new venture relating to opportunity detection and resource access, mobilisation and generation. It is argued that the solution of these problems configures competence which then enables the firm to respond to changing industrial opportunities and threats.³ Moreover, Garnsey incorporated the possibility of multiple growth trajectories such as early plateau or growth reversal, along with the identification of the kind of dynamics underlying their manifestation. A third aspect introduced by Garnsey is the emphasis of the firm's embeddedness in the environment, an idea implicit in Penrose. The firm co-evolves with others in its changing environment.

To illustrate the approach here taken it is useful to refer to Argenti's seminal study on the study of corporate collapse [Argenti 1976]. Argenti operated at a lower level of abstraction and espoused different objectives than Penrose (examining decline, not growth), but his work is nevertheless a valuable methodological exemplar for us. His approach consisted of two steps. First, he identified the three archetypical collapse trajectories shown in figure 1.

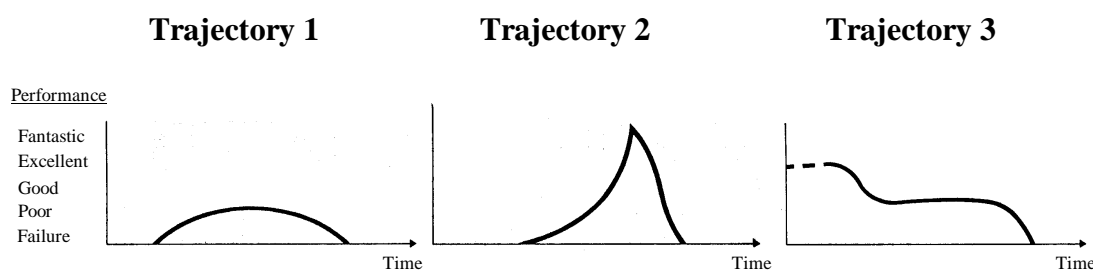


Figure 1: Three 'trajectories of collapse' identified by Argenti [1976]

Second, he developed archetypical 'process stories' which outline the sequence of events that drive these trajectories of collapse. Argenti's motivation for developing such 'storylines' underpinning failure was dissatisfaction with the prevailing practice of identifying factors associated with decline:

² The annual growth threshold of 5% was above the inflation rate throughout the entire analysis period (Statistisches Bundesamt Deutschland 2002).

³ The idea of focusing on concrete activities in the life of a venture has recently been recognised as a promising route for the study of corporate development and strategy (Whetten 1987, p. 337; Foss 1997; Porter 1996; Hogarth et al. 1991).

“...I have now come to believe that a mere list of causes and symptoms, no matter how coherent and comprehensive it may be, is not enough. What is missing from such an inventory – and indeed from all previous work in this field – is the dynamics of failure, the sequencing of events. We need a storyline that binds together all these causes and symptoms into a working model” [Argenti 1976, p. 121]

Argenti articulated the following ‘dynamics of failure’ storyline for trajectory 2. Type 2 firms enter into growth reinforcement early on driven by “the energy and ability of the proprietor, together with what is often a brilliant product” [Argenti 1976, p. 158]. Sales continue to expand and the firm’s success attracts external capital. Then, a self-reinforcing dynamic starts that ultimately positions the firm for failure:

“...the company is noticed by the press... now the company *has* to succeed because it is publicly expected to, so it has to sell more, so it has to borrow more, so it has to succeed more. ... No one knows that [an] ... inevitable turning point has been reached because creative accounting begins ... In a frantic attempt to keep turnover and profits rising at the rate that the proprietor, his backers, his public, his employees have come to expect, he now reaches into the absurd. ... The collapse is now quite swift, partly because once the press scent trouble there is no hiding it from the banks or the stock market. No amount of denial or creative accounting can stop the collapse... ” [Argenti 1976, pp. 158-159]

4.0 Key findings of the exploratory quantitative analysis

Our creation and investigation of an exploratory data set has features in common with Argenti’s step 1, the identification of specific growth patterns. Indicators were developed in an attempt to capture some of the discontinuities and dramas that shape the real experience of firms, concealed in cross sectional growth measures or success attributes. Our analysis shows that even for a group of firms that are exceptional in surviving the difficult first eight years, growth is not a smooth process. As the tables below demonstrate, the early growth of the successful cohort here examined featured significant interruptions and growth setbacks.

The records for the firms in our database were coded to designate years in which the growth variable had increased by more than 5%, had declined by more than 5%, or had varied between +5% and -5% change in the growth indicator. These thresholds were chosen to ensure comparability with prior research by Garnsey and Heffernan [2001]. Compression procedures were applied to the coded data using algorithms programmed in Visual Basic (Microsoft Excel), yielding the following classes of information:

- The number of growth, decline and plateau years per firm.
- The number of ‘episodes’ per firm and type of episode. An episode is any uninterrupted period of growth, decline or plateau years for a particular firm. In our database, an episode is at least one and at most seven years long.
- The number of growth ‘formations’ by formation type. A formation is any combination of two consecutive years, such as ‘growth-growth,’ ‘growth-decline,’ ‘plateau-growth.’

TABLE II – Revenue growth patterns of cohort of 136 German technology-based firms 1991/2-1999: Growth characteristics

	Growth	Decline	Plateau
Firms that experienced continuous growth, decline, or plateau (in % of firms)	4	0	1
Firms that experiences at least one episode of growth, decline, or plateau (in % of firms)	95	59	88
Average length of episode (in years)	2.0	1.2	1.6

Base: 136 German technology-based firms incorporated in 1991/92

TABLE III – Revenue growth patterns of cohort of 136 German technology-based firms 1991/2-1999: Incidence of growth formations* per firm

	Growth-Dec.	Growth-Plat.
Firms that experienced at least one ‘growth-decline’ or one ‘growth-plateau’ formation (in % of firms)	30	71

Base: 136 German technology-based firms incorporated in 1991/92

TABLE IV – Revenue growth patterns of cohort of 136 German technology-based firms 1991/2-1999: Number of episodes per firm**

	Growth	Decline	Plateau
Firms that experienced 0 episodes of G, D, P (in % of firms)	5	41	13
Firms that experienced 1 episode of G, D, P (in % of firms)	29	40	36
Firms that experienced 2 episodes of G, D, P (in % of firms)	49	15	39
Firms that experienced 3 episodes of G, D, P (in % of firms)	17	3	13
Firms that experienced 4 episodes of G, D, P (in % of firms)	0	0	0
Total	100	100	100

Base: 136 German technology-based firms incorporated in 1991/92

TABLE V – Revenue growth formations* in a cohort of 136 German technology-based firms 1992/2-1999

	Period t		
Period t+1	Growth	Decline	Plateau
Growth	58	46	36
Decline	12	17	17
Plateau	31	37	47
Total:	100	100	100

Base: 816 formations* consisting of two years each

TABLE VI – Employment growth patterns of cohort of 136 German technology-based firms 1991/2-1999: Growth characteristics

	Growth	Decline	Plateau
Firms that experienced continuous growth, decline, or plateau (in % of firms)	1	0	5
Firms that experiences at least one episode of growth, decline, or plateau (in % of firms)	85	49	99
Average length of episode (in years)	1.7	1.3	2.1

Base: 136 German technology-based firms incorporated in 1991/92

TABLE VII – Employment growth patterns of cohort of 136 German technology-based firms 1991/2-1999: Incidence of growth formations* per firm

	Growth-Dec.	Growth-Plat.
Firms that experienced at least one ‘growth-decline’ or one ‘growth-plateau’ formation (in % of firms)	18	71

Base: 136 German technology-based firms incorporated in 1991/92

TABLE VIII – Employment growth patterns of cohort of 136 German technology-based firms 1991/2-1999: Number of episodes per firm**

	Growth	Decline	Plateau
Firms that experienced 0 episodes of G, D, P (in % of firms)	15	51	1
Firms that experienced 1 episode of G, D, P (in % of firms)	39	33	31
Firms that experienced 2 episodes of G, D, P (in % of firms)	41	15	51
Firms that experienced 3 episodes of G, D, P (in % of firms)	5	1	16
Firms that experienced 4 episodes of G, D, P (in % of firms)	0	0	1
Total	100	100	100

Base: 136 German technology-based firms incorporated in 1991/92

TABLE IX – Employment growth formations* in a cohort of 136 German technology-based firms 1992/2-1999

	Period t		
Period t+1	Growth	Decline	Plateau
Growth	44	30	27
Decline	10	26	10
Plateau	46	44	63
Total:	100	100	100

Base: 816 formations* consisting of two years each

NOTES:

+ Where totals do not add to 100 this is due to rounding error.

++ All data drawn from the records of CREDITREFORM and supplemented by CREDITREFORM data maintained at ZEW Mannheim.

* A growth 'formation' is any combination of two consecutive years, such as 'growth-growth,' growth-decline,' 'plateau-growth' etc.

** A growth 'episode' is any uninterrupted period of growth, decline or plateau years for a particular firm. In our data set, an episode is at least one and at most seven years long.

Discussion of results

Looking at revenue growth, we can see that only 4% of firms experienced year-on-year growth while 59% experienced at least one decline episode and 88% experienced at least one episode of stagnation (table II). The average growth episode lasted 2.0 years while the average plateau episode lasted 1.6 years, and the average decline episode was even shorter at 1.2 years (perhaps not surprising given the fact that the cohort consists of survivors). Moreover, the analysis suggests that growth comes in spurts since 49% of the firms in the cohort underwent two distinct growth episodes while 17% even experienced three such episodes (table IV). There also seems to be evidence for 'growth reinforcement' processes. The operation of reinforcement processes would imply that a year of growth is more likely to occur after a period of growth than after a period of decline or plateau. This dynamic seems to exist since 58% of all formations which registered growth in period 1 also exhibited growth in the subsequent period (table V).

The data on employment growth produces a similar picture with merely 1% of the firms experiencing continuous employment growth. This contrasts with the 49% of firms which experienced at least one period of decline and the 99% which retreated onto a plateau at least once (table VI). The average length of an employment growth episode was 1.7 years, the average plateau episode lasted 2.1 years and the average decline episode 1.3 years.

The representation of growth depends on the measure used. This analysis of growth in terms of both revenue and employment indicators made it possible to compare the two measures. One difference between growth patterns measured in terms of revenue and employment is that

employment data is characterised by more plateaus than revenue data (51% of firms experienced two episodes of employment plateau whereas only 39% experienced two episodes of revenue plateau). Employment plateaus also appear to be longer than their revenue counterparts (2.1 years versus 1.6 years). Although interpretation at this aggregate level must proceed with caution, this finding confirms what might be expected, that employment does not immediately mirror developments on the revenue side but reflects a delayed response to business conditions. This may be a culturally variable phenomenon calling for inter-regional and international comparison.

The findings of this study – that growth is an uneven process marked by setbacks – accords with previous empirical research by Garnsey and Heffernan [2001]. Analysing employment data (collected every two years) on a cohort of 237 high tech firms of which 93 survived over ten years in Cambridge (UK) they reveal that only 6% of the survivors grew continuously over the entire period (i.e. for 5 consecutive periods). A total of 22% of these survivor firms experienced a growth reversal (a ‘growth-followed-by-decline’ pattern), which is broadly in line with the corresponding 18% of firms in the German cohort (table VII). Moreover, while Garnsey and Heffernan find that 54% of the Cambridge firms suffered a decline at some point in their ten year life, the German data again provides broadly similar results with 49% declining at some point (table VI).

Analysing growth data in this fashion had not been done before these complementary studies were undertaken because the experience of growth as a process has not been a research issue. We are confronted with the question as to why growth should be such an uneven process. The pilot study included only firms with an exceptional survival record. More extensive analysis would make it possible to investigate how fluctuations in the firms' fortunes of the kind documented here resulted in closure in many of the non-surviving firms. A key question concerns what kind of dynamics at the individual level give rise to growth discontinuities. In practical terms, the data provides managers and entrepreneurs with a more realistic idea of what to expect and can help them to situate their own experiences.

5.0 From aggregate patterns to underlying dynamics at the firm level

While an analysis at the level of a plurality of firms identifies patterns of growth neglected in the literature, understanding what gives rise to these patterns requires moving to detailed observation at the level of the individual firm. To generalise from the firm level with more

insight than the aggregate data can provide, we need generic concepts linked to an explanatory model.

5.1 The new venture development framework

The new venture development framework was informed by detailed study of 15 individual firms in three technology-intensive industries: electronic messaging, photovoltaics and software. The framework helps to understand the ‘adaptive behaviour’ of young technology-based firms as they struggle to survive and prosper in the context of rapidly changing and highly uncertain environments.

5.2 The conceptual framework

The firm is conceived as an open system embedded in and continuously co-evolving with the others in an environment that includes resource providers, institutional and regulatory players, competing and complementary firms.

Numerous triggers can stimulate entrepreneurs to create a new venture. A specific resource – for instance software, a plan for an improved production process or a prototype of a new solar cell – may arouse recognition of a particular opportunity. An environmental event may combine with the entrepreneur’s disposition or a change in circumstances, such as the end of a research programme. As the opportunity is considered, a clearer sense emerges of the resources needed and the activities to be undertaken in a new resource-activity system. There is a need to solve a number of generic problems: financing the venture, developing and producing the product or service, hiring and organising employees, connecting to suppliers and customers and so on. The business idea⁴ is subject to continuous refinement in discussions with others.

Collins and Moore referred to the emergence of the business idea as a process of ‘projection’ which consists of “drawing lines of thought into the future” [Collins and Moore 1970, p. 116]. In this process the entrepreneur detects available elements and “begins a procedure through which, at some point in the future, these elements can be brought into a new configuration...” [Collins and Moore 1970, p. 116]. Quite often certain resources dominate, or become the basis of, this process of projection [Collins and Moore 1970, p. 121].

⁴ The term business idea was used by Normann (1977) to refer to the firm’s ‘total formula for profit’ that includes (1) the target market niche, (2) the product or service system to satisfy the niche, and (3) the resources and systems to deliver the product or service in question. However, Normann argued that the business idea does not exist until it has been realised and generates profits. We take a different view, since, as our cases have shown, business ideas rarely appear fully fledged, but tend to emerge gradually and evolve over time.

Resource acquisition and mobilisation

The entrepreneur can now access the required resources or create those that cannot be accessed, as where sophisticated production equipment is too expensive for a firm, forcing it to develop its own solution. If a required resource cannot be mobilised, entrepreneurs have to modify the envisaged resource-activity system accordingly or adapt the target opportunity so that it can be exploited with available resources.

Investors buy into a venture with expectations created by the entrepreneur and an assessment of environmental opportunities and trends. Hence firms perceived to operate in promising industries will find resource acquisition less problematic than others. In return for funding the venture, investors obtain influence in the venture and become a force to be reckoned with.

Problems arising in this process of accessing and creating resources as well as modifying perceived resource requirements often contain the seeds of new opportunities. Such problems represent signals that contribute to a gradually unfolding view of reality as entrepreneurs test and refine their original assumptions and thus learn about the features of the environment in which they have chosen to operate. Problems in this phase are usually related to resource deficits, i.e. the inability to gain access to resources perceived to be necessary. But there may also be resource surpluses since, as Penrose pointed out, resources are often acquired in uneven multiples, making the full utilisation of all resources difficult to achieve.

Resource generation

Before initial resource endowments are exhausted, the new firm must have solved start-up problems and begun to generate resources through its productive activities, i.e. not from capital investment or other financing activities (transfer of funds). With growth, asynchronies arise in the form of resource deficits or surpluses and again constitute a call for action. Solutions to these problems open new opportunities. The firm's proceeds may be reinvested, accumulated or extracted from the venture. The choice will influence the firm's resource base and thus affect its ability to respond to environmental opportunities and threats as these change in the future.

5.3 Using the framework to trace firms' paths

We can now illustrate the new venture development framework by using it to trace the development journeys of individual firms. It is important to realise that the framework only

applies to the early phases of a new venture's life, i.e. before it has accumulated sufficient financial reserves to secure its position through unforeseen difficulties. Two examples of resource requirement modification and resource creation dynamics identified in our research are given below. They illustrate how entrepreneurs solve growth problems by continually scanning their environment, finding ways to attract resources, altering requirements or the target opportunity and enhancing their firms' internal capabilities.

Example 1: Resource requirement modification

A new firm develops a business plan to sell a software product. It decides to approach venture capitalists in search for funding. The entrepreneurs request £ 2 million, but are rejected. They modify the business plan (envisioned resource-activity system) and reduce their financial resource requirements by £ 0.5 million. However, they are again rejected. They continue to modify their resource requirements until they arrive at a level of funding acceptable to an investor.

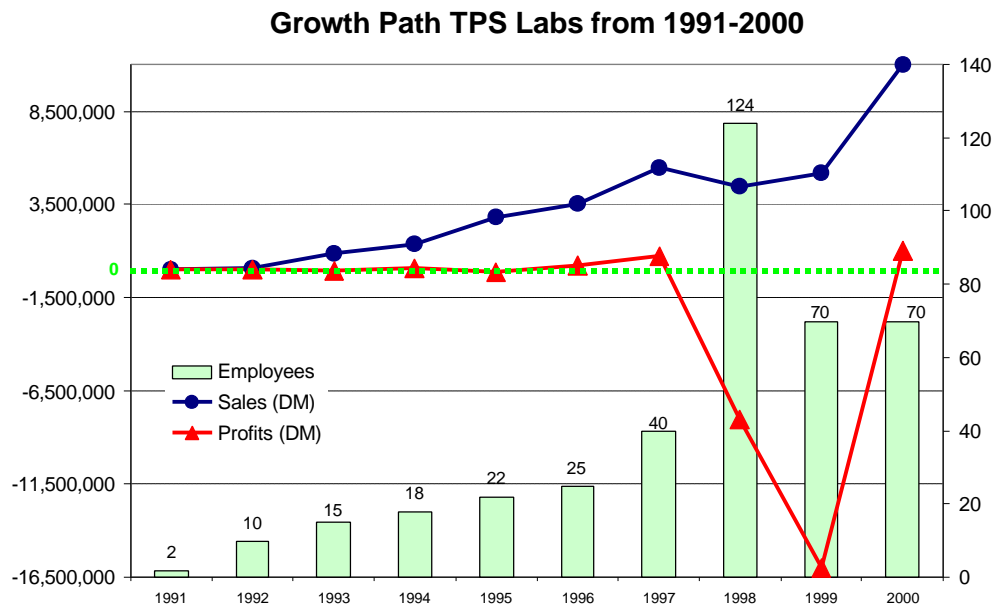
Example 2: Unable to access external resources, a firm creates a new resource internally

A firm has launched an online service which meets with unexpected success. More users sign up in a month than were projected for the entire year. As a result, the firm's systems collapse due to overload. The entrepreneurs now face the option of either rationing the service (restricting usage) or expanding server capacity. Since they intend to become a leading online service, they decide against rationing. In order to expand capacity, they turn to vendors of standard software but find that software running at the levels of capacity they require has not yet been developed. Since they lack the funds to hire a consulting firm to create bespoke software for them, the entrepreneurs are forced to develop a more scalable server technology internally. Fortunately, the firm succeeds in this effort. As a result, it has created a resource of particular value: a highly scalable server technology [Hugo and Garnsey 2001; Hugo and Garnsey 2002].

6.0 Case study: TPS Labs GmbH

We will now relate a case study which illustrates some of the development dynamics of the framework. The case is based on primary as well as secondary research.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Sales (DM)	40,000	100,000	900,000	1,400,000	2,800,000	3,500,000	5,500,000	4,500,000	5,200,000	11,000,000
Profits (DM)	0	10,000	-40,000	75,000	-100,000	250,000	700,000	-8,000,000	-16,000,000	1,000,000
Employees	2	10	15	18	22	25	40	124	70	70



6.1 TPS Labs

TPS Labs was founded in 1990 in Munich by two mathematicians who had met while studying at Munich's Technical University. Like many students in those years, Philip Debbas and Till Gartner had been playing and working with personal computers ever since these technologies emerged in the public domain in Germany in the early 1980s: "Programming was a hobby of ours. We all received our first PCs at the age of 12 or 14. We are just part of that generation." While at university, the two founders soon recognised the commercial value of their programming skills and occasionally worked as freelance programmers developing software for customers whom they acquired through personal relationships, mainly friends and acquaintances.

Upon graduation, the founders decided to formalise their activities by creating their first legal entity, the "TPS Labs GbR." The idea was to sell programming services to anyone who might require them. Seeking self-employment seemed natural for the two founders, both of whom had been raised in entrepreneurial families. Like previous projects, the first contract which the newly founded venture took on was secured through a friend. Due to his personal background,

this friend was aware of specific administrative problems experienced by ‘driving schools’ that, in his view, were easily amenable to a software-based solution.

In the summer of 1991, TPS Labs was unexpectedly awarded a contract by the PC producer Compaq. The contact to this eminent customer had been created through another friend who was completing an internship at Compaq’s German headquarter in Munich at the time. In the course of his internship, the friend had come to believe that Compaq could greatly benefit from a ‘sales information system’ and accordingly proceeded to put his superior at Compaq in touch with TPS Labs. The Compaq manager (responsible for ‘Sales Controlling’) would soon become an important mentor for TPS Labs: “The manager was aware that any solution initially achieved would be a temporary one. He encouraged us ‘to just begin programming’ based on the intern’s analysis. Though he knew how long a full-scale implementation would probably take, he did not specify a fixed time frame.” Lacking experience in developing such systems, the founders suggested that it would require three months. At the end of three months, however, they had only developed a first prototype, not the final product as initially expected.

As the firm’s activities with Compaq began to expand, TPS Labs undertook several steps to accommodate growth. First, it changed legal status to limit personal liability of the founders in the face of growing activity and thus exacerbated levels of risk. Moreover, the firm rented an office since it could no longer be managed from the homes’ of the founders. Third, TPS Labs began to recruit additional employees resulting in a workforce of five to ten people, some of whom contributed on a freelance basis in parallel to their university studies. Fourth, due to the acquired reputation, the firm now took on several other projects in the periphery of Compaq’s IT department.

In 1994, TPS Labs’ mentor at Compaq provided crucial advice which would change the course of the firm. According to the co-founder: “Our activity at Compaq grew, grew and grew. And then, in 1994, we acquired a second customer. The manager at Compaq had said to us ‘hey, you need a second customer.’ The dependence on Compaq was very large. We worked on many projects for Compaq. Basically, we were one of their service companies.” Reflecting his commitment to the firm, Compaq’s Sales Controller engaged his personal network to help TPS Labs develop its customer base. Through him “new contacts to new firms were created. He recommended us to his personal contacts at other firms. DASA and others came to him and looked at the system as a reference project.”

TPS Labs continued to grow and by 1996, it already employed 25 people and had half a dozen customers. Rising activity levels again placed pressure on the firm to adapt. First of all, the firm became acutely aware of the fact that despite its increasing specialisation on 'sales information system software,' it still lacked a truly standardised product. As a result of a lack of standardisation, the software required significant implementation and customisation effort for every new customer and this ultimately became an acute bottleneck. Michael Wenglein, one of the firm's earliest employees, recalls: "We did not have enough IT specialists to perform all the projects we wanted to. This was a clear factor limiting our growth potential." Addressing this issue, TPS Labs developed specific software tools to facilitate the customisation of the product during its implementation at the customer site. "With these tools, implementation time and effort declined significantly."

A second consequence of rapid growth was a strain on the firm's credit facilities for financing work in progress. Increasing numbers of projects meant that an ever higher level of expense (salaries and advance services) was incurred. This, in turn, raised the funding required to bridge the gap between cash outflow and cash inflow since TPS Labs only billed customers at the end of certain milestones or after project completion. It did not take long before the bank started to notice this development and asked the firm to consider adjusting its financial structure by introducing more shareholder equity.

To accommodate the bank's demand, TPS Labs began to search for additional capital. Through its lawyer, the firm entered into contact with a former employee of IBM who, in turn, was acquainted with Munich's venture capital scene which was just emerging at the time. By October 1997, the firm had managed to raise the sum of DM 8 million – significantly more than it actually required. As a result, the entrepreneurs felt compelled to move into a more aggressive, proactive mode of behaviour which was difficult for them because it differed from their accustomed modus operandi. As the founders recall: "The first six years of the firm were not 'planned' years. They were mainly dominated by certain lucky coincidences and then the management of these coincidences. Coincidences like the contact between Compaq and DASA which led to a new contract for us, for example. And in such situations, you have to react well and if you do react well, you will have gained a customer. The reacting was never very difficult for us. It was the proactive mode that was difficult after the first round of financing."

Urged by the VC and somewhat worried about their ability to proactively build a business to larger scale, the entrepreneurs decided to bring in a professional manager. Their choice fell on the former IBM executive with whom they had developed a trusting relationship in the course of seeking financing. The new manager assumed responsibility as General Manager for Marketing, Sales and Service.

At this point, a number of decisions were taken that ultimately pushed the firm onto an unfortunate trajectory of decline. On the basis of a sales projection that foresaw an annual turnover of DM 23 million by 1999 (a massive increase over 1997 sales of DM 5.5 million), the new management team began to rapidly expand the workforce. Within one year, 80 new employees had been hired, almost tripling company size. However, the level of planned sales was not achieved. Instead, revenue actually dropped from DM 5.5 to 4.5 million, reflecting an overly optimistic interpretation of a contract with VW (Volkswagen) which ultimately failed to become effective, as well the decision to turn away a number of possible programming contracts since the firm wanted to develop a product focus. In a press interview, the co-founder analysed the situation thus: “After one year, we felt that something was fundamentally wrong. The firm had simply not progressed a single millimetre. We had hired 80 people based on a planned turnover which we did not achieve. It would have been better to acquire as many customers as possible first and then recruit employees” [Heilman 2000, K-10].

With sales failing to materialise, the firm had burned through its cash reserves by 1998 and a liquidity crisis ensued. TPS Labs now retrenched into what the entrepreneurs called a ‘reaction mode’ and at the end of 1998, the founders had managed to secure a bridge financing that saved the firm until early 1999 when it was able to attract a massive investment of DM 24 million in venture capital finance. At the height of Internet boom, Philip Debbas recalls, accessing such an amount had become a realistic option. The management team had by now been exchanged and the original founders were back in full control of the venture. By the end of 1999, TPS Labs had signed up nine new customers. Unfortunately, revenue from these customers materialised later than expected so that by December 1999, the firm began to search for a third round of financing.

However, investor trust had at that time deteriorated to a degree that a third round failed to transpire. Ultimately, TPS Labs – worth tens of millions before – was sold at a fire sale price. Recalls Debbas: “I triggered legal procedures to liquidate the firm knowing already how the

deal for saving the firm would work – namely the sale to Bäurer AG. It was the only way to save the firm, the product, the customers’ investment in it and the jobs. The financing round failed in February 2000, on the 10th of February. And we all knew that we had no more cash. At the end of the month, we would not have been able to pay salaries. So I had two or three weeks time to do the entire deal.”

6.2 Analysis in terms of the framework

The table below summarises key dynamics that could be observed in the history of TPS Labs, with reference to the conceptual framework.

In our analysis of the first eight years of TPS Labs’ life we will focus on four key dynamics: (1) the evolution of the firm’s business idea, (2) the impact of its first and (3) second growth spurt, and (4) the way the interaction with resource providers contributed to growth and decline.

Dynamic 1: Evolution of the business idea.

The initial business idea was to provide a relatively generic set of programming services and the entrepreneurs were typically alerted to project opportunities through their network of friends and acquaintances. TPS Labs’ business idea began to shift when it took on a project for Compaq to develop a ‘sales information system.’ The performance of its software solutions as well as the excellent relationship which developed with a senior Compaq manager meant that TPS Labs could assume increasing project responsibility for its customer. Over time, the firm came to be viewed as one of Compaq’s own service units and enjoyed a relatively high degree of company access.

The impulse to apply a knowledge base that was increasingly specialised on ‘sales information systems’ to other potential customers also originated from its main customer. The manager at Compaq recognised that TPS Labs’ significant growth meant that it should decrease its dependence on Compaq, currently its sole customer. Reflecting their excellent relationship, the Compaq manager began to endorse TPS Labs to other firms through his personal network. This resulted in a second ‘sales information system’ project for a prestigious customer, DASA.

TPS Labs’ business idea thus gained definition in a process of interacting with influential early customers. The interaction with Compaq had two impacts. First, it served to generate resources for the firm, representing the implementation of its initial business idea. Second,

increasingly specialised knowledge was developed which soon came to provide the basis for TPS Labs' transition from a 'generic programming service' to a specialised developer of standardised 'customer relationship management' software.

Dynamic 2: Resource-activity mismatch created by first growth spurt.

As TPS Labs' activities at Compaq grew, the firm needed to adjust its resource-activity system to current requirements. First, it had to move into a new office since working from home was no longer practical. Second, the founders decided to change the firm's legal status in order to reduce the levels of personal risk which an increasing volume of business entailed. Third, the firm began to recruit more employees. In doing so, it relied on its network of contacts to the university, largely hiring fellow students of mathematics, some of whom contributed on a freelance basis.

Dynamic 3: Resource-activity mismatch created by second growth spurt.

Rising activity levels exerted pressure on the firm to adapt once again when additional customers, in particular DASA, had signed on. The entrepreneurs were now facing several asynchronies in the resource-activity base which prompted action. First, increasing numbers of projects had come to strain the number of qualified system implementors. To avoid continued overload of implementors, specialised software tools were developed to automate parts of the implementation process. Resource creation was thus triggered by resource overload.

A second incongruence in the firm's resource-activity system was perceived by a resource provider: its bank. Growing activity levels entailed rising credit requirements for financing work in progress, which came to be seen as incompatible with the firm's equity structure. The bank's suggestion that TPS Labs obtain additional shareholder equity triggered a search for VC investment. Due to the situation at the time (the VC scene was just emerging in Munich and the Internet/tech boom was underway), the firm found it relatively easy to acquire a significant level of funding.

A direct consequence of the successful acquisition of external capital was a change in the management structure of the firm. The VC made clear that it would look favourably upon the introduction of professional management, a move which the founders supported since they were unsure whether they had the experience to build the firm's turnover to the agreed levels.

The dangers of externally imported management are highlighted by the experience of TPS Labs. New senior management from IBM proceeded to expand the workforce at an unprecedented rate assuming that sales would follow. When a particular sales contract with VW that would have provided several million DM in revenue failed to transpire, TPS suddenly faced a severe liquidity crisis. The underlying problem can be seen in different ways: (1) expansion was too aggressive, or (2) the contacts with VW were interpreted too optimistically, or (3) the sales approach failed to produce rapid results in boosting turnover.

Dynamic 4: Resource provider interaction.

A fourth dynamic critical to understanding the growth and untimely decline of TPS Labs is its interaction with external resource providers, especially banks and venture capitalists. This interaction can be seen as having been both a source of strength and a weakness to the firm.

First, the firm's bank triggered its search for venture capital which resulted in comprehensive changes in its direction and mode of growth. Second, TPS Labs found it relatively easy to acquire a total of DM 32 million in two rounds of financing. This was in part due to the firm's strong development record but also due to the fact that there was an abundance of capital in Germany at the time of the Internet/tech-boom. However, the significant financial investment led to the introduction of 'professional management' perceived to be necessary to achieve this goal. Unfortunately, the new managing director appointed under the influence of venture capital did not have experience in running a start-up with minimal reserves. The entrepreneurial route of economising on resources until some level of security is reached was abandoned.

Third, the immediate reason for TPS Labs' failure (and final sale to a competitor at a low price) must also be understood with reference to its dependence on financial resource providers. Since the process of revitalising the firm took longer than expected, TPS was forced to seek a third round of finance. However, attempts to achieve a third round failed since venture capitalists had lost confidence in the firm's ability to turn around.

7.0 Conclusion

This case study illustrates the type of causal mechanisms that give rise to the growth spurts and reversals so common in new firms, as quantified in our aggregate analysis. Because of reinforcement effects, these dynamic processes can accelerate growth and decline and explain

sudden reversal of fortune lost to view in cross sectional studies using average measures of growth. To complement previous research on new venture emergence and growth that focuses on factors associated with the success of these firms using cross-sectional analysis, we have pursued an approach that traces developmental processes that unfold and cumulatively change the new ventures over time. We have developed a two-pronged research approach that combines quantitative and qualitative data. Our exploratory quantitative study analysed a database of 136 technology-based firms incorporated in Germany in 1991/92 with an exceptional eight year survival record in order to trace change over time in young firms and to take into account difficulties that can arise after initial success. We explored ways of representing growth paths, instead of using a cross sectional approach. Our analysis demonstrates what is known from case study evidence but had not been shown at the aggregate level, that the growth paths of new firms, as represented by this cohort, are characterised by significant growth spurts, setbacks, interruptions and periods of decline.

The second contribution of the research is a 'new venture development framework' which we inductively generated from 15 case studies in the areas of photovoltaics, electronic messaging and software. The framework builds on and extends prior work by Penrose [1995] and Garnsey [1998]. It makes it possible to identify important dynamics in the early development of firms, including entrepreneurial responses which shape the evolution of the business idea and effect modifications to the new venture's resource base. A process-oriented approach to new venture development has implications for theory and practice. While managers stand to benefit from a fuller understanding of dynamic processes, theoretical work will be enriched by attention to issues which lie at the heart of enterprise formation and growth.

Further work

This pilot study was carried out on a small scale basis. Further work could investigate the growth experience of firms in the cohort that survived over a shorter period and associate their difficulties with measurable features of their growth paths. It would also be possible to investigate internationalisation issues from case study evidence. Burgel et al. have usefully pointed to attributes of firms with a successful internationalisation record [Burgel et al. 2001]. The move into export markets often makes heavy demands on new firms' resources and competences, but sustained growth often requires this move in highly specialised high-tech fields, as has been demonstrated by Burgel et al. [2000]. Growth interruptions may relate to

co-ordination difficulties of expanding operations in new markets. Future work could investigate growth spurts and reversals in relation to this issue.⁵

⁵ In future work, dissimilar pressures to achieve rapid growth could be related to uniqueness of technological resources. Delays in growth are a greater threat to firms whose technologies offer only a short window of opportunity, pressing them to obtain new resources rapidly, as found by Burgel et al. (2000, p.13). Firms with a longer window of opportunity created by their unique technological resources “seek to realise productivity gains with existing staff resources” (Burgel et al. 2000, p. 13). This demonstrates resource economy of the kind found to promote further growth of competence among our case studies, suggesting the hypothesis that unique technological resources can produce positive feedback effects. Exploring the impact of such pressures requires investigation beyond the scope of this pilot study.

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