

## Centre for Technology Management

### **Growth Setbacks in New Firms**

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## Abstract

This paper examines setbacks in the early growth of new firms. Growth interruptions mark the unfolding, cumulative processes of firm growth overlooked in standard studies that use cross sectional methods. To probe for possible patterns in growth setbacks, we examined a cohort of 200 high technology firms founded in about 1990 and analysed the growth paths of survivors. Simple compression techniques yielded seven types of growth turning points. Growth setbacks are the norm even among firms with better growth records. Growth crises can be represented as a shift in phase state. To understand what such a shift implies, we focus on the micro-evidence relevant to processes of firm growth and illustrate growth crises from case studies. Growth crises represent both limits to knowledge and the means by which knowledge is revised and learning accelerated in the firm.

## Keywords

*Growth; Setbacks; Cambridge; Technology-based Firms; Employment; Limits to Knowledge; Learning; Cohort Study; Complex Adaptive Systems*

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## Introduction

*New technology based firms “are business experiments, founded on conjectures that may or may not turn out to be valid. Their fortunes are inherently unpredictable...”*

[Metcalfe 2000 p. 7]

Growth crises in new firms demonstrate the limits to practical knowledge and challenge our abstract knowledge. Are there recurring patterns in firms' early growth setbacks? Why do they occur and with what consequences?

Consider the following scenario. A new enterprise has been performing well, though only five years old. Its growth record is impressive, measured in terms of sales and revenues as well as employee numbers. Early success makes it possible to expand further through retained earnings and externally obtained funds. Resource providers view its prospects favourably. Morale is excellent among its members whose intensive efforts have contributed to the firm's performance and who have good prospects of rewards if this is sustained. One of its members has to take prolonged leave for personal reasons. Six months later he returns from abroad to find the situation transformed. Sales are down and unsold stocks have built up. The banks have withdrawn loan facilities. Creditors are demanding payment. There have been lay-offs and more are expected. The enterprise faces an enforced sell-out or bankruptcy.

A sudden shift in phase state is typical of complex dynamic systems where the effects of change are not additive. As interlinked elements alter at the micro level, they have knock-on effects which can shift the internal coherence, structure and performance of the whole system, sometimes quite rapidly. Firms are subject to complex dynamic processes. Growing firms experiencing setbacks are liable to crises through the amplification effects of feedback. The prevalence of setbacks is a measure of new firms' vulnerability.

Cumulative processes inherent in firm growth cannot be tapped by the cross sectional methodologies dominant in the literature. For example, the Confederation of British Industry (CBI, 1997) study of high performance high technology firms in 1997 took as its criterion for inclusion among Tech Stars (fast growth firms) those reaching £1 million turnover within three years. But this encompasses a group of firms highly heterogeneous in their activities, with diverse resource endowments and requirements, about which it is difficult to make meaningful generalizations as to the achievement represented by a given level of turnover.<sup>1</sup> However, this choice of indicator did indirectly acknowledge that the more common use of firms' rate of growth over a few years is an inadequate measure of a young firm's cumulative achievements, which are not captured in many 'fast track' indices and aggregate studies based on growth rates.

In this paper we investigate interruptions in the early growth of new firms, viewed as a challenge to knowledge and practice. In the first part, we ask why the issue has not been addressed directly in the mainstream literature on firm growth. There is extensive indirect evidence of early growth interruptions and reversals in quantitative research, while case studies provide direct evidence. To probe for the prevalence of growth setbacks, in the second part of the paper we examine a cohort of 200 high technology firms founded in about 1990 and analyse the growth paths of survivors. Simple compression techniques reveal patterns and turning points in the firm's growth paths.

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<sup>1</sup> Resource requirements and availability for a given type of activity, and extent of outsourcing should be taken into account when assessing the achievement represented by growth of turnover.

Setbacks are the norm even among firms with a largely successful growth record. In the third part of the paper we focus on micro-evidence on growth setbacks since it is at this level that causal factors can be ascertained.

## Growth Setbacks in Rapid Growth Firms – a neglected issue

Rapid growth ventures are the favourites of investors and policy-makers. They are equated with the elite group of firms that offer massive returns on investment and from which the major employment-creators will be drawn. Fewer than five per cent of new ventures are reputed to provide investors with ninety percent of their returns. Fewer than five per cent of a cohort of new firms create over fifty percent of jobs ten years after start-up [Storey 1994; Kirchoff, 1994]. Fast Track Indexes are compiled to identify these fast growth favourites [Storey, 1997; Virgin 100 Fast Track Index]. However, rapid growth databases do not follow the subsequent progress of their early prize winners. Typically they track only three or four years' recent growth. But more firms achieve fast track status for a period than become industry leaders and a large proportion of the early favourites later experience a decline in growth rate.<sup>2</sup> This includes UK companies identified as the ten per cent most successful and promising among over 7000 on the basis of their growth record.<sup>3</sup>

Growth interruptions and crises have not been directly addressed in leading studies on enterprise growth. For example the topic of growth interruptions and growth reversal is not included in influential studies of firm growth and development conducted by Bhidé 2000, Storey 1994, Oakey 1994, Kirchoff 1994 or Audretsch 1994.<sup>4</sup> Yet these are inevitable concomitants of the widely-cited figures on firms' aggregate growth performance which show that:

1. A minority of new firms survive at all beyond the early growth of their first five years.
2. A large proportion of surviving new firms fail to expand beyond a small size after a period of early growth sufficient to ensure survival.
3. Among the minority of firms with an early growth record, only a few firms sustain growth sufficiently to become industry leaders [Stanley et al., 1996; Baldwin, 1995; Audretsch, 1994; Kirchoff, 1994 Storey, 1994<sup>5</sup>].

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<sup>2</sup> Nevertheless, if more new firms grew to a higher average size, the employment consequences would be considerable.

<sup>3</sup> "It may be thought surprising" that a number of this elite "experienced very slow growth or even declining sales" at the end of the four year period during which they were studied. 14 per cent were classed as "temporary fast growers" on this basis [Storey 1997 vol. 2 p. 6]. Had the sample extended beyond the top ten percent and over a longer period than four years, it can be conjectured that the proportion of "temporary fast growers" would have been higher than 14 per cent.

<sup>4</sup> Some authors acknowledge the volatility of growth performance: "The 1980s saw many firms show spectacular growth only to be followed by precipitate decline." [Barkham 1996, p 4]. But this is attributed to external conditions.

<sup>5</sup> The most comprehensive evidence is presented by Kirchoff 1994. About 800,000 new US firms were formed in 1977-8, as shown in the Small Business Administration database. Sixty per cent of these firms terminated as a continuing unit within the first six years; these included most of the new firms that contracted in size. Many of the surviving firms were "plateau" firms (38 per cent of survivors showing no change in size) while fewer than half of surviving firms (46 per cent) showed growth in employee numbers [Kirchoff, 1994, p.184]. As regards employment creation, in the cohort as a whole, it was the four per cent of highest growth firms formed in 1977-8 that created 74 per cent of employment growth in the whole cohort of firms six years later [Kirchoff, 1994, p.186]. All available studies show that sustained job growth is concentrated in a small group of firms in a designated cohort. The longer the period studied, "... the more concentrated is employment creation in a small number of firms" [Storey, 1994, p. 118]. UK studies found that under five per cent of a cohort of new firms provided over fifty per cent of all jobs in those firms ten years later [Storey et al., 1987, p. 152; cf. Cosh and Hughes, 1996, p. 11].

Aggregate studies use predominantly cross sectional methods of analysis and do not examine evidence on firms' growth trajectories. Where panel data provide evidence by age of firm on survival and failure, this has not been used to examine growth paths or the timing of growth interruptions and reversals. Many studies have identified obstacles to growth, but in providing a disconnected list of obstacles and determinants, or classifying constraints by internal versus external causes, this literature does not address the causes of syndromes which drive growth crises. Interpretation of these data requires a conceptual scheme and evidence at the level of the firm.

In economic studies on Small and Medium-sized Enterprises (SMEs) there is an absence of explanatory models to filter observations at the micro level on growth interruptions and guide the framing of questions and interpretation of findings. Qualitative studies of firm growth in organisational studies have shown greater recognition of growth interruptions and crises than quantitative studies in industrial economics.<sup>6</sup> Some life cycle models of firm growth see transitions as marked by major growth problems. In particular, in a classic paper by Greiner, the new firm is viewed as going through a series of transitions, in which evolution alternates with revolution in a process reminiscent of punctuated equilibrium theories [Greiner 1974]. The transitions are marked by crises of growth. However Greiner's analysis was concerned with the transitions corporations undergo over the long term and paid only passing attention to early growth crises. These are of particular interest because of their onset while conditions are formative and the new firm is vulnerable. They can have a critical impact on firm survival and emergent industry leadership.

The managerial literature on stages of growth has been subject to considerable criticism [Storey 1994; Bhidé 2000]. These critiques have overlooked the extent to which early problem-solving has sequential dimensions in the new firm. Though stages of growth are not invariant, new firms go through early developmental processes [Garnsey 2001]. A drawback to growth stage theories is the absence of a theory of the firm or its co-evolution with others. This has reduced the contribution that the study of internal transitions might have provided to other work on firm growth.

In conventional economic theory on firm growth there is still "... no notion of an internal *process* of developments leading to cumulative movements..." [Penrose 1959 p.1]. The resource-based approach to the firm, increasingly influential in the strategy literature, avoids many of these shortcomings. Penrose viewed firm growth as "a process of development ... in which an interacting series of internal changes leads to increases in size accompanied by changes in (firm) characteristics". Quantitative economic studies on firm growth lack the holistic concept of the firm adopted by Penrose.<sup>7</sup>

Aggregate data on firm growth are relevant to establishing whether typical growth paths can be identified and how common these are. These are needed to situate the experience of growth setbacks in particular firms. We wanted to trace the measurable "tracks" of firms' growth over time, since firm growth is path dependent and reflects cumulative processes. Turning points or inflexion points in a firm's growth are of particular interest as evidence of growth setbacks.

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<sup>6</sup> Crises of growth among firms are even viewed as inevitable in some qualitative studies [Slatter, 1992; Kotter and Sathe, 1978].

<sup>7</sup> The Penrosean approach is congruent with critical perspectives on complexity [McGlade, 2001]. The emerging firm can be viewed as a complex dynamic system, shaped by initial conditions, growing through path dependent processes, active in a turbulent environment and so subject to chance perturbations [Garnsey 1998]. The firm is activated by agents whose cognitive maps of their own system and its environment motivate their actions.

A broader methodological concern is to find ways to align studies of internal growth processes in new firms with aggregate studies of new firm growth patterns. In what follows, our aim is to signal the relevance of studying growth as a cumulative process and to indicate on a preliminary basis how this can be achieved even with limited data, as well as to identify typical turning points in firms' growth paths.

### Mapping the growth paths of a cohort of new firms

There are of course many indicators of firm growth: in terms of inputs (employees, investment funds), outputs (sales, revenues, profits) and valuation (assets, book value, market capitalisation). These measures move out of alignment with each other but the divergences among them are in themselves revealing.<sup>8</sup> Despite their limitations as measures of firm development, employee numbers, the most commonly used indicator, do offer comparable data on the rate and direction in which a firm has been expanding. Comparative growth rates, using any measures adjusted for relative size, obscure the paths that firms follow over time<sup>9</sup>.

To trace new firms' growth paths we required time series data for cohorts of firms over a ten-year period or so. We used a database of high technology firms in the Cambridge area<sup>10</sup>. There was a good deal of turbulence as firms were formed and closed over the ten years (Figure 1).

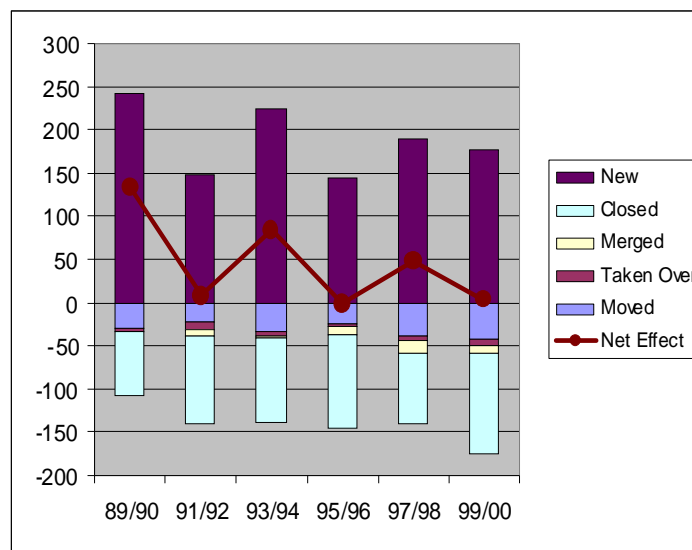


Figure 1 - New, Closed, Merged and Moved Firms 1989-2000<sup>11</sup>

<sup>8</sup> Subsequent work will incorporate data based on a variety of growth measures. Here we draw on available data on employment for a population of high technology firms, and on sales data from case evidence below.

<sup>9</sup> For example: The David Birch Employment Growth Index [Birch, 1987] corrects for firm size by employing the product of absolute growth and percentage growth. However, by reducing growth to a single index it completely obscures the path over which the growth takes place.

<sup>10</sup> Cambridgeshire County Council records on the population of high technology firms in the county were used to create a database derived from biennial surveys of employment in local firms. While employee numbers have certain disadvantages as a growth measure, they are a standard measure. The relationship between employment numbers and financial measures varies by sector, for instance, service-based firms tend to have lower turnover per employee than firms which generate revenues from the licensing of Intellectual Property. However, since the focus here is on changes in size rather than absolute size, the differences are unlikely to have a significant effect on the analysis.



However, the analysis of survival or hazard rates (Figure 2) showed that this population of Cambridge high technology firms had a relatively good survival performance. Around 25 per cent closed within the first four years, a period of early vulnerability during which many studies show around half of a cohort ceasing to trade. The closure rates for all cohorts of Cambridge high technology firms over a decade (45 per cent) compare well with hazard data from other studies. Storey [1994] reported 60 per cent of all-sector UK firms ceasing to trade over a decade. Slatter [1992] reported failure rates for high technology firms in the USA of around 66 per cent over ten years. Kirchoff [1994], also in the USA, reported 70 per cent failure over eight years.

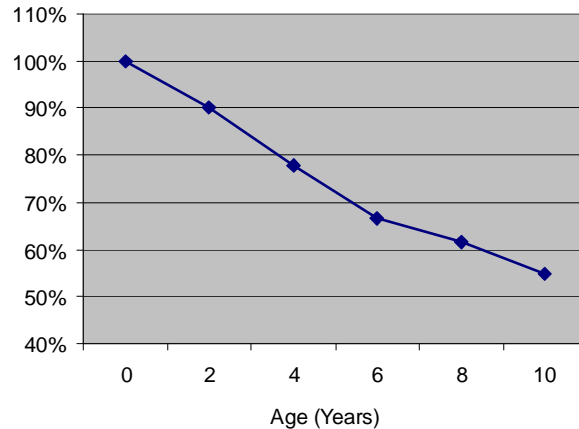


Figure 2 - Survival of Cambridge High Tech Firms 1989–2000<sup>12</sup>

Thus, in examining the growth paths of surviving firms in this cohort, we are looking at the more successful group of firms within a population with good survival rates, though none of the firms show outstanding growth.<sup>13</sup> From the available data, we have no reason to expect this group of firms to be unusually prone to growth interruptions.

In principle, there could be as many paths as there are firms, since every firm is historically unique. Figure 3 shows growth paths of individual firms which survived over a ten-year period to illustrate these variations.

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11 Calculated from Cambridgeshire County Research Unit (CCRU) records.

12 Calculated from CCRU records.

13 A number of Cambridge firms had achieved very high levels of capitalisation by 2001, but the licensing business model of a firm like ARM does not entail high levels of local employment – 58 per cent of firms employ less than ten people and less than one per cent employ 1000 or more. Analysis of growth in terms of other growth indicators awaits further data collection and database enlargement.

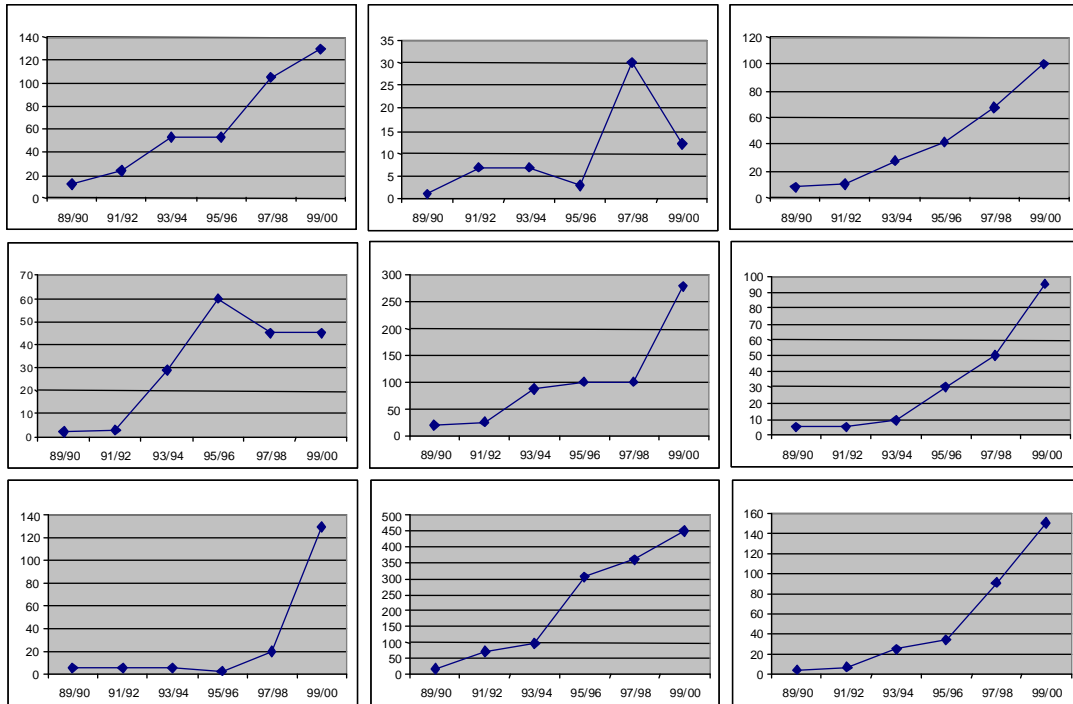


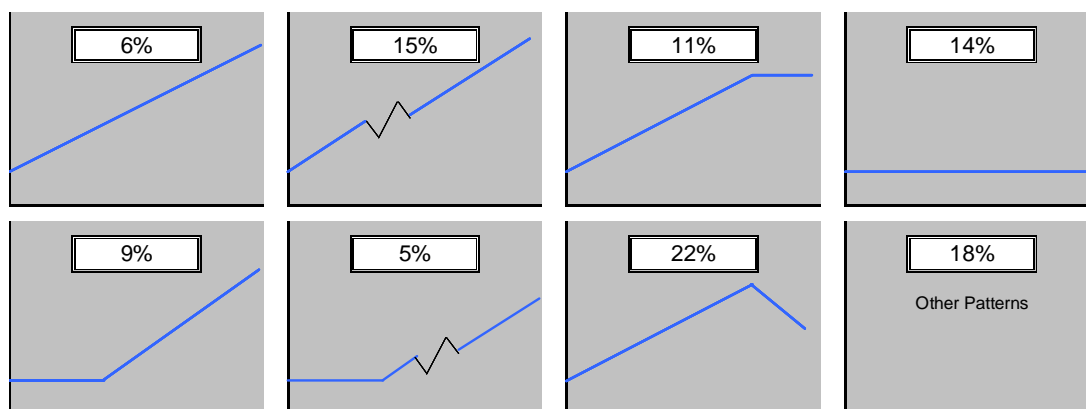
Figure 3 - Growth Paths of a Sample of Cambridge High tech Firms started 1989-1990<sup>14</sup>

We examined the data on an exploratory basis to see if it was possible to summarise trends without losing relevant information on comparative growth paths. In particular we wanted to identify growth interruptions and other patterns relating to turning points in the firms' growth paths.

The data points making up the growth paths provide information that can be compressed in ways that are informative.<sup>15</sup> For the 93 high technology firms that survived over ten years and remained in Cambridge, out of the 237 founded in 1989 and 1990, the compressed growth path data formed seven types as shown in Figure 4.

<sup>14</sup> Calculated from CCRU records.

<sup>15</sup> The data were compressed in two ways. First, interval scale data were reduced to nominal scale by converting employment level to direction of change from previous period. Data-point paths were coded for growth reduction greater than 5 per cent, for increase greater than 5 per cent, and for change in either direction of less than 5 per cent. In a subsequent compression, the resulting measures were coded according to key turning points in evidence. Growth paths are categorised by dominant turning point(s), presented as archetypal growth paths in figure 3. The Seven archetypes accounted for over 80 per cent of the firms' paths.



100% = 93 firms founded c.1990 still active in Cambridge area in 2000 (analysis of CCRU records).

Figure 4 - Common turning points in growth paths of Cambridge High Tech Firms

Only six percent of firms grew continuously over the ten years, with another nine percent growing continuously after a delay or preparatory period, though another 20 per cent recovered impetus after growth interruptions. Table 1 summarises the information in Figure 4 on 'growth paths' classed by turning points for the 93 firms formed around 1990 which survived ten years and remained in Cambridge.

n=93					All		
Growth Path Type							
	Continuous	Interrupted	Curtailed		No Growth	Archetype	Other
	6%	15%	Plateau	11%	14%		
Delayed Growth	9%	5%	Reverse d	22%			
<b>Total</b>	15%	20%		33%	14%	82%	18%

Table 1 - Proportion of 93 Cambridge High Tech Firms Surviving Ten Years by Growth Path Type

Interruptions to growth included not only stalled growth but periods in which growth declined. Not shown in the table is that reversal accounted for 79 per cent of the fourteen cases of interrupted growth (40 per cent of the five cases of interrupted growth following a slow start). Among the firms that survived ten years, over half (54 per cent) had experienced some growth reversal (including firms not fitting the archetypes), while 37 per cent had not recovered to their previous size level after a period of growth reversal.

Firms that did not grow were less likely to survive. Figure 5 shows that as the cohort of firms aged, the survivors included fewer firms that had not grown (40 per cent after 2 years to 20 per

cent after ten years). This is consistent with Kirchoff's findings for high technology firms [Kirchoff 1994 p. 184].

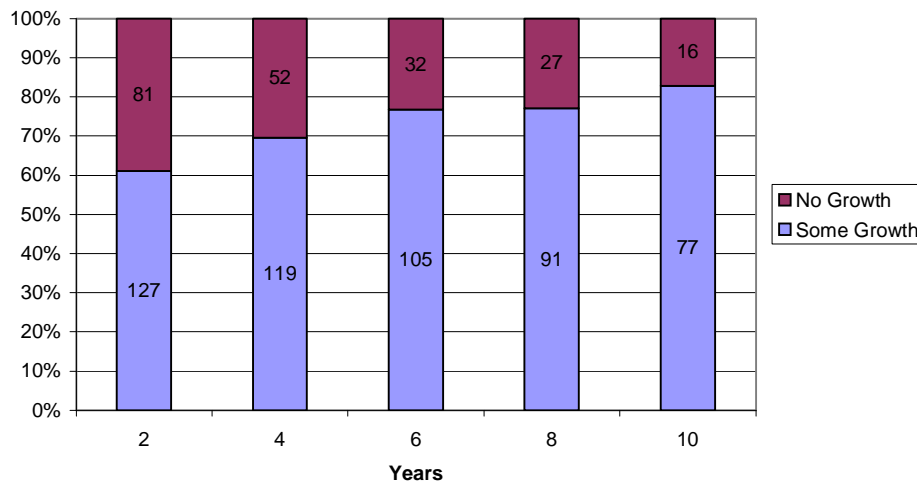


Figure 5 - Growth and No Growth by Age of Firm – 1990 Cohort<sup>16</sup>

It is possible that in some firms the decision to lay off employees would have been planned and desired, e.g. through the sale of a division. But the evidence on the ill effects on survival prospects of failing to grow (Figure 5) suggests that most firms would not have intended cutbacks that increased their vulnerability to closure. A proposition requiring further investigation is that most growth reversal is the unintended result of setbacks encountered.

Comparisons with other populations of firms await investigation.<sup>17</sup> The frequency of growth interruptions and their implications have been missed in mainstream studies which do not examine growth as an on-going, cumulative process. Thus standard studies of firm growth, which focus on cross-sectional data, have not captured potential findings relating to growth paths. We have seen that in this study, over half of the firms with the best survival record experienced growth interruptions and a third of these survivors did not subsequently recover to their earlier size. The implications of these growth paths for “Fast Track” indices and associated support and investment policies should be explored further.

To understand turning points of the kind revealed by the data, it is necessary to consider factors operating at the level of the firm. Focussing in particular on growth reversal, we can identify various elements of this syndrome from case study evidence. Space allows us only to examine two types of crisis which exemplify mistaken business conjectures and the limits to knowledge:

<sup>16</sup> The number of firms shown in Figure 5 includes 'other firms' which do not fit the seven archetypes.

<sup>17</sup> In an unpublished study carried out for the UK Department of Trade and Industry on the growth of 22 firms in a wide variety of sectors between 1987 and 1965, Hughes provides employment charts which show an early plateau of some kind for all but seven cases. There are two cases of continuous growth, four of reversal in employment (and another of sales reversal), one of recovery from interruption and the remainder moving onto a plateau, for the most part without significant growth. This sample is too small and industrially diverse to provide conclusions on growth paths, except to confirm the predominance of the early plateau revealed by larger samples [Hughes 1998 p. 75].

1. Firms with good prospects running down resource endowments until forced to close
2. Firms which, after an early growth record, hit difficulties which throw its growth into reverse.

### Exhausting early resource endowments

A firm which at the time of foundation is believed to have good prospects is well placed to obtain resources from investors. It can grow in terms of input-resources and assets (e.g. the value of premises or capital equipment) before it grows in terms of such outputs as revenues and profits. By attracting resources it is likely to be in a better position to grow than a firm that depends on its own internal funds and revenues for expansion. But it is also highly vulnerable to the terms on which resources were made available.

The future of any firm cannot be predicted with any degree of certainty and, for this reason, investment capital has traditionally been hard to obtain for new firms without a performance track record. Those that obtained funding reflected high hopes for a promising new technology or business model, but in the face of limits to knowledge about the future, they remain only hopes. For example, Anamartic, a UK semiconductor venture, obtained major support from venture capital on the promise of an exciting technology and promising business model [Garnsey and Wilkinson 1995]. Problems of developing their technology to the point where it could generate revenues in the absence of a strong management team undermined the firm. Figure 6 shows that its revenues failed to take off before its investors withdrew their support. This involved writing off over £20m invested in the venture.

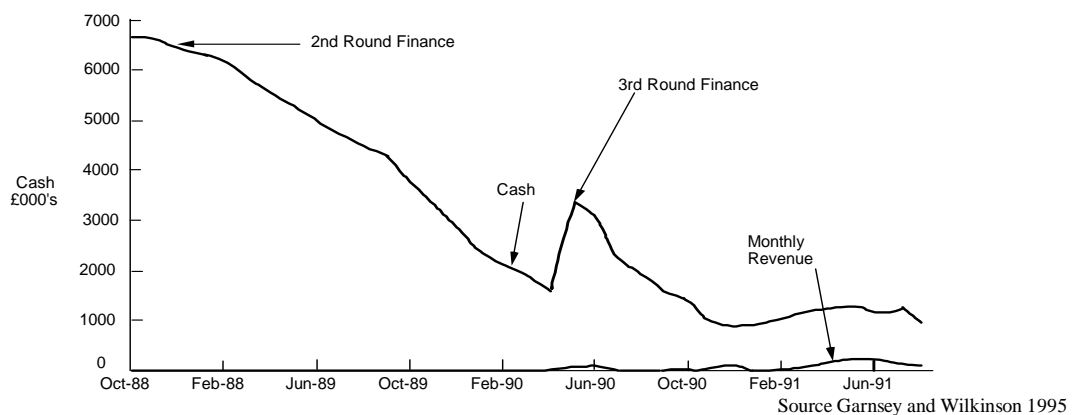


Figure 6 - Burning Anamartic's Resource Endowment

The CEO of another venture which exhausted its early funds, the hand held computer company, GO, succinctly expressed the dangers of accepting funds on the basis of making available equity in the firm.

*"How do you like our new offices?...Now we look like a real company...But we're missing one thing...Revenues...We look like a company, but we are only a venture. Ventures have investors, while companies have revenues. Every month we delay a revenue stream, we have to sell off more equity to stay alive. If we delay too long, the price of the equity goes down...eventually no one wants to buy..."*

[Kaplan 1995 p.93]

This was to be the destiny of his own enterprise. Many others were to repeat the fate of these start-ups even as a few successful enterprises were fuelling investors' appetite for returns from investment in high growth technology start-ups during the 1990s.

Kaplan depicted in 1992 exactly the crisis that hit Internet ventures in the speculative boom of the millennium. Firms enjoying a boom in share price were able to buy into real assets sufficiently rapidly to grow through acquisition.<sup>18</sup> But firms dependent on external capital are highly vulnerable to investor disaffection. If they do not meet early expectations, investors are likely to withdraw support in a self-fulfilling response to profit warnings. An enforced trade sale or bankruptcy may be the consequence of this collapse of confidence.

It may be thought that this was simply the outcome of the unique financial climate of the new millennium and miscalculations over the prospects for Internet ventures. But the danger to entrepreneurs of running out of resources had been recognised as endemic by David Packard seventy years earlier. Packard articulated the danger of accepting even bank loans in the view of the prospect of an unforeseen crisis.

*"I often helped my father in looking up the records of those companies that had gone bankrupt. I noted that the banks simply foreclosed on firms that mortgaged their assets and these firms were left with nothing ... The firms that did not borrow money had a difficult time, but they ended up with their assets intact and survived ... From this experience I decided our company should not incur any long-term debt. For this reason Bill and I determined we would operate the company on a pay-as-you-go basis, financing our growth primarily out of earnings rather than by borrowing money."*

[Packard 1995 p. 84]

It is to avoid the ill effects of dependence on outside finance that many entrepreneurs prefer to rely on their own resources. However, the concern with self-reliance leaves them resource-constrained and thus more likely to plateau early or exhaust their own resources. Even when the firm does not encounter a dramatic growth crisis, the fear of this outcome exerts an influence on growth plans and indirectly accounts for the large numbers of new firms that fail to reach the point where they can generate revenues, or which plateau early for lack of resources to maintain growth.

### Failure to sustain early growth record

Another category of firms that exemplify limits to knowledge and mistaken business conjectures grow rapidly, not only in terms of inputs, like the first group, but also in terms of outputs - revenues and profits - only to run into unexpected setbacks. In these firms, growth has fed further growth. But this process can have perverse effects when it creates resource shortages and synchronisation problems.<sup>19</sup> If key resources - people, components, premises - cannot be renewed at the pace required, output and productivity suffer. Bottlenecks create delays with knock-on effects.<sup>20</sup> These growing firms cannot coordinate the resources required. The cash flow crisis is a synchronisation syndrome; if cash returns do not come in fast enough to pay for

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<sup>18</sup> Growth through acquisition of other firms is also subject to Penrosean constraints: planning delays, delays before new staff become useful, constraints on decision-makers.

<sup>19</sup> See, for example, data analysed by Harrison and Taylor [1996] for the UK.

<sup>20</sup> See also Garnsey 1998 on growth crises of new firms, with examples.

outlays required by the pace of expansion, further productive activity can be halted by lack of cash.

Sometimes problems build up steadily and visibly - as a niche market becomes saturated, for example, the order book ceases to grow and no new sources of custom emerge. More insidiously, when rapid growth is underway, feedback may go undetected and reversals can occur unexpectedly as an essential resource is exhausted, as in our introductory example. All aspects of growth are interconnected; hence these difficulties may escalate before they are addressed. From a period of successful growth, the enterprise is suddenly faced with a reversal in its fortunes which may be so dramatic as to be akin, metaphorically speaking, to a shift in phase state, as in our introductory example. This is particularly likely to occur when industry conditions alter unexpectedly while the firm is overstretched.

Our introductory example described the experience of crisis at Acorn between September 1984 and March 1985 [Fleck and Garnsey 1988]. In this company, the entrepreneurial founders had been outstandingly successful, but were too inexperienced to interpret the evidence on their "business experiment" as the impending crisis built up. There had been a collective effort to gear up production to meet the expected 1984 Christmas sales peak, which they had missed in the previous year because of a shortfall in output, with the result that demand was deflected onto competitors. A shakeout in the microcomputer industry in the US and warnings of low order books and retailers' returns went unheeded. The shift in mindset required to change direction and cut back production was too abrupt. The assumption that the future will be like the past represents a common limit to knowledge.

The capacity of decision-makers to assimilate knowledge, co-ordinate and plan was identified by Penrose as the major internal constraint on growth. It also plagues attempts to turn around a company that runs into growth problems. Complexity greatly increases the knowledge those in charge have to assimilate, slowing the rate at which they can take considered decisions. What information systems exist within the young firm must be in a constant state of change to deal with the rapidly evolving internal and external environments. Co-ordination and planning, together with attempts to redress errors, require intensive effort by a select group of people - founders or leading managers who have the authority to take decisions for the firm.

Informal entrepreneurial leadership cannot cope as the firm grows more complex. New leadership requirements are accelerated under rapid growth. Professional managers from big business lack experience of the special problems of young growing firms. People who know how to institute efficient procedures cannot be brought on board fast enough. This underlies the statistics showing that relevant business experience among founders improves performance [cf. Oakey 1994].

These firms are subject to limits to intensity of effort.<sup>21</sup> In the start-up period, the unmistakable impact of individual effort is highly motivating, creating the new venture buzz. As the organisation grows more complex, communication problems set in. As routines develop, repetitive attention to detail is required. When the excitement of the start-up period fades and new procedures are experienced as constraints, motivation and commitment decline [Slatter 1992]. Overworked staff can suffer burn-out. Conflict and departures occur. This often results in competitive spin-outs of a new venture by former employees. Loss of key members of staff can be disastrous to firms which still rely largely on tacit knowledge. Crises are particularly difficult to overcome where the whole basis of the firm's activities have to be reconsidered [cf. Argyris and

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<sup>21</sup> This is another dimension of the sigmoid growth curves found in complex systems [Richardson 1991]

Schon 1978]. This may require the departures of founders and new forms of leadership which may take longer than circumstances allow.<sup>22</sup>

### Some examples

The impact of crises can be illustrated from four Cambridge high technology firms with an early growth record. These firms all experienced the kinds of problems examined above, but in three of the cases, these were exacerbated by their relationships with external resource providers.

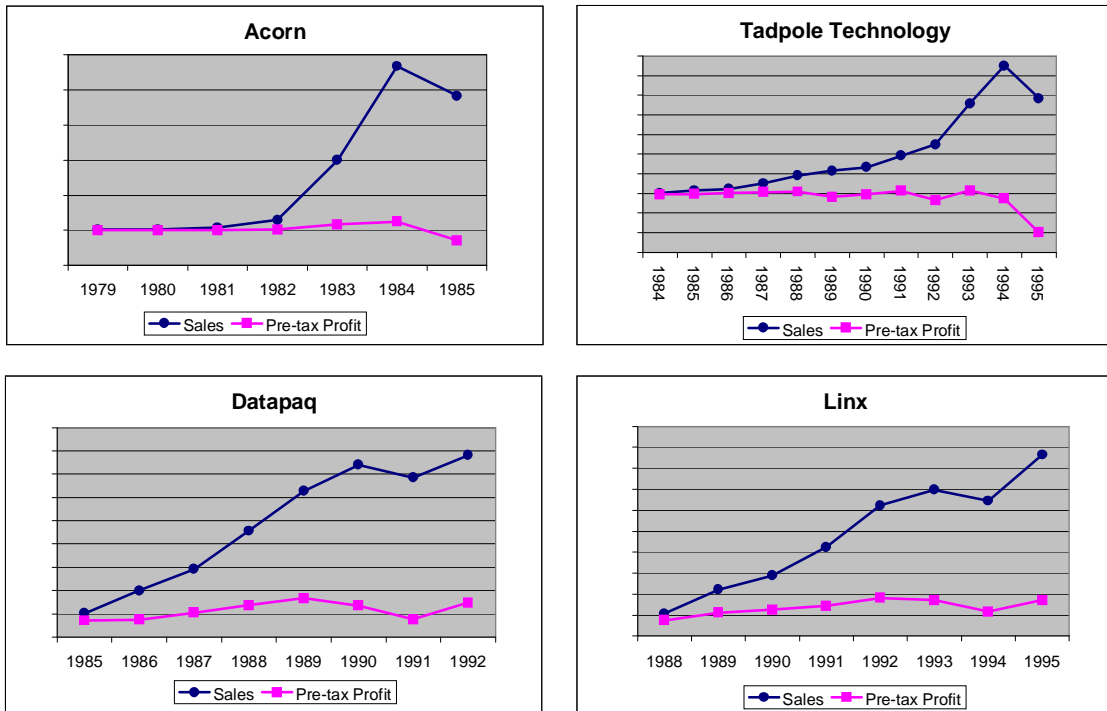


Figure 7 - Growth Reversal in Four Cambridge Firms

Tadpole Technology was founded in 1983. Figure 7 shows a steady increase in sales until 1991. The company achieved a full listing on the UK stock exchange in December 1992 and its shares became a favoured speculative stock for over 3,000 small shareholders. Its sales and profits grew rapidly to 1994, when they fell precipitously, just as occurred at Acorn in 1984-85 when demand for the BBC computer had not met forecasts and stocks had built up, creating a cash crisis [Fleck and Garnsey 1988]. Tadpole's share price slumped and trading was suspended in the wake of the announcement of pre-tax losses of almost £6m by 1995.<sup>23</sup> The pressure to provide venture capitalists with the chance to realise their assets in the venture had created strong incentives to turn to the stock market for funds. Prior to flotation, profits had been generated mainly in a niche market - the provision of specialist computer boards to computer companies, and the production of the SPARC notebook. The need to show substantial profits encouraged managers to move

<sup>22</sup> David Potter, the founder of Psion believes that early growth crises are a key learning experience. If the crisis does not destroy the firm, the experience "keeps entrepreneurs humble" and makes them more apt to go on learning (interview Dec 1998). This was also the experience at Oxford Instruments, as reported in a communication by the founder, Martin Wood.

<sup>23</sup> Financial Times, 12 May 1995.



into a broader market, with a new product, the P1000 notebook. This unfamiliar market proved difficult to penetrate and over-optimistic sales forecasts were made. A drastic sales shortfall, coupled with shipping delays on the SPARC product, had disastrous consequences. This sequence was a close repetition of the difficulties which had beset Acorn Computers ten years earlier.<sup>24</sup>

There are other under-documented examples. Datapaq Limited, a company producing thermal monitoring systems for industry, founded in 1984 was sold to the Quota group in January 1992 after a setback in sales and profits following early growth.<sup>25</sup> Datapaq's founders had accepted an early stage joint offer from two venture capitalists for an equity stake of 25%. This was considerably less than the sum they had needed. Their venture capitalists were in a strong bargaining position when a cash flow crisis occurred in 1991. Additional funds of £100,000 were made available, on condition that if the company was not sold within a year, the equity stake would be increased to 50%. Datapaq was acquired the following year and soon recovered its sales and profits under new ownership, which sold out a few years later for almost three times the sum earlier paid to the founders. Pressures to sell Datapaq were experienced as the result of a change in management at the venture capital firm. From the new fund managers' point of view, the investment of a further £100,000 to liquidate the investment was rational, as they would be assessed on returns generated by this £100,000. The precipitous decline in sales made it impossible for the company to generate the profits or external resources required to sustain growth, and as at Acorn, this was followed by acquisition.

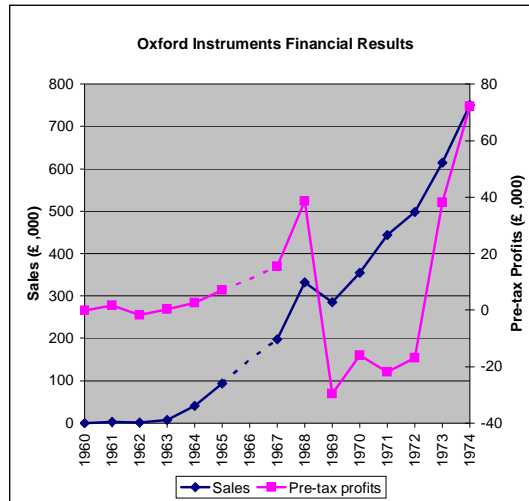
Tadpole was unable to find a purchaser and struggled on without regaining its growth impetus. Linx Printers, however, recovered after a brief period of sales decline and retained its independence. This company did not run out of cash, incur heavy supply costs or lose the confidence of their investors in the manner of the other three companies in Figure 7.

A better known instance of decline and recovery, at Oxford Instruments in 1967, points to a common feature of the growth reversal crisis among UK high technology ventures, over a thirty-year period [Garnsey, 1998; Wood, 2000]. After a period of successful growth, management and technical problems overwhelmed the young company, leading to pressure from their bank to sell the company. A relatively small injection of funding enabled the founders to reorganise the company for recovery [Wood 2000].

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<sup>24</sup> Tadpole had no reserves to tide it over this crisis, in part because their lead investor had refused to provide any subsequent funding, and it was believed by some that they would have used any means to exit their investment. The refusal to provide a further round of funding resulted from VC objections to the make-up of the management team. Other venture capital firms took their lead from the current venture capitalist. This illustrates the extent to which prospects for a firm depend on their relations with key resource providers.

<sup>25</sup> London Business School Teaching Case on Datapaq, updated by interviews with founder and venture capitalist purchaser.



Source: data kindly provided by founder Audrey Wood

Figure 8 - Growth Setbacks Overcome at Oxford Instruments

These cases are presented to allow more detailed explanation than aggregate data provide for. But our aggregate data show that growth setbacks are sufficiently common and significant to require that growth models explain growth reversal as a predictable feature of early firm growth [Garnsey 1998]. They should not be treated as aberrations, as occurs when the firms which encounter setbacks are removed from samples used to track growth.

*External Relationships and Recovery from Growth Setbacks*

In explaining growth setbacks, we have identified internal dynamics and management problems as a common set of causes. But external relations are no less important. In each of these cases, the crisis was caused by delays or breakdown in resource recovery. When growth faltered, inputs were curtailed just when these were essential to restore output performance. The firms' dependence on their entourage of suppliers, funders, distributors and customers is intensified by a cash crisis.

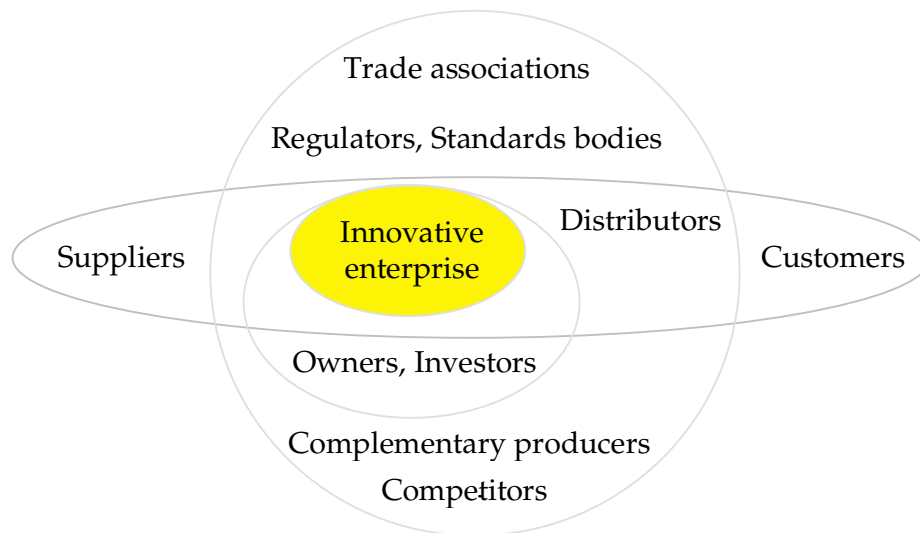


Figure 9 - The Firm's Entourage

In none of the cases illustrated in Figure 7 could the firms have resolved matters on their own. Those firms that had failed to establish cooperative relations such that funders, suppliers or customers were prepared to help tide them over the crisis were unable to retain their independence. The firms cited that recovered without losing their independence, Linx Printing and Oxford Instruments, had created relationships with external parties that saw them through their early growth setbacks. However, external funding is insufficient to ensure longer-term recovery unless the companies that negotiate a reprieve are able to reconfigure their activities to alter the internal conditions that contributed to the crisis.

### *Monitoring Throughput*

Private sector firms in a market economy operate as dissipative systems, that is systems engaged in a continual exchange of energy with their environment. When they require a continuous flow of resource inputs because they have no reserves, new firms are highly vulnerable. Delays or bottlenecks in the production and exchange processes can deprive them of the cash they require to sustain productive activity. Moreover new firms often lack sufficient knowledge of resource flows through their own system and cannot yet interpret signals from their entourage. Creating and responding to indicators which monitor resource flows is a first step to obtaining the knowledge they need. A classic growth crisis was described by Chandler (1962) in the case of General Motors in 1911. This account of Durant's shortcomings could have been written about entrepreneurs at Acorn Computers in 1984.

*"In carrying out expansion...he never prepared for nor hardly even considered possible a temporary decline in demand and so failed to build up his cash reserves. He made no attempt to collect information about output and demand in order to make adjustments in production that might prove necessary. Nor was he interested in building an organisational structure to give him information about and control over his operations or to help him achieve potential economies...As a result...when sales dropped below scheduled production he lacked funds to pay his suppliers and work force..."*

It takes only minor perturbations to block the inflow of resources in irrecoverable ways. Unless they have the knowledge required to anticipate and monitor resource flows, new firms are in danger from unexpected setbacks before they can take action to avert them. Creatively devised throughput measures, specifically designed to link the firm's internal resource flows to changing market conditions are needed. Knowledge of this kind can enable firms to change direction in time, as described by the CEO of Intel in relation to the crisis that gripped Intel in 1985. They were able to shift from memory chips into micro-processors in response to information on changing margins and demand (Grove 1988).

## Growth crises that reflect industry evolution

### *Scalar effects and emergent properties of new industries*

Our analysis highlights how rare it is for new firms that grow substantially. Those few new firms in which growth reinforces further growth, for a variety of path dependent reasons, may sustain outstanding performance despite being in an industry where average profits are "unattractive". The skewed distribution of firm size found in many sectors where large firms are scarce and small firms very plentiful does not fit the prediction that firms in a given industry can be expected to grow to the optimal size for that industry. The presence of only a very few highly successful outliers reflects the way that firms operate, as dissipative systems that are vulnerable to failure, especially in their early years. Firms that overcome initial problems and achieve an early growth record are also unusual, even when this performance is not sustained. The entry of further new

firms of small size and attrition rates that prevent more than a few reaching substantial size shape size distribution of firms in a sector. Ten years after a cohort of firms start up, their size distribution is highly skewed, with large numbers of them remaining small, fewer reaching medium size and very few having become large firms. The skewed size distribution of firms is spatially scale invariant; it is found in the local distribution of firms and at the national level. The larger the size of the firm, the smaller the number of firms in that size category. Distributions that follow a power law are a feature of complexity [Buchanan, 1999 p.40].

Many attempts have been made to discover whether internal or external factors make a more important contribution to new firm growth. The mainstream literature is divided on the relative importance of internal and external factors on growth prospects for a firm. The approach associated with Porter holds that the key factor promoting new firm growth is attractive levels of profitability in that industry [Porter 1991]. However other studies have provided evidence showing that internal factors are more important than external factors in explaining successful growth [Hughes 1998; Stanley et al 1996]. A recent study on firm versus industry effects on profitability has examined the performance of exceptional firms in relation to average performance for that industry. This study provides support for the idea that the non-Gaussian distribution of firm size in most industries could make it difficult to distinguish firm from industry factors contributing to growth in standard variance studies:

*"A significant proportion of the estimates of the variance of firm-specific factors in our study is due to the presence of a few exceptional firms in an industry: the two firms that outperform their industry and the two that under-perform in comparison with the rest. The majority of studies show that firm-specific factors were more dominant than industry effects in explaining firms' profitability. But new data show that only for a few dominant value creators and destroyers do firm specific factors outweigh industry specific factors."*

[Hawawini et al 2000]

This might be taken to mean that the majority of firms in an industry are subject to the ebb and flow of industry trends, while a few outstanding or incompetent managers steer paths to exceptional gains or losses respectively. However, an industry, as a complex dynamic system, has no separate existence from that of its constituent firms, and its properties emerge from the activities of those firms, which in turn are the result of the actions of the individuals employed within them. These properties include patterns of adoption of dominant design and the development of interactive protocols and other industry standards over time, which impinge back on the constituent firms in the industry. These developments undoubtedly exert strong industry level influences on the growth and prospects of individual firms. Strategies are devised and modified in the light of the firm's objectives and in response to industry and market factors which are influenced by the firm and its entourage. The firm and its industry therefore co-evolve, each influencing and being influenced by the other. If firms create the industry in which they operate, it is not surprising to find that the performance of the majority is in line with the industry average. There is circularity in the debate as to whether firm or industry factors are more significant in determining performance since there are close linkages between internal and external factors. Co-variation among firms renders interpretation of the results of analysis of variance problematic. Averaging out effects at the lower level of aggregation does not reveal what is bringing about aggregate effects that are emergent (relational) properties at the higher level.

The growth process of new firms is closely linked to the evolution of competition in new industries, where pioneering firms can have a formative influence. They may be able to take on

technological leadership, shape standards and pre-empt key assets. Through co-evolution, firms impact on each other as competitors or providers of complementary output [Hugo and Garnsey 2001]. Outstanding new firm growth is associated with pioneering firms drawing early mover advantage from the expansion of new sectors and industries. But pioneers are subject to the hazards of uncertainty in an emerging industry without accepted protocols or standards. For many industries, after a period of early growth, a shakeout of firms occurs and consolidation takes place [Klepper and Graddy, 1992]. The firms shaken out are often those that failed to lead or back emerging technical standards in the industry. To do so requires awareness of moves by competitors, complementary producers and standards regulators (fig 9). New firms growing in new industries are particularly vulnerable to this shakeout. A major factor limiting sales expansion for Acorn Computers was its proprietary operating system, incompatible with the rapidly diffusing MS-DOS standard.

Attraction is exerted by technical standards because of the extent to which these facilitate exchange and interaction between users and joint solutions to production problems among producers. In a networked industry, such as communications and IT, in which users and producers are in close interaction, standards are likely to emerge early. In industries with interactive products and services, standards operate, as it were, as basin of attraction, drawing in most firms in the emerging industry through adoption of common standards. Those firms that fail to adopt the standard remain on the periphery of the industry and are particularly vulnerable unless they create for themselves a secure niche. It is unclear early on which standards will come to dominate. This creates advantages to second movers who head for the emerging standard, avoiding non-standard variants. But a few exceptional first movers are able to install very high switching costs, protect their IP, and so lock in customers.

### *Overheating and Growth Reversal at the Industry Level*

Just as individual firms may make mistaken conjectures, so large numbers of firms may miscalculate as new developments in an industry emerge. For example, in telecommunications a 'consensual vision (or cognitive framework)' shaped the thinking and decision making that drove the Telecoms Boom from around 1996-2000. (A 'vision' or cognitive framework consists of an interrelated set of beliefs, embodied in assumptions and expectations, which serve the purpose of making the world seem intelligible and therefore orienting decision-making' [Fransman 2001 p.9]. The central notion in the case of the telecommunications industry was that there would be 'explosive demand for bandwidth.' However the saturation effect of the usual sigmoid diffusion curve for new technologies had not been taken into account, so that though there was increase in demand it was less than was forecast under the optimistic assumptions of the 'consensual vision'. Nor did this vision take into account the increase in supply stimulated by current predictions of profitability. Barriers to entry had been dramatically lowered by modularisation and the commodification of telecoms components which made it possible for new entrants to configure innovative offerings (much as had occurred in PC peripherals). However these companies did not have control over unique intellectual property, making them vulnerable to the entry of further competitors and so lowering profitability.

There was a deficiency of information gathering and a lack of integrated analysis taking into account developments in the telecoms industry viewed as a dynamic system. But, Fransman points out, there was also inevitable interpretive ambiguity resulting from the uncertainty of future demand for bandwidth-intensive applications such as video enabled websites and conferencing. Just as individual managers may act in error as a result of the unpredictability of the environment they face, so a whole industry may engage in erroneous predictions. "Mistakes are an inevitable consequence of the irreducible uncertainty which always shrouds complex events such as those

which occurred in the Telecoms Industry in the Internet Age from 1996-2002 [Fransman 2002.33].”

What is striking about growth setbacks in a new industry is the extent to which individual actions taken in pursuit of individual interests produced in the aggregate unintended consequences which were desired by no one, viz falling profits and overcapacity. The unintended consequences of self-interested and atomised decision-making were not those assumed by Adam Smith. Since they are also employees, citizens and shareholder, any benefits consumers may enjoy in lower costs – here of telecommunications service provision – are cancelled out by the unwanted effects of recession.

The Internet boom and crash provides many examples of companies subject to runaway growth pressures and of subsequent reversal in growth among many of them at once. Such effects have been experienced before in history. During the railway boom of the 1840s, small investors crowded into the sector drawn by profits achieved by second round investors. These imitators had capitalized on the efforts of pioneering innovators, many of whom had made losses. The third generation of investors saw their funds engulfed in what Marx identified as a crisis of over-production. In the past, demand has eventually caught up with previous excess capacity in industries based on new technologies.

*“There was huge speculation in railway shares followed by a spectacular crash in 1845 even in the shares of those companies that would become giants of the industry in later decades. Then as now, stock markets found that pricing shares associated with an exciting new technology is extremely difficult, reflecting the considerable uncertainty about the value of the technology, both to the economy as a whole and to the shareholders.”*

(Baines et al 2001).

## Conclusion

New firms in emerging industries are subject to complex dynamic processes which defy attempts at prediction embodied in business conjectures. Academic specialisation does not currently encourage integrated and systemic analysis. The internal structure of firms and organisations is studied as a specialism distinct from the industry-level approach that prevails in industrial structure-based strategy studies and industrial economics. The literature is dominated by static rather than dynamic approaches at both levels. But entrepreneurs and managers do not have the luxury of specialisation. Entrepreneurial managers must take decisions in relation to both internal and external dynamics. The case studies illustrated the extent to which

1. There is insufficient information to understand the environment or for investors to understand the new firm with an emerging technology.
2. The pursuit of opportunities before entrepreneurs have the resources required to realise them makes them particularly vulnerable to uncertainty.
3. Firms require a very specific resource mix, and the timing of resource availability is critical. Even where growth draws in further resources, the pace of growth may outstrip the synchronisation of specialised resources, and the time, competence and knowledge of decision-makers.
4. Industries, like firms, may move abruptly from under to over-capacity.

In a volatile environment, many of the conjectures and experiments represented by new firms will be invalidated by events. If this occurs within the first few years of the new firm, before sustained

revenues and resource recovery are achieved, the new firm has no reserves to fall back on. Those encountering growth reversal are confronted with what amounts to a sudden shift in phase state, a sudden transformation from growth to decline, from shortage of stocks to inventory build-up, from confidence bred of success to fear and doubt. These changes are interlinked and demand a radical reconceptualisation of the firm's resources and opportunities. Those in charge of a firm in the throes of a crisis cannot solve these problems in isolation; they must draw on relationships with others in their entourage and reconfigure the wider flow of information and resources.

The prevalence of reversal after a period of growth has wider implications. Emphasis on rapid growth ventures and fast track stars diverts attention from the need to view new firm growth as an unfolding process in which the future cannot be extrapolated from the past. Variance based approaches have dominated the literature; more process based work is now needed.

For individual firms, crises are not always an unmitigated disaster. New and unexpected problems can challenge frames of reference and accelerate learning.<sup>26</sup> The overheating of whole sectors followed by slump provides an opportunity for public debate on objectives of growth and its costs. There is problem-solving to be done at the collective or policy level. Higher order decision-making can aim at counter-cyclical policies; industry-wide collective action may reduce uncertainty. Just as the lessons of growth reversal at the level of the firm call for reconceptualisation of business aims and direction, so accelerated growth followed by slump at the industry level call for a public reassessment of the direction and pace of industrial development and of the kinds of institutions and policies required to promote new objectives. Ultimately some new consensus on the aims of growth and its limits is needed to replace earlier unfounded conjectures.

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<sup>26</sup> Psychologists measure learning in terms of adaptive changes in behaviour undertaken in response to experience. [e.g. Evans, 1991]

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