

Early Growth and External Relations in New Technology-Based Firms

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Abstract

This paper develops further the resource-based system model of the early growth of new, technology-based firms. In many growth models the environment in which the firm operates is viewed as exogenous or as the theoretically residual category. Here we attempt to show how key environmental factors become internalised through the operation of the growing firm's external relations and resource dependencies. The resource-based system model developed by Garnsey (1996) is extended by an analysis of the influence of network relationships on growth processes and competence building. This type of analysis can explain the rationale for networking patterns which cannot be inferred from cross-sectional survey findings.

1 Introduction

In this paper we argue that a firm's early growth depends above all on effective external relations with other organisations. New firms can use their own resources for leverage, to secure a dynamic market position and enhanced capability. In recent years, theories of the firm have been actively debated in the microeconomic and strategy literature (Hart and Moore, 1990; Conner, 1991; Kogut and Zander, 1992; Barney and Zajac, 1994; Brynjolfsson, 1994; Foss, 1996a; Conner and Prahalad, 1996; Kogut and Zander, 1996; Foss, 1996b). This debate is of value to strategy and entrepreneurship research, as it focuses on the fundamental issues of the existence and evolutionary dynamics of firms. As Conner and Prahalad (1996) argue, any theory that seeks to understand performance differences between firms must incorporate a theory that addresses the question of why firms exist.

In the context of small and medium sized firms, effective performance is most often interpreted as growth: growth in sales, assets, number of employees, value added, and so on. As growth and profitability may actually have an adverse effect on each other, growth is the preferred measure of success among SMEs, whereas profitability measures, such as ROI and ROE, are more commonly used as a metric of success in large firms. We focus on early growth, which often makes or breaks the firm at a vulnerable stage of its existence.

The literature on the theory of the firm assumes a firm already in operation. Even Penrose's theory of the growth of the firm starts with a firm already in existence and examines the inducements to and constraints on growth rather than the process of start-up and early enterprise (Penrose 1995). It is in the practical management literature that the issues of stages of growth, including early growth, have been addressed (Greiner, 1972). However growth models in the management literature lack an explicit theory of the firm; the unit of analysis is taken as given rather than requiring a grounding in theory. This deprives these diagnostic models of the contribution theory can provide to the understanding of interlinked causal processes involved in small firm growth, which are not addressed by the description of variations in growth stages. A more explicit link between theory of the firm and models of growth could provide a common discourse unifying approaches to growth, competence building and strategy. Such an approach could help in identifying ways in which cumulative constraints are created internally and encountered externally, providing managers with a better basis for strategic positioning.

The theoretical foundation for such an approach is provided by the definition of the firm as a system of activity, an input output system operating in wider networks of production and consumption. The present paper develops a growth model that is based on the resource-based view of the firm, as originally put forward by Penrose (1959) and up-dated by systems thinking. It draws on the extensive literature on the resource-based (or knowledge-based) view of the firm stimulated by Penrose's ideas, building on the work of Garnsey (1996) and Yli-Renko and Autio (1996) for the 41st ICSB World Conference, Stockholm. The growth model developed by Garnsey is extended by a discussion of the influence of network relationships on growth processes and competence building, and on ways to exploit complementarities between firms to achieve growth. Growth plateau and growth reversal situations, largely neglected in existing models, are a focus of attention.

We begin by reviewing 'traditional' models of the growth of small firms and outlining their main characteristics. We go on to summarise the growth and network models used in the analysis. Finally, a revised model of the growth of new, technology-based firms is developed by integrating the network approach with the resource-based model of early firm growth. Further work is underway on the operationalization and empirical application of the revised model.

2 Traditional Models of the Growth of Small Firms

Numerous growth models have been designed to depict the development of small firms. Since Greiner's work (1972), and even earlier, a variety of growth models have been proposed. In addition to that of Greiner, well received growth models include the ones by Churchill and Lewis (1983), Kazanjian (1983; 1988), Flamholtz (1990), Scott and Bruce (1987), Kazanjian and Drazin (1990), and Eggers et alii (1994). The above models are all linear stage models, conceptualizing firm growth as a sequence of growth stages. Particularly in earlier models, the sequence of stages is predetermined. The early growth models are linear, in the sense that all firms are expected to go through the same sequence of stages.

The model by Greiner (1972) identifies five stages of growth and turbulent transitions between these. As a company progresses through developmental phases, each evolutionary period

creates its own revolution. The reaction to each revolutionary period determines whether the company will move into its next stage. In the model, the external factors determining the rapidity of growth transitions are industry growth rate and its profitability. Greiner was not concerned in particular with start up and early growth, with which he deals in passing.

The stage model by Churchill and Lewis (1983) is an application of the Greiner model to small firms. Growth is not considered to be the only alternative available for the firm, as the model recognizes also stages of non-growth or stability. In the model, such stages are presented as a kind of disengagement or failure. The situations of non-growth can be either caused by the small size of the industry segment or by the lack of growth motivation by the entrepreneur.

The Scott and Bruce (1987) model is an elaboration of the Churchill and Lewis (1983) model. The Scott and Bruce model takes a broader look at each growth stage, extending the discussion by considering managerial and industry issues in addition to the organizational issues considered by Churchill and Lewis. Similarly to Greiner (1972), Scott and Bruce identify crisis points between different growth stages, during which points the firm is more likely to fail.

The model proposed by Kazanjian (1983, 1988) represents a special application of the stage model approach to technology-based firms. However there are no major departures from the more general growth models. The model comprises four stages, each associated with dominant problems typical of the respective stage. Kazanjian's model conceptualizes growth largely as production intensive, with the problems in the main growth phase arising from scaling up production and sales capacity to build up market share.

In a later work, Kazanjian and Drazin (1990) linked stage models to contingency perspectives in management. The central thrust of this discussion is on the fit between the growth stage of the firm and the design of the organization. They propose that decision-making centralization and formalization as well as functional specialization define the management processes that need to fit each growth stage. A similar approach can be found in the study of McDougall et alii (1994), in which industry conditions are conceptualized as the contingency with which strategy has to fit to produce an above average performance.

Recently, Eggers, Leahy, and Churchill (1994) have revised the original Churchill and Lewis model. The new model allows for stability of the organization as a third stage, thus no longer taking growth aspiration as granted. As a result the possible number of stages is expanded to six. Moreover, the authors have relaxed the linearity of the model. They recognize that a firm may skip one or more stages during its growth. They also identify situations of growth reversal, in which the firm may slide back to a previous stage. As a result the 'stages' of growth should be considered as constituting configurations of the firm rather than as a predetermined sequences that all companies have to go through.

The above discussed models share a set of common features:

- 1 they are stage models, identifying stages of growth and transitional periods between these
- 2 they all emphasize the fit between the design of the organisation and growth stage; growth is considered to distort the balance between the design of the organisation and the stage of growth, and the task of management is to restore this balance; in this sense, the models

- reviewed are also metamorphosis models, as the organisational configuration of the firm needs to be changed for each stage
- 3 growth orientation itself is seldom questioned in the earlier models; later models have started to recognize that not all new firms are growth oriented and the linearity of the models has been relaxed
 - 4 the organisational growth models acknowledge the importance of external conditions but do not incorporate these as theoretical components of the conceptual scheme; rather they refer to environmental contingencies as external conditions to which the firm must adapt; the rate of growth of the industry is one such parameter influencing the speed of growth; however, the descriptive focus of the models is what goes on within the firm

It is our view that it is necessary to find ways to build into a model with explanatory potential the mechanisms of influence connecting the industrial environment to the firm's growth pattern. The firm's environment impinges upon it via its relations and interactions with others in that environment - and through the absence of such relationships for the isolated firm. The firms interact with the customers for and distributors of its outputs, and with suppliers of inputs on which the firm depends (such as knowledge, labour, funds, material resources). Even competitors affect the firm through the relationships which constitute the firm's transaction environment or network, since it is through the pre-empting of customers, the disruption of relations, etc, that a firm experiences the forces of competition as conceptualised by Porter (1991). The firm, in turn, is able to influence its environment to a certain extent through its interactions with others in that environment (March 1981). This cannot be incorporated into a perspective on the environment as a set of external conditions to which the firm must adapt.

While the number of studies on small firms in networks is abundant, growth models using a network perspective for small firms are scarce. There has been no shortage of theorizing and empirical studies on the external relationships of small firms (e.g., Håkansson, 1989, 1990; Amendola and Bruno, 1990; Rothwell and Dodgson, 1991; Gemünden and Heydebreck, 1992; Autio, 1995), but no network growth models to speak of have been proposed. Many of the empirical studies take the perspective of innovation theory, focusing on technology and knowledge links between small, often technology-intensive firms and their environment. Thus, their approach comes close to the resource-based perspective, as technology constitutes the core resource of the firms. Explicit references to theories of the firm, especially to the resource-based perspective and agency theory, are made by Autio and Koskinen (1995). They do not propose growth or evolution models, however, but are concerned rather with the applicability of agency theory to new, technology-based firms in particular. Focusing on the internationalization process of small firms, McDougall et alii (1994) point to the lack of a unifying theory, and propose steps for developing a kind of resource-based theory of the internationalization of small firms.

In the present paper, we attempt to sketch out how relations with other agents in the industrial environment can be incorporated into a model of firm growth which emphasises the importance of shifting relationships for the firm as it grows.

3 A Resource-Based Model of the Growth of the Firm

The resource-based model of the early growth of the firm on which we build here includes as an explanatory factor the influence of external players on the firm's growth prospects (Garnsey 1996). In the following, this model is briefly summarised; reference to interdependencies and systemic feedback mechanisms are of special interest in relation to the integrated network model developed below.

Growth phases are symptoms of the dominant problems to which growth processes give rise, consequently phases vary in duration and extent of overlap. It is the problems and processes that are universal, not their phase manifestations. Resources must be accessed and mobilised in order to generate further resources if a firm is to become a system of activity with growth potential. (1) Founders go through a preparatory search phase of identifying matching resources and opportunities. (2) Once the founders embark on a viable course of action they must gain use of the required resources and set up a resource conversion process with revenue potential; this set of problems dominates the resource mobilisation phase. Sometimes it is necessary to return to preparatory work when resource mobilisation is unsuccessful. The problem-solving undertaken in the first two phases is put to the test as the resource conversion (production) process reaches operational stage. (3) In the resource-generation phase, problems centre around ensuring that the process of generating revenue on the basis of the firm's output is both operational and sustainable.

Incubated firms spin out of another organisation with a resource-generating process in place if, as a previous unit, they were already producing output or services for customers. In incubated or spin-out ventures, the need to access, mobilise and generate resources has already arisen. In spin-outs these problems may have been addressed before the boundaries of a newly incorporated firm are formed. Either way, when these early problems are solved, the firm reaches a minimum level of self sufficiency.

The challenges of sustaining resource generation overwhelm many firms, leading to closure or to a struggle for existence. Other firms move onto a plateau, either because entrepreneurs have limited growth ambitions or because they are locked in by unfavourable market relations. (4) However in some cases, growth reinforcement occurs and constitutes a distinct phase in which the problems surround how to use the forces propelling growth to good effect. (5) Growth beyond the capacity to be self-sustaining has its own problematic and sets off negative feedback effects which have to be overcome if growth is to continue. Growth reversal processes may be such as to create a distinct reversal phase. (6) The relative strength of the growth-reinforcing and growth-offsetting effects determines the firm's capacity for resource accumulation which occurs when the firm reaches maturity.

Structural factors and chance are at work, but both leave scope for initiative. Attributes of successful firms are likely to include foundation by a team rather than an individual, by founders who aim for growth and have qualifications and relevant business experience. These attributes increase the networking capacity of founders and their ability to match opportunities and resources and to develop production competence. The successful firm is likely to be innovative and secure market position by offering significant benefits to a growing set of customers. Its members build

partnerships and alliances to secure complementary assets and achieve market repositioning. In these ways they increase exposure to favourable demand and investment conditions.

Initial conditions and resource endowments incline the system in a certain direction, but the actual path taken is unpredictable because it is subject to contingent occurrences and the initiative of agents. Not all chance events are significant; only those subject to reinforcing or feedback effects which result from the internal dynamics of the firm and its external interactions. In growing firms, chance occurrences are significant when they bring about a change in perceptions that affects the ability to address and solve problems, when they make available or close off resources, when they initiate or alter key interactions and relationships.

Penrose (1959) recognised the unpredictability of specific growth paths but saw that growth involves certain common processes. She sought to uncover general incentives for and constraints on growth in established firms, and especially those that emerge within the firm. In extending her analysis, the model here uses the concept of the firm as an open system interacting with others in its environment to identify incentives and constraints which originate from the environment and those which form through the internal dynamics of growth.

Industrial structure sets the bounds of opportunity, but among the factors which make it possible to realise opportunities, the most important, as Penrose emphasised, are the perceptions of entrepreneurs and managers. Market aspirations and attitudes to finance are influenced by interaction with others in a common business culture and by incentives linked to the institutional framework. The perception by others of the firm's prospects is no less important. How many new ventures will seek funding on the stock market and at what stage of development is a function of institutional structures and economic conjunctures, together with the entrepreneurs' assessment of the risk-reward trade off.

Those entrepreneurs who do aim for growth are likely to encounter a number of the problems which are brought on by the very processes of growth. These factors include the increasing complexity of the firm as it grows. The mix of resources required for growth is very precise, and shortages of any one resource can create bottlenecks with knock-on effects. People with the right combination of skills and experience are the most difficult of resources to ensure for the growing firm, and the assimilation and motivation of staff can create serious difficulties. These are exacerbated if labour markets cannot provide qualified recruits, another institutional effect. As the firm grows there is increasing complexity in the information relevant to running the growing firm. The difficulty for decision-makers of assimilating and making considered judgements increases under conditions of rapid growth. Where reserves have been run down, delays and ill-judged decisions can bring growth to a halt. These problems cannot easily be remedied; decision makers in authority who have built up knowledge and experience of the firm cannot be obtained on the external market.

Factors stimulating and facilitating growth are the obverse of these inhibitors, and again internal developments are linked to factors in the wider environment. The drive and ambition of entrepreneurs is in no small part influenced by their cultural setting and the example and help of others. Sponsorship can provide forms of accreditation which can reduce the "liability of newness". Access to key staff and financial resources depends in part on training and labour mar-

ket conditions; funding is shaped by wider selection processes in the economy. Within these structures there is scope to obtain leverage from resources and to pursue external opportunities. As early problems are resolved, there is pressure to exploit the unused capacity associated with resource discontinuities for further growth, allowing members of the firm to build on past experience to enhance their competence and career opportunities. These internal pressures will be reinforced by external pressures in the growing firm, as funders, customers and distributors call for expansion. Growth reinforcement processes propel further expansion. However here growth may run into difficulties. Unless the firm is developing the capacity to integrate its new resources, respond to market discontinuities and synchronise expanding activities, the firm that earlier experienced successful growth is likely to encounter serious setbacks.


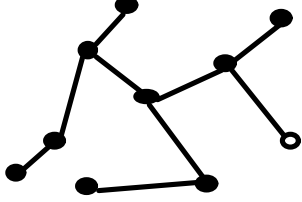
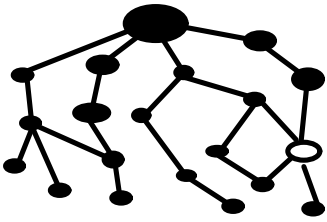
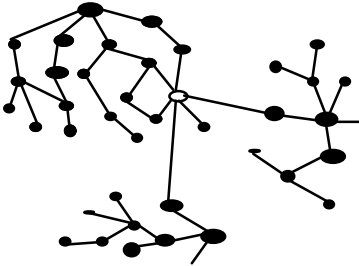
We have seen that key relationships with others have a major impact on the firm's growth prospects. We turn now to a model which analyses further the network in which a high technology enterprise operates.

4 Network Model of the Evolution and Growth of New, Technology-Based Firms

The “network model of the evolution and growth of new, technology-based firms,” developed by Yli-Renko and Autio (1996), looks at constraints on the growth of firms imposed by their systemic environment, as well as the growth opportunities provided by network evolution. In this sense, the model complements the resource-based theory of the early growth of the firm by Garnsey and work on innovative supplier relations (Garnsey and Alford 1996).

In the network model, the new, technology-based firm is viewed as operating in an innovation network or production chain. The model thus takes a systemic perspective to the evolution and growth of new, technology-based firms. The network, of which the firm is a part, both imposes constraints on and facilitates the evolution of the new, technology-based firm. The systemic evolution model of new, technology-based firms is presented in table 1.

Table 1 *Systemic evolution model of new, technology-based firms*

	<p>1 New, technology-based firm is founded</p> <ul style="list-style-type: none"> · a new, technology-based firm is founded as a spin-off or as a private venture to exploit new technological solutions
	<p>2 New, technology-based firm is linked to network or chain</p> <ul style="list-style-type: none"> · new, technology-based firm develops initial customer and other connections · some of these connections become intensive · new, technology-based firm starts to become embedded in an innovation network or a manufacturing chain
	<p>3 Cluster develops</p> <ul style="list-style-type: none"> · positive externalities develop in the network; development and growth starts to feed itself · many new, technology-based firms are founded · locomotive effect takes place · locking-in into paradigmatic technological stage · firm is manufacturing and or technologically embedded
	<p>4 New, technology-based firm is able to link into other networks and clusters</p> <ul style="list-style-type: none"> · new, technology-based firm has developed firm-specific distinctive competencies · new, technology-based firm has reached critical mass · it is possible for the firm to link into other networks and clusters and become less dependent on the initial cluster

The new, technology-based firm is held to be founded either as a spin-off firm or as a private venture. The technology, application, and the capabilities of the management team determine the potential of the firm to reach stand-alone growth. As most new, technology-based firms do not possess realistic potential for stand-alone growth, they tend to become embedded in an innovation network or in a manufacturing chain. In Garnsey's terms, the dominant process in this start-up phase is prospecting, to match resources and opportunities (*resource access*).

As the network is established, in stage 2, the new, technology-based firm becomes embedded in it, by developing relationships with customers, suppliers, research institutions, etc. *Resource mobilisation* takes place in the individual firm, and the firm finds its place in the network. Shifting to a more aggregate level, many new, technology-based firms are founded in the network, often but not always in proximity. Thus for individual firms there is the opportunity to grow with the network, in this third phase of the network model. At some point, a lock-in to a dominant design takes place. Positive externalities develop in the network. The expansion of the network starts to be self-reinforcing. The dominant process at the individual level for the new, technology-based firm in the network is *resource generation*.

The development of the cluster is often driven by a locomotive firm. The locomotive firm benefits from the technological network externalities, gaining competitive advantage over its competitors. It may expand through direct organic growth and by acquiring other firms. Dynamic complementarities are exploited between the constituent firms of the network.

In such a synergistic value-creating system, the new, technology-based firm develops distinctive competencies, to create value for its customers in the network. At this point, the new, technology-based firm is often very dependent on the locomotive firm and the development of the network. This has been observed in practice in many of Nokia Corporation's small supplier companies in the Finnish telecommunications industry.

The growth of the new, technology-based firm is facilitated or constrained by the network. To decrease this dependence, a new, technology-based firm may seek to establish linkages to other networks in new geographical or application areas. At this stage, the new, technology-based firm may be able to carry out this expansion, through a *growth reinforcement* process, having developed its distinctive competencies in the initial network. These firm-specific competencies make the new, technology-based firm valuable to firms in other networks. Also, with the growth of the initial network, the new, technology-based firm has reached the critical mass necessary for moving into new networks. For example, several of Nokia's supplier firms have expanded into international telecommunications markets or gained new customers in other industries, such as home electronics. Some of these firms may even become new locomotive firms themselves.

If, however, the favourable network evolution, as described above, does not take place, the new, technology-based firm may be trapped in its network position, with limited growth opportunities. It has not yet developed its distinctive competencies or reached the critical mass necessary for growth reinforcement. This situation is characteristic of a *growth plateau* or *growth reversal*.

Thus the network model is concerned with the systemic environment in which the new, technology-based firm operates. The model has strong resource-based characteristics, making it intellectually compatible with the resource-based model of firm growth developed by Garnsey, with which it shares a common Penrosian concern with competence and learning.

5 Partnerships for Resource-Based Growth

The growth models by Garnsey and by Yli-Renko and Autio take a systems perspective, emphasising the linkages between the firm and its environment. Garnsey's resource-based growth model illustrates the way in which dominant problems underlie each stage. External influences and relations with others are more likely to have an impact when they are subject to reinforcing or reversal feedback effects. The consideration of systemic feedback mechanisms constitutes an important addition to earlier growth models; it opens a way to addressing the effect of external relationships and contingencies on firm growth. In what follows, we attempt to construct a 'resource-based network model' of the growth of new, technology-based firms.

In examining the influence of external relations on the firm, we are in a position to refine the analysis of the environment. Instead of taking it as given, we include in our analysis various

contingencies which will influence the nature of relationships affecting the firm's growth prospects. In dealing with interorganizational relationships (IORs), we refer to analysis by Oliver (1990) of critical contingencies affecting firms, applying her approach to issues of growth.

In her extensive overview of research and theory on interorganizational relationships, Oliver distinguishes six critical contingencies (as italicised) affecting relationship formation. For small firms, *necessity* refers to the need of the firm to access external resources, a tenet of resource dependence and open systems theories. *Asymmetry* refers to the potential to exercise power or control over other organizations or customers. *Reciprocity* refers to balanced co-operation and to exploitation of complementary strengths between partners. In the context of small firms, *efficiency* refers to the pursuit of economies of scale through different mechanisms. *Stability* refers to predictability and to the reduction of uncertainty. *Legitimacy* refers to the demonstration or improvement of reputation, image, prestige, or congruence with prevailing norms.

In the following, incentives to set up partnerships at various stages in the firm's development path (Garnsey 1996) are examined. A summary table is provided at the end of the discussion, relating relationship formation to various growth stages, and to illustrate how critical contingencies, internal and external, affect whether relationships serve to solve or create problems for the growing firm.

A firm's position in wider production chains is clearly the most significant basis for its relations with other firms. Firms that are producing leading-edge products usually require close relations with sources of technological knowledge in the national or international research base. The nature of the product also affects the relationship with other producers. Certain products, notably in telecommunications and computing, must be compatible with other commodities because these products and services are only useful to the purchaser as an integrated product set, or require an infrastructure (Katz and Shapiro 1994). Diverse incentives to form alliances or produce in-house follow from the availability of internal competence and the systemic or autonomous nature of the firms' products (Chesbrough and Teece 1996 p. 73).

Resource Access

In the earliest prospecting phase, the potential market for the product and funding availability are key considerations. An alliance with a customer provides the basis for a realistic market position. Some new ventures spin-out of incubator organisations where the resource access and mobilisation phases were carried out. This enables them to move straight into the third phase of growth, where the dominant problems are concerned with establishing revenue-generating trade. Firms spinning out of other firms are also at an advantage if they have a lead customer. For example, the team in Logica that started up Vocalis, a UK phone software house, already had a contract with a large Swedish customer for call-control phone software when the spin-out from Logica was agreed. This made the start-up viable and provided the basis for extending a customer base. However at a certain stage, and especially if the parting was stormy, ties with the incubator are broken. The spin-out may be friendly, but the new venture may also enter into competition with its parent organisation. Either way, a relationship with an incubator

constitutes the most formative type of alliance in which a new venture can engage, and continues to shape the firm's development long after it becomes self-sufficient.

In terms of critical inter-organisational contingencies, relationship formation is driven by the necessity of finding resources and establishing legitimacy, or credibility as a trading partner, in order to avoid “moral hazard” (Williamson 1975). Horizontal relationships can enhance credibility, provide funding and risk sharing in resource mobilisation. The search for a position in the production chain (which may take part in an innovative network) where inputs can be obtained and output exchanged drives the search for vertical relationships (to identify potential customers and suppliers).

Resource Mobilisation

Resource mobilisation is put to the test when attempts to generate further resources are made. A case in point is an academic start-up firm, Cedar Systems, a spin out from Cambridge University. The background to this venture involved the line-up of various partnerships and alliances between 1984 and 1989, with a view to generating revenue for digitising recordings. Each time the arrangements failed, until after five years of negotiations and early development work in the university, a joint venture with Cable and Wireless was undertaken. Cedar Systems moved into an established market right away. Removing scratches from old records for which there is proven demand involves meeting an old customer need in a new way. A mature market offers proven demand for a product already adopted by consumers, but also the likelihood of domination by established companies which can dictate terms - even to innovative firms providing a new service. Competitive structure dominated by powerful buyers can limit the new venture's growth opportunities, keeping the firm on a plateau. However whether in a new or a mature market, partnership arrangements with customers may be essential to reduce the vulnerability of the new venture and can decrease uncertainty, one of the central problems of the start-up.

Vertical relationships may be used to increase credibility for resource mobilization (risk capital in particular), whereas horizontal relationships, particularly with universities, may be used to increase the credibility of the new venture in the eyes of customers in addition to providing valuable knowledge. Reciprocity concerns dominate the drive to set up vertical customer relationships in which dynamic complementarities between small and large firms are exploited (Rothwell and Dodgson, 1991). Horizontal reciprocal links may be set up in order to create a ‘virtual product’ family, as is sometimes the start-up strategy of small software and consulting firms. Complementary resources and assets may be sought out through attempts to establish vertical links with customers and suppliers.

Resource Generation

Supplier relations

Because new ventures in high tech usually take on a specialised role in the production chain, relations with suppliers are of key importance in establishing revenue-generation either through a production process or by some other means. There are attractions in obtaining low cost

components on a "cherry picking" basis, as Alan Sugar of Amstrad puts it, that is through more or less impersonal market exchange. But the danger of arms length supplier relations is illustrated by Acorn Computers, a UK company which failed to obtain the support of its suppliers when it encountered a major cash-flow crisis. In effect, a winding up petition from one of the suppliers precipitated the take-over by Olivetti. By the same token, close supplier relations can keep a company going through a difficult period (Sako 1992). The suppliers of Tadpole Technology, another UK computer company, provided funding when cash flow was a problem for the computer venture. In certain cases, a high tech venture can become a lead customer to a major supplier, which may use the venture to try out new waters with a new product. Tadpole Technology had close relations with Motorola, which supplied them with the chip they used in their SPARC notebook computer. This greatly enhanced the credibility of the start-up computer firm in the market, since it provided an informal endorsement of their technology.

Sub-contract arrangements

Because of the demanding requirements for establishing a production system capable of generating resources on a continuous basis, high tech ventures often avoid in-house production. However, orchestrating the production of others requires special competence; it is necessary to build supplier management skills since these are unlikely to be available in a new venture. Sub-contracting arrangements often lead to cash flow crises when inventories tie up resources in the face of a sudden fall in demand. Acorn Computers and Tadpole Technology both faced serious difficulties from this source.

Partnership with suppliers and sub-contractors can greatly facilitate the management of the supply chain, affording more predictable and continuous sourcing and producer quality control. Various writers have noted that dynamic networks characterising innovative specialist firms which perform complementary activities in the production chain, are favourable to successful innovation (Miles and Snow 1986). Often proximity offers further benefits to members of such networks. Where firms enter into relations of co-production with other firms, the question of location becomes significant. Where continual consultation and interchange is needed between those designing and manufacturing a product, for example, proximity can offer considerable advantages; this is one of the reasons for the clustering of firms engaged in similar or complementary activities in a given location (Saxenian 1990).

Licensing

Rather than orchestrating the production of other firms as in sub-contracting and co-production, the firm may decide to avoid any involvement in production. This can be achieved by gaining revenue from licensing a design or software directly to potential distributors, or, even more directly, to customers (Teece, 1986). This has been the strategy of ARM, a semi-conductor firm from Cambridge with an innovative RISC chip, which has licensing relationships with leading companies in a wide range of markets. The benefits of licensing is that it gives immediate access to users and therefore once again secures the licensee a specific position in the market (ie the production/consumption chain or nexus.) The drawbacks of licensing are that it often requires extensive contacts and time for networking if the product is ultimately to reach consumers. The demands of networking may be so extensive, and the network become so complex that the entire complex of deals may collapse like an elaborate house of cards. The networking undertaken by

MIPS in Silicon Valley is a case in point. Moreover the motivation for purchasing a license is the prospect of revenue from customers; the licensee is deliberately forgoing such revenues. However, the difficulties of gearing up for production and reaching customers to secure market position are such that they often surpass the resources available to a new venture, especially in a mature market. So it is that it is in the maturing markets of telecommunications and computing, complex licensing alliances are especially common. An example is Ionica, a Cambridge firm with novel radio technology for providing low cost customer access and services.

Of the various IOR contingencies, reciprocity and efficiency are likely to dominate relationship formation in the resource mobilization phase. Reciprocity can be exercised in exploiting dynamic complementarities in vertical relationships, if the core technology resource of the firm is distinctive and sustainable enough. Also reciprocal horizontal relationships can be used for the advantage of the small firm, particularly when operating a virtual corporation through a joint marketing interface. Efficiency concerns may drive the setting up of vertical relationships to scale up production through outsourcing arrangements, as described above.

Growth Reinforcement

Even once they have established a viable production process, or some other way of generating revenue, the new firm must act to sustain growth if it is to avoid moving onto a plateau where its prospects are at best static. Indeed survival itself may call for a stream of new products to update the product range as existing products reach maturity. Few new and small firms are able to cope with the pressures to volume production and cost reduction which accompany the maturing of markets and entry by more powerful competitors. A strategy many technology-base firms must follow is to produce a stream of new innovative products to keep ahead of the competition. Those firms that are able to develop reliable partnerships to promote new product introduction are likely to be at a considerable advantage over firms attempting to "go it alone" on the basis of self-sufficient new product introduction strategies. For example, Soft-Line, a growing Finnish new, technology-based company, supplies an essential software component to laser printers. Developing new generations of the software is a continuing process carried out in tight co-operation between Soft-Line and Canon.

The problem of new product introduction becomes pressing once the revenue-generating potential of its initial product is threatened. Firms that remain on a plateau may be able to remain in a niche market producing largely the same, or somewhat up-dated products. But firms whose niche is threatened, or who wish to move into more promising growth markets, must address the issue of introducing new products. This raises once again the question of the maturity of the market for the product. As the market matures, a dominant design is likely to have become industry standard, making it more difficult to gain acceptance for non-standard products. For example, Unda, a Finnish company, saw the niche market for its graphical workstations for advertising agencies dwindle away, as PCs became more powerful and gradually took over the market.

We saw that even for the initial product it may be necessary to form alliances from the outset, so as to ensure that the product will be compatible with other supporting products and receive the endorsement required to provide credibility to the new product. This problem arises

repeatedly in connection with new product introduction, so that alliances are of continuing importance as time goes on. Through new product introduction, the firm can to a certain extent select its position in a new production chain, should the production-consumption nexus be unfavourable for its initial products. Alliances may be required to facilitate market entry, whether to provide endorsement for a very new type of product, so as to encourage consumer adoption of the innovation, or to ensure compatibility and consumer acceptability for products in more mature markets.

When coping with the pressures of growth, the firm faces a multiplicity of problems. All of the critical IOR contingencies come into play in this growth reinforcement process.¹

Growth Reversal, Plateau

If growth reversal occurs, or if the firm reaches a growth plateau, the need to secure market position and reduce instability becomes critical. The firm caught on a plateau needs to define and stabilize its niche in order to be able to sustain a profitable operation. In addition to strengthening its customer base, links with sources of technology are important, as they enable the firm to sustain the distinctiveness of its core technology resource. The more distinctive an advantage the technology resource of the firm can offer, the better a position it is in to offset dependency and promote reciprocity in its customer and supplier relationships. If no such avenue is available, several small firms may, if their networking capability permits, link up to enhance their bargaining power in relation to suppliers.

Resource Maturity

A variety of external contingencies continue to affect those firms that reach the resource maturity stage. Our focus has been on firms in the vulnerable early growth stage. A firm that comes through this stage successfully may be able to use its key position in the supply chain to its own advantage in the industrial network. Reciprocity concerns may encourage the active use of horizontal relationships to encourage network externalities and keep the virtuous circle of positive feedback in motion. Efficiency concerns become increasingly important, reflected in emphasis on scale and more rapid throughput assisted by strong vertical relationships, and in the drive toward industry standard inputs and outputs. In the maturity phase, it continues to be important to reinforce the firm's legitimacy by enhancing its reputation and image. The influence of critical inter-organisational contingencies on growth is outlined in table 2.

6 Discussion

We can predict that those firms that are able to form extensive alliances are more likely to overcome the early difficulties of sustaining expansion than those that are isolated. Through partnerships firms can access the complementary resources that extend their capacity to appropriate returns on its activities. Alliances allow a firm to use its resources to leverage access into new markets, as where licensing to firms in different markets opens up a new source of

demand for a design or for other intellectual property. Alliances with distributors and suppliers allow a firm to extend its activities up or down the production chain more easily.

The reason for the difficulties with partnerships and alliances usually stems from the changing needs of the firm along its development path and shifts in the markets in which it operates. As the firm moves from early resource mobilisation to accumulation, its partnership requirements alter. It may no longer wish to sell through the outlets of its former distributor, who may not be prepared for this repositioning. As it grows, the firm may no longer be satisfied by a subcontractor who could meet its earlier specifications but not its more sophisticated current requirements. Moreover, markets also change, altering the structure of incentives and dislodging firms from their former positions, shifting the incentives a firm can provide to partners and the balance of power. There is tension in partnerships when firms individually require both commitment and flexibility, when each firm needs both clearly specified goals from the alliance and the capacity to change direction as the need for the unexpected arises. These are frequently incompatible requirements for an alliance, leading to breakdown. Yet there are examples of alliances - as between Hewlett Packard and many of its suppliers - which outlive both early development problems and market vicissitudes, affording benefits to both parties (Saxenian 1990). These usually involve a high level of trust and relations of power which retain a certain equilibrium though the nature of give-and-take shifts over time. If trust is not built up and preserved, then when the balance of power shifts, an alliance can break down dramatically, as in the notorious case of IBM and Microsoft.²

The logic of alliances and partnerships that operate among firms is not self evident, and the rationale for networking patterns is not apparent without an understanding of the inter-systemic context of these interactions. It is consequently hard to interpret cross sectional survey research that present diverse quantified evidence on inter-firm relations without reference to the nature of the firms' production chain and product markets. The rationale for developments can be better understood when firms are viewed as engaged in a web of evolving and interdependent systems of production and consumption and motivated by the incentives and constraints to which these give rise. Firms can be locked into partnerships that no longer serve their best interests as a result of the balance of power. This is often the fate of plateau firms. Firms are more likely to succeed when they are proactive in shaping their relations with others, and use these to reposition themselves and renew their competence. The most successful of firms use their relations with other firms to shift market configurations instead of remaining constrained by them.

Footnotes

¹ The asymmetry motivation may drive the firm to initiate alliances with suppliers of critical components to improve their position in a potentially vulnerable period when all resources are fully stretched. Reciprocal relationships may initiate virtuous growth circles, in which growth reinforcing positive feedbacks are in operation. The drive for efficiency may drive the firm to standardize supplier interfaces, as dominant designs start to emerge. The firm may also actively support the emergence of dominant designs, especially through horizontal licensing agreements (stability contingency). Legitimacy concerns may become critical again, as entry to foreign markets is contemplated.

² Microsoft changed its bargaining position in relation to IBM by finding a partner to help it develop a PC compatible operating system, as a result of which Microsoft was able to extend the market for the software it had developed initially for IBM. This expansion of Microsoft's competence beyond its earlier skills of computer language and software development reduced its dependence on IBM and shifted the incentives which had earlier maintained the alliance, allowing Microsoft to achieve market dominance.

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Table 2 Critical IOR contingencies in different phases of growth

Phase	Asymmetry	Reciprocity	Efficiency	Stability	Legitimacy
Resource access				Horizontal: share risks in resource build-up	Horizontal: identify potential resources Vertical: identify potential customers and suppliers
Resource mobilization		Vertical: set up dynamic complementarities Horizontal: create virtual product family	Horizontal: externalize support activities	Vertical: secure access to funding and complementary assets	Vertical: increase credibility for resource mobilization Horizontal: increase credibility for customer search
Resource generation		Vertical: exploit dynamic complementarities Horizontal: operate virtual corporation	Vertical: scale up production through outsourcing Horizontal: externalize support activities		
Growth reinforcement	Vertical: develop supplier interlock for ecosystem control	Horizontal: generate a virtual circle of growth reinforcing feedbacks	Vertical: standardize supplier and customer interfaces	Vertical: secure supplier and distributor relationships for sustained growth Horizontal: facilitate the emergence of dominant design	Vertical: increase credibility for foreign market entry
Growth reversal, plateau	Horizontal: link up with similar firms to enhance bargaining power	Vertical: operate in niche, enhancing core technology resource		Vertical&horizontal: define a role for the firm in value creating system	
Maturity	Vertical: operate supplier interlock for ecosystem control	Horizontal: operate a virtual circle of positive feedbacks	Vertical: increase scale	Vertical: standardize inputs and outputs	Horizontal: Enhance positive image