Stages Of Discovery And Entrepreneurship

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STAGES OF DISCOVERY AND ENTREPRENEURSHIP[1]

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Abstract

In an attempt at a systematic theory of entrepreneurship, this paper connects various literatures, from economics and business. In economics, there are many notions of entrepreneurship, some of which seem to contradict each other. For example, there are notions of entrepreneurship as an equilibrating and as a disequilibrating force. In this paper, these differences are connected with the issue of exploitation and exploration from the business literature. The question is how one can explore while maintaining exploitation. For this, a cycle of discovery has been proposed, with stages of equilibration and disequilibration which build on each other, in process where exploitation leads to exploration. It is proposed that different notions of entrepreneurship can be associated with different stages of that cycle. In this way, different types of entrepreneurship complement each other in an ongoing process of discovery.

Key words: entrepreneurship, innovation, discovery, organizational learning

[1] A large part of the text of this paper is taken from Bart Nooteboom: Learning and innovation in organizations and economies, Oxford: Oxford University Press, 2000 (paperback in 2001).

Introduction
In the history of economics one finds a variety of notions of entrepreneurship, emphasizing different activities (cf. Hébert & Link 1982, Chell et.al. 1991, Thurik 1996, van Praag 1996, Blaug 1997), as follows:

- acceptance of ('real') uncertainty (Knight)
- innovation (Bentham, Thünen , Schumpeter and perhaps Say)
- creative destruction by novel combinations (Schumpeter)
- arbitrage: the identification and utilization of possibilities for matching supply and demand (Cantillon, Smith, Menger, Mizes, Hayek, Kirzner)
- the provision of capital (Marshall)
- creating or entering new markets (Mangoldt, Schumpeter)
- the configuration and management of production factors for efficient production (Say, Marshall, Mizes)
- finding a proper balance between market and organization (Coase) and a proper governance structure for forms of organization 'between market and hierarchy' (Williamson)

According to Schumpeter entrepreneurs form an elite, while according to (other) Austrian theorists (especially von Mizes) entrepreneurship is widely dispersed. Associated with different roles of entrepreneurs different characteristics, resources or competencies have been identified:

- alertness, perceptiveness, open - mindedness, imagination, idiosyncratic perception and initiative, independence, internal 'locus of control'
- judgement, sense of realism, decisiveness
- risk acceptance, risk reduction
- perseverance, ambition or need for achievement
- charisma, strength of personality; capability of leadership, managerial capability,

How do we reconcile these widely diverging notions of entrepreneurship? Do the different types of activity have to be combined at the same time, or are they required at different times, in some development process, by different people perhaps? Can the different characteristics be combined in one person, or do they have to be distributed across different people who complement each other?
It has been argued that the provision of capital is not part of entrepreneurship, since capital can be obtained from capital markets, and that management is not part of it, since that can be hired (Blaug 1996). However, in view of the 'real', Knightian uncertainty involved in entrepreneurship, and the idiosyncracy of perception and initiative that characterize entrepreneurship, outside supply of capital can be problematic, so that the entrepreneur has to supply his own at least in part (Casson 1982). Management is not routine in the early stages of exploring Schumpeterian novel combinations, so that the entrepreneur has to supply his own leadership and management. I will also argue that the development and adaptation of organization after initial stages of innovation constitute a non-trivial task, requiring ingenuity and the ability to effect organizational change. So, it seems that the provision of capital and management are still part of entrepreneurship.
I propose that rather than any single notion or characteristic of entrepreneurship, or any specific configuration of some of them being 'the correct one', regardless of context and conditions, different notions fit different stages in an overall process of discovery. The analysis draws from the work of Nooteboom (1999a, 2000). For readers familiar with Austrian economics: entrepreneurship is framed here in terms of a Hayekian discovery process. One may think that such a theory of discovery is logically impossible, since it would entail the prediction of discovery, and if discovery could be predicted it would no longer constitute discovery. But this is mistaken: we may well be able to specify a heuristic of discovery without thereby being able to predict its outcomes.
A central issue is whether entrepreneurs achieve equilibrium, by arbitrage (Cantillon, Kirzner) or destroy it (Schumpeter). I will argue that equilibration and disequilibration build on each other, are stages in a process of development. Hence, discovery requires both, succeeding each other in ongoing cycles of discovery.

This is related to the issue of exploration and exploitation in the organisation literature (Holland 1957, March 1991). In order to survive in the short term, firms must efficiently exploit current resources. In order to survive in the long term they have to develop new resources. Thus, to survive now and later, they need to combine exploitation and exploration. That is a paradoxical task.
The heuristic of discovery used here links exploitation and exploration, with shifts of emphasis from the one to the other. The heuristic consists of several stages succeeding each other in an ongoing cycle. Here, a brief summary is given, and in later sections the stages will be discussed in more detail. First, to start somewhere on the circle, there is a process of reducing variety of content (equilibration, here called 'consolidation'), which yields a 'dominant design' as the basis for efficient exploitation, as recognised in the innovation literature. This yields a platform for transferring the practice or product to novel contexts (diffusion, here called 'generalization'), and that yields a basis for exploration, while maintaining exploitation. In novel contexts one encounters limits of viability and usefulness, which require adaptation (called 'differentiation'). Contacts with similar practices in the novel context suggest opportunities for importing new elements, in a process of hybridization (here called 'reciprocation'). This puts existing architectures of products and organizations under strain for several reasons, but especially because the constraints that they impose prevent novel elements from realizing their full potential. This yields pressures to break them down (creative destruction) and to develop novel configurations of elements from different practices and contexts. Experience accrued from the earlier stages of generalization, differentiation and reciprocation feeds imagination, gives indications for what elements and architectural principles to try out. Thus experimentation with novel combinations is not blind or completely random, but there still is radical uncertainty, and much trial and error. And here we are back at the beginning, with an ambiguous novelty that requires consolidation. Summing up: discovery emerges from an alternation of variety of content and variety of context. Variety of content is reduced (equilibration), is then subjected to an opening of variety of context, which yields the basis for creating new variety of content (disequilibration).
The theory of discovery is based on a theory of knowledge, which has implications for the theory of the firm. These will be briefly summarized. But first I further discuss the issue of equilibration and disequilibration.

Equilibration and disequilibration

The entrepreneur according to Schumpeter has variously been characterized as being non - adaptive, causing disequilibrium, generating innovation in the form of 'novel combinations', giving rise to creative destruction, and increasing uncertainty (Cheah & Robertson 1992). The entrepreneur according to (other) Austrians (Menger, Hayek and more recently Kirzner) is adaptive; reacting to exogenous shocks of change, and draws the economy towards equilibrium, even if such equilibrium will never be achieved, due to changes of conditions along the way. There is an important difference, also in the more modern Austrian theory of Kirzner. Consider the following quote (Kirzner 1973: 127, quoted in Foster 1998: 14): 'For Schumpeter the entrepreneur is the disruptive, disequilibrating force that dislodges the market from the somnolence of equilibrium; for us the entrepreneur is the equilibrating force whose activity responds to the existing tensions and provides those corrections for which the unexploited opportunities have been crying out'. In this arbitrage view of entrepreneurship Kirzner is close to Cantillon.
While Kirzner's entrepreneur is more 'alert' to new possibilities than other people, this is '... not really a theory about how agents create new data, but how they react to new data' (Foss 1994: 111). The question is how entrepreneurial action can also yield 'new data': how entrepreneurs can break through existing categorical imperatives.
Note that even Schumpeter was unable to endogenize creation in the form of invention (cf. Witt 1993): innovation was the realization of potential offered by invention. In the present theory of discovery the ambition is to endogenize not only the realization but also the creation of potential, and thereby bring diverse notions of entrepreneurship together in a unifying theory.
Schumpeter made a well - known distinction between two different sources of innovation. The first, often called Schumpeter's 'mark I' notion of entrepreneurship, is the independent small entrepreneur, who acts by intuition, in bounded rationality, and survives or succumbs in trial and error. The second or 'mark II' source of innovation is the large, rationalized Weberian firm, with innovation by planning on the basis of specialized teams. Usually, these 'first' and 'second' notions of entrepreneurship are interpreted as Schumpeter changing his mind. On the basis of quotes from Schumpeter's older and later work Langlois

(1998) shows that the mark II notion was already present in his earlier work. The two notions are sequential not in the sense that Schumpeter changed his mind but in the sense that in the development of capitalism both the early (1909, English translation 1934) and late (1942) Schumpeter expected mark I to be replaced by mark II, in an ongoing Weberian process of rationalization. But this yields a puzzle: can one have radically novel combinations, and the associated creative destruction of technology, while preserving the organizational integrity of a large firm? I will argue that this is problematic, and that while there are good reasons for Chandlerian integration of activities in a large firm, disintegration is needed for ongoing innovation. It will be argued that mark I and mark II follow each other, in an ongoing cycle of discovery. There is no end to history.
In his later work Kirzner (1985) recognized the linkage and complementarity between Schumpeterian innovation and Austrian arbitrage. Cheah & Robertson (1992) made a further attempt to demonstrate the complementarity and interdependence of Schumpeterian and Austrian entrepreneurship, by proposing that along the product life cycle shifts occur between the two types of entrepreneurship. Here, their argument will be extended and partly modified.

Discovery and utilization

There are cases of entrepreneurship that are difficult to assign to either the Schumpeterian or the Kirznerian type, because they contain elements of both. Schumpeterian entrepreneurs build on inventions that were already there and in that sense also 'merely' utilize existing potential. And there are different levels of innovativeness: radical and incremental, innovations of principle and innovations of application, in different fields or contexts.
An important type of innovation, between Schumpeterian entrepreneurship and entrepreneurship according to (other) Austrians, is product differentiation. It can be reconstructed as bridging gaps between supply and demand in Lancasterian product characteristics space (Lancaster 1966), by offering novel combinations of available product characteristics. This is Austrian in that no new characteristic appears, and gaps are bridged in characteristics space by varying the intensities of characteristics in their mix. Differentiation becomes more Schumpeterian when it consists of the addition of a new product dimension, which subjects the positions of existing products and preferences to a jolt (Péli & Nooteboom 1999).
Another example of an innovation that contains elements of both Schumpeterian and Kirznerian entrepreneurship is the example of railroads discussed by Schumpeter (1939). Uncertainty is reduced as railroads diffuse, and entrepreneurship in this area becomes increasingly routine. But now consider the 'ice station' innovation of beer brewer Annheuser Bush (AB). By combining railroad transportation with the cooling of beer by means of 'ice stations', AB greatly extended the feasible distance between market and production, thereby realizing great economies of scale in brewing. An innovation that seems Schumpeterian was produced as a combination of well diffused, settled technologies of railroads and cooling, in an identification of possibilities from existing technology and practice which might as well be seen as Kirznerian.
Schumpeterian entrepreneurs build on inventions that were already there, and in that sense also 'merely' utilize existing potential. And there are different levels of innovativeness: basic innovations, which have pervasive effects for many production sectors and markets, and cumulative innovations in the form of diverse applications and modifications of such basic technology in different fields or contexts. Without such innovations of application, creative destruction would not take place, and the basic innovation would remain a mere potentiality. Is this secondary innovation Schumpeterian or Kirznerian? It is Schumpeterian in that it creates forms that did not exist before, upsets the allocation of resources established before, and exerts creative destruction. It is Kirznerian in that in the process of diffusion, along the 'technical trajectory' (cf. Dosi, 1984), uncertainty is reduced, and gaps between actual and possible use are reduced. Thus, along the trajectory we find a combination of the two types, with the emphasis shifting from Schumpeterian to Kirznerian, as pointed out by Cheah & Robertson (1992). Conceptually the distinction may be maintained, but mixes or intermediate cases appear.
Note that diffusion does not consist in a simple mechanical 'working out' of a single innovation. Generally, new contexts or new applications require adjustment or 're - invention'. Often, novel combinations are achieved in a mix of complementary innovations in technology, marketing, organization and institutional conditions. Different firms have different, partly firm - specific constellations of resources, partly embedded in teams, organizational structure and culture, where adoption of

innovation is seldom a mere slotting in and typically requires a reconstruction of existing structure, procedure and culture. What is established on an industry level may require quite fundamental shifts on the firm level. That is why in the innovation literature a distinction is made between processes new for the world, for an industry and for a firm. In short: diffusion requires innovation on the part of users.
In this paper, entrepreneurship is seen in both the creation and the realization of potential. A Schumpeterian entrepreneur creates potential in the form of a new product or process, which is subsequently diffused, but realizes potential in that existing knowledge (invention) is transformed into commercially viable products and processes. An inventor creates potential for Schumpeterian entrepreneurs, but realizes potential from pre - existing knowledge. So, we retain the conceptual difference between Schumpeterian and Kirznerian entrepreneurship, as the production and realization of potential, but in a framework which allows for intermediate cases and recognizes that entrepreneurship will have more or less of the one or the other. We no longer have a Schumpeterian Shiva of creative destruction, far above the uniform grey masses of routine conduct, but a spectrum of innovation and diffusion, of creation and realization of potential.
The point now is that in order to satisfy the Schumpeterian challenge, not only innovation but also the formation of perception, knowledge, meaning and preference must be endogenized (cf. Rosenberg 1992). Furthermore, as will be shown, the creation and realization of potential are mutually dependent, not only because realization requires prior creation, but also because realization provides the basis for a next round of creation. We need a theory that gives an account of the process of realization and creation of potential, which shows how creation arises from realization endogenously. How can we conceptualize an ongoing and open - ended process (Vaughn 1994: 169)? What conceptual framework can we devise to reconcile permanence, coherence and flexibility (Vaughn 1994: 157)?
If innovation is creative destruction, what are the sources and process of creation? Does it strike at random? Is it like mutation in biological evolution? Does economic structure evolve from chance hits of entrepreneurial success, and evolutionary pressures eliminating maladapted firms? We need a theory of discovery. For that we need an underlying theory of knowledge. That, in turn, has implications for the theory of the firm.

Theory of knowledge and learning

Economics has no explicit theory of knowledge and learning. The implicit, espoused view is that of naive realism: we can observe reality, this yields information, which may cost time and money to collect, but when available yields the same, objective knowledge to different people. Language and communication are seen according to the label and conduit metaphors. A term is a label attached to an entity that is its meaning, and in communication these labelled packages are shipped across communication channels.
Here, a different theory is employed, which is espoused in the organizational literature (Weick 1979, 1995, Smircich 1983, Nooteboom 1992, Weick and Roberts 1993, Choo 1998). People observe, interpret and evaluate the world according to categories of perception, interpretation and evaluation that in turn have been developed in interaction with the physical and social world. This implies possible path-dependence of cognition. It also precludes claims of objectivity, because knowledge is constructed. However, it is likely to be in some way connected to reality, or representative of it, since it is by interaction with the world that we develop our ways of seeing it. This yields what Lakoff and Johnson (1999) called ‘embodied realism’. However, we can’t make independent claims of realism, since we cannot ‘climb down from our minds to see how knowledge is attached to the world’.
Our ability to construct views and interpretations in interaction with the world is inherited from evolution. Since this is a shared heritage, there is bound to be some similarity between people in the way they do this, and perhaps also in its outcomes. This saves us from the arid extremes of post-modern relativism. However, since this ‘knowledge’ is developed from one’s specific, idiosyncretic experience in specific contexts, it is also bound to vary between people, to the extent that they have developed in different environments and have not communicated with each other.
The resulting variety of cognition, and the ambiguity it entails, is not a problem but an opportunity. It yields a source of innovation; of Schumpeterian ‘novel combinations’. Since we cannot climb down from our minds to inspect the realism of our views, the variety of views that people have, from different experiences, yields the only opportunity we have for correcting our errors of knowledge.

As a result of this cognitive variety there is always greater or lesser 'cognitive distance' between people. Learning from interaction requires sufficient distance for novelty but also sufficient proximity for understanding (Nooteboom 1992, 1999b). If effectiveness of learning is the mathematical product of comprehensibility and novelty, comprehensibility decreases linearly and novelty increases linearly with such distance, then effectiveness increases and then decreases according to an inverted U, whose top indicates optimal cognitive distance. The location of optimal distance depends on the relative importance of comprehensibility and novelty. Note the difference between crossing cognitive distance and reducing it. Crossing cognitive distance entails communication between people who think differently. Reducing cognitive distance entails convergence of cognition. In intensive, long term interaction cognitive distance will reduce, especially if it is also exclusive, i.e. if partners do not have different interactions with others as well.

Purpose and identity of the firm

The simple theory of knowledge indicated above gives the basis for a competence view of the purpose and boundaries of the firm. The basic purpose of the firm is to achieve a common purpose among people with complementary competencies. This requires a certain amount of alignment of cognitive categories for perception, interpretation and evaluation (which includes value judgements and intentionality). In other words: reduction of cognitive distance. This constitutes the notion of the firm as a 'system of shared meanings' (Smircich 1983), 'focusing device' (Nooteboom 1992), 'collective mind' (Weick and Roberts 1993) or 'interpretation system' (Choo 1998). The proper alignment of cognition, in this broad sense, including motivation and goals, is the primary task of leadership. It is related to the Schumpeterian notion of charisma as a crucial trait of entrepreneurs. Note that this alignment of perception and motivation reduces problems of opportunism: it reduces both the perception and the utilization of opportunities for opportunism. This widens the scope of human behaviour beyond the obsession with opportunism on the part of most economists. However, of course this does not imply that opportunism can be ignored.

However, cognitive alignment in the firm's focus entails a risk of myopia: relevant opportunities and threats are not perceived. To compensate for this, the firm needs complementary cognition from outside partners, to utilise 'external economy of cognitive scope' (Nooteboom 1992). This yields a new dimension for evaluating the purpose, choice and governance of inter-firm relations. Williamson (1999) claims that the competence view has not been able to give sharp predictions concerning the boundaries of the firm. But the present view gives such a prediction, and it runs counter to transaction cost economics. According to that theory, greater environmental uncertainty will (should) yield more integration under 'hierarchy', because it makes contracting and monitoring more difficult as an instrument to protect against the hazards of opportunism. According to the present perspective, greater uncertainty, in the sense of greater complexity and volatility of technology and markets, increases the need for outside complementary cognition, and hence will (should) lead to more, not fewer outside relations. This controversy is amenable to empirical test: Is there more or less integration when uncertainty in this sense is greater?

Cognitive alignment in the firm, or in networks of firms, should not go so far as to reduce cognitive distance to zero, with everybody having the same, shared experiences and no outside contacts, or identical contacts. Homogeneity of cognition tends to have priority when efficient production is strategically crucial (exploitation), with division of labor and the utilization of economy of scale, requiring strong connections between component activities. Then the need for cognitive proximity prevails; optimal distance will be relatively small. Variety and novelty of cognition have priority when innovation (exploration) is strategically crucial. Then the need for cognitive distance prevails, and optimal distance will be relatively large.

This brings us to the problem of exploitation and exploration. Exploitation often takes a narrow focus and integration, while exploration requires wider scope and disintegration. Thus boundaries of the firm depend on stages and conditions of learning and innovation. According to the logic set out above, boundaries of the firm will shift and there will be more or less integration, depending on whether the emphasis is on exploitation or on exploration. Alternatively, the firm (or a unit within a firm) engages in exploitation while conducting exploration with other organizations (units) at a larger cognitive distance.

The problem of abduction

The paradox of exploitation and exploration cannot be solved on the basis of rational choice among alternative options, because of (radical) uncertainty: we are dealing with a problem of abduction (Peirce 1957). We need to find out what the options are. Options often materialize after taking action. The identification of options may follow rather than precede choice. How can we act on the basis of available knowledge and other competencies (exploitation) in a way that yields insights how to acquire new knowledge and competencies (exploration)? How can we gather elements and directions for Schumpeterian 'novel combinations'?

Nooteboom (1999a, 2000) proposed a 'heuristic of discovery' to solve the problem of abduction. The heuristic consist of a number of stages that are repeated along the cycle: consolidation, generalisation, differentiation, reciprocation and novel combinations. They are summarized below.

Consolidation

Novelty (in knowledge, technology and organization) does not spring forward ready-made and out of the blue. This happens only in the ancient Greek myth of the goddess of war and wile Pallas Athene springing fully armed from the brow of Zeus, the chief of gods. Novelty (novel concepts, practices, products, technologies) at the outset tends to be incompletely determinate. It emerges as a groping around with improvizations that need to crystallize and achieve consolidation in best practice, on the basis of experience with success and failure.

Schumpeter recognized this in his distinction between invention and its realization in a viable practice. This principle is also recognized in the notions of 'industry recipes' (Spender 1989) in industries, 'dominant designs' (Abernathy & Utterback 1978) and 'technological regimes' (Teece 1988) in technologies, and 'dominant logics' (Bettis and Prahalad 1995) in organizations. In organizations they are embodied in rule based procedures, such as 'performance programs' or 'routines'. Similarly, in cognitive science we encounter 'paradigms' (in the sense of exemplars to be emulated), 'mental models' (Johnson-Laird 1983), 'scripts' (Abelson 1976, Shank and Abelson 1977), 'prototypes' (Rosch 1977) and 'stereotypes' (Putnam 1975). These indicate that across all these fields of technology, organization, knowledge and language novelty becomes consolidated in a standard practice, which provides the basis for efficient exploitation.

It is only after consolidation that geniuses can be distinguished from fools. When a person acquires a new practice, this tends to be ill defined and messy, with encumbrances from previous practice, and lapses back into more familiar practice. This is most pronounced in the case of learning from practice: a novel way of doing things seems to suggest itself, but it is not clear how or why precisely it should work. It happens even in areas that appear to be quite determinate and purely deductive, such as mathematics. The mathematician Gauss once exclaimed: 'I have got my result; but I do not know yet how to get it' (Popper 1973: 16). This move to consolidation reflects a passage from tinkering to understanding, from intuition to knowledge, from tacit to codified knowledge, from technology to science. But also in formal learning, based on codified knowledge, the phenomenon of initial lack of clarity, confusion and stumbling arises, and practice is needed for the novel activity to be mastered smoothly.

Repeated trials and application, supported by ancillary innovations in tools, methods, materials, are required to find out what properly belongs to the novel practice and what not. This yields increasing efficiency from a process of narrowing down, in a reduction of variety; by elimination of what step by step is found out to be redundant, inefficient or counter - productive. This entails learning to conduct an existing practice more efficiently, in exploitation.

Note that the outcome need not be optimal and need not be unique. Several candidates may compete for dominance, or on the basis of ongoing improvements an old practice may compete, and alternatives may coexist for a long time. A well-known example of an old technology keeping up for a long time with a novel one is the prolonged existence of sailing ships next to steamships (Rosenberg 1972).

In industries, the speed of the process depends on the need for standardization. In case of network externalities, for example, that pressure is great. The famous example is the race towards the technical standard for videorecorders. The emergence of one outcome among possible alternatives is influenced by current institutions and flukes of chance and coincidence: what happens to be around in the form of adequate materials, skills, instruments, organization, infrastructure, attitudes, habits of thought and other institutions. In other words: it needs to be embedded in existing institutional arrangements. That is why a given technology may yield different practices in different countries or even in different organizations

within an industry. Barley (1986) gives an example of how the use of electronic scanning devices is organized differently, with different results, in different hospitals. The outcome often is not predictable and may not be intended. Development may be locked into a path that later turns out to be sub-optimal or even counter-productive (Arthur 1989, David 1985).

In the history of technology science has often followed from the 'tinkering' or trial and error of technology, and the externalization of tacit knowledge, rather than leading technology. Mokyr (1990: 170) claimed that in the last 150 years the majority of inventions were used before people understood why they worked. This occurred in agricultural technology, mechanical machinery, metallurgy, the textile industry and shipping. Increasingly, from the second half of the nineteenth century, scientific understanding came to feed technological development. An example is the invention of telegraphy, which required the theoretical notion of electro - magnetic waves invented by Maxwell in 1865 (Mokyr 1990: 144). Chemistry also was also to a large extent guided by science. Nevertheless, the reverse order of practical tinkering preceding understanding still occurs, as has been exhibited in the information technology revolution (Dosi 1984).

Why does consolidation take place? It results from a drive towards efficiency and standardization of operation, application and production. At first, the drive is toward feasibility, in the form a working model. But the innovation also has to be fitted into systems of use, production and distribution, and when appropriate systems are not in place, they need to be developed. Alternatively, an inferior innovation with better fit in existing systems may win. When a novel product, in a constellation or architecture (Henderson or Clark 1990) of components or elements, consolidates, it gets translated into an organizational architecture for efficient production, with specialized activities for different elements. Subsequently the focus shifts from the architecture of product and organization to the optimization of elements or activities within them. The firm in its function as a focusing device shapes cognitive categories around existing architectures.

The occurrence and speed of consolidation depend on competitive pressure. As novelty becomes diffused, and patents wear out and the competencies involved become less tacit and more imitable, competition increases and exerts pressure to produce more efficiently, by utilizing economies of scale and scope. Economy of scale requires expansion. It typically entails division of labour, with specialization of labour across different linkages in a chain of production and distribution. This requires systematization and standardization, which requires that tacit knowledge be 'externalized' into documented knowledge (Nonaka and Takeuchi 1995), so that it can be efficiently incorporated in standard operating procedures and specifications of systemic linkages

The outcome of consolidation serves as a platform for expansion and new applications. It provides the 'techno-economic paradigm' (Freeman and Perez 1989) to be followed along a 'technical trajectory'. Next to the achievement of efficiency in exploitation, this provides the second rationale for consolidation. It will be argued that this expansion, called 'generalization', provides the basis for exploration, for accumulating experience as input for the next novelty. The transformation of tacit to codified, documented knowledge, in consolidation, is part of this. Such codification serves to abstract know-how from the specific context in which it developed. This is needed for the transfer of knowledge for efficient exploitation in new contexts. In consolidation tacit knowledge is partly transformed to codified knowledge and partly lost. In application in novel contexts new tacit knowledge is absorbed again.

In the stage of consolidation we can identify several types or aspects of entrepreneurship. First, there is a need to escape from the chaos of trial and error, to commit on a design and carry it through development, testing and entry to markets. This requires leadership and charisma to mobilize people in an uncertain and sometimes quite arbitrary looking venture, as recognized by Schumpeter. For those reasons it may be difficult to obtain outside capital, so that the entrepreneur may also have to be a capitalist, as recognized by Marshall. It requires the willingness to accept risk and tenacity to survive the inevitable setbacks, as recognized by Knight. There is also an element of arbitrage, in matching supply and demand, as recognized by Cantillon and the Austrians. However, it is not adequate, in this stage of the cycle, to conceive of this in terms of given products and demand on the basis of given preferences. There is still experimentation and selection among different product forms. Users are trying to grasp the use and usefulness of the new product, adapt their preferences to the new possibilities, and may postpone purchase until uncertainty about the product and its price drop, due to economies of experience and scale in production. Subsequently, as a dominant design arises, a

different kind of entrepreneurship is needed, to establish a fitting organizational architecture. As sales expand, authority and control have to be delegated, since control can no longer be exerted by direct observation, more formalized procedures have to be designed. The firm needs to be set up as a focusing device. This is related to the notion of management, as recognized by Marshall and Say. However, here management is certainly not routine. I propose that this organizational development requires a genuine kind of entrepreneurship. It entails risk and requires imagination and leadership for the development of novel forms of organization. But it is different from the earlier kind of entrepreneurship. Often, the initial entrepreneur fails to make the turnaround to this managerial type of entrepreneurship. This may result in the firm being taken over to consolidate its success.

Inertia

While consolidation is needed for efficient exploitation and for generalization, it can develop into inertia. Why this inertia? Why stick to established practice in the face of failures? Clearly, inertia can be disastrous. But directly after a novelty has settled down, and 'come into its own', one could not possibly step directly to the next novelty. Such a leap is difficult to imagine. Entrepreneurship may consist of radical jumps into the dark, with a large risk of failure and a small chance of successful radical innovation. On the aggregate level of the economy such jumps are beneficial when the weight of incidental success exceeds the weight of frequent failure. But on the level of the firm it is generally ill advised. It is counterproductive to drop and replace practices too soon, before one knows their limits and possibilities for replacement. That would lead to random drift rather than improvement (Lounamaa & March 1987).

Kuhn (1970) not only noted, descriptively, that scientists tend to stick to the 'puzzle solving' of 'normal science', but also indicated, normatively, that a certain amount of theoretical tenacity is rational. First, there is a principle of economy: we do not and should not surrender theory at the first occurrence of a falsifier, indicating that our theory is not perfect. It is rational to wait until the cumulative weight of anomalies becomes excessive in some sense. But there is more: it is only by ongoing tests of theory that we find where its real strengths and weaknesses lie. Even Popper (1970: 55) recognized this, in spite of his drive to keep science open to criticism:

'I have always stressed the need for some dogmatism: the dogmatic scientist has an important role to play. If we give in to criticism too easily, we shall never find out where the real power of our theories lies'. But in the spirit of his critical rationalism, Popper elsewhere says (1970: 52): 'in my view the "normal" scientist, as Kuhn describes him, is a person one ought to feel sorry for'.

We need to exhaust our theories to a sufficient extent, before we give them up, not only to recoup our investment in them, so to speak, but also to develop the motivation for a novel alternative, by an accumulation of anomalies. This has been recognized also in the literature on organizational learning. There is a trade-off between the need to adapt and the costs involved in terms of uncertainty whether novelty will be successful, and uncertainty about the organizational repercussions (March 1991). To make the step to novel practice one must be prepared to 'unlearn' (Hedberg 1981), in the sense of no longer taking established procedures for granted. Thus a condition for innovation generally is that there is perceived need, mostly from external pressure, a threat to continued existence or a shortfall of performance below aspiration levels, as has been the dominant view in the literature on organizational learning (see the survey by Cohen & Sproull 1996).

However, this is not a necessary condition: one may stumble, so to speak, on novelty without seeking it to repair bad performance. Nor is it a sufficient condition. While necessity may be the mother of invention, that may also need a father. Above all, we need to accumulate experience to find out what elements are eligible for preservation in the exploration of 'novel combinations', and what other elements and from where, to combine them with. This point does not yet seem to have been appreciated in the literatures on innovation and organizational learning. Thus a certain amount of conservatism is rational, but of course it can easily become excessive and block innovation.

The basic idea deriving from this is that before we can replace any practice, of theory, technology or organization, we first need to pursue its potential, in a range of applications in a variety of contexts. We need this in order to build up the motive for change, to discover limits of validity and to gather indications how to change it and what elements to preserve from it, and how, in a novel practice. We

do not know beforehand which elements are robust under changing contexts, and hence worth preserving, before we have subjected them to a variety of trials. This is how we might conduct abduction and reconcile exploitation and exploration: while employing the practice we are at the same time exploring its limits and opportunities for its change and replacement. Or, to put it more succinctly: as in crime, the transgression of existing principles requires motive, opportunity and means. Before the need for replacement of an existing practice arises such a move would be wasteful, and before opportunity and means arise it would be impossible.
This puts the notion of 'inertia' of organizations into a new perspective. Inertia is not only needed for co-ordination and control, for the sake of efficiency in exploitation. It also represents the principle of tenacity: the need to preserve existing principles in order to find out where and why they fail and how they might be replaced, as a contribution to exploration.

Generalization
Let us see how exploration is likely to proceed, if due to competitive pressures it is to proceed effectively and efficiently. The most straightforward way to explore the limits of effectiveness or validity of an existing practice, and at the same time survive by ongoing exploitation of available resources, is to generalize application of the practice to novel contexts. This what we see in individual development as well as development of firms and markets: attempts are made to carry a successful practice into neighbouring areas of application. This second stage I call the stage of 'generalization'.
Consolidation provides the basis for generalization: for carrying the practice to novel contexts. This enables us to profit from the variety of context. This can only be done if sufficient flexibility for adaptation is allowed there. For this, dominant designs may operate as 'prototypes' (Rosch 1977). Deviations are allowed in details, while sufficient similarity to the prototype is maintained to preserve the identity of the dominant design. This can yield a variety of manifestations that in principle may have no feature in common, while each preserves sufficient resemblance to the prototype, in chains of 'family resemblance' (Wittgenstein).
If the objective is to conduct exploitation in such a way that it contributes to exploration, we should seek to do it in a way that optimizes both profit from exploitation and the gathering of the elements of discovery: motive, opportunity and means. More specifically, these elements of discovery are the following. First: insight into limitations of current practice. Second: identification of elements of current practice that can be preserved in novel combinations because they do not form the cause of such limitations and are persistently effective. Third: elements from other, neighbouring practices with which they can be combined with a reasonable perspective for useful and workable novelty. Fourth: insight in architectural principles by which these elements can be combined with a reasonable chance of success in utilizing their potential. For all this we need variety of context. We need the movement from one context of application to another in such a way that the next novel context is sufficiently close to afford viable exploitation and sufficiently different to yield novelty of tests and novelty of insight where limitations and opportunities for improvement lie. This is related to the notion of cognitive distance discussed earlier. We need sufficient distance to yield novelty, but distance should not be so large as to preclude comprehension. Note that generalization is not automatic. It may be blocked by exit or entry barriers, which deprive progress of its source of variety.
The contexts across which a practice is generalized may be new markets for existing products. For example: new segments in domestic markets, foreign markets, new technological conditions of production (labour, materials, components, machinery, tools), or new conditions of markets (use, competition) and distribution systems.
New contexts may also entail new applications of existing technology, or of forms of organization or governance, in new products or new organizations. In all cases one will encounter differences of context that may necessitate or may suggest modifications, which lead to differentiation. In the case of firms, 'neighbouring practices' from which one may derive inspiration for change may be competing products, alternative technologies with similar uses, alternative distribution systems, new practices or needs of customers.
I propose that there is an underlying, pervasive 'imperialistic' drive to utilize resources in novel contexts, in all living systems. This drive may be innate in people because of its evolutionary advantage in providing the basis for learning that I claim here. Such Imperialism also has an economic rationale.

Extension of an existing practice to wider fields of application carries the potential reward of economy of scale and scope.
Exploration of novel applications across contexts can to a greater or lesser extent be done virtually rather than actually, by thought experiments, scenario's, simulation of prototypes, inspection or 'reverse engineering' of practices or products used elsewhere. There is great leverage in communication with others, at an appropriate cognitive distance, fitting to one's communicative ability. But as in all speculation it will at some point need to be put to the test of reality. That is where the surprises occur from which we can learn.
In this stage of generalization we find entrepreneurship in opening up or entering new markets, as recognized by Mangoldt and Schumpeter. There is also an element of arbitrage: carrying products to unsatisfied demand.

Differentiation and reciprocation
As one moves through a variety of novel contexts, the practice needs to be differentiated to fit to them, or novel opportunities for improvement may present themselves. This is the next stage of 'differentiation'. One may need to adjust to a different availability of material inputs and tools, competencies of people, acceptance of products produced. Note that this adaptation is not guaranteed. In a seller's market without much competitive pressure the incentive to adapt and improve may not be sufficient.
Here, the process of narrowing by eliminating redundancies, and the reduction of variety of practice, in the first stage of consolidation, is reversed into a process of widening into different versions and extensions of the novelty, with increasing variety.
It does not seem a coincidence that the geographical discoveries, in the 15th to the 17th century, preceded the surge of scientific and technological discoveries in Europe. Perhaps they reflect the challenges and opportunities of generalization that I propose here as crucial for innovation. Conversely, part of the explanation why the tremendous early technical progress in China came to stagnate after 1400 may lie in the halting of geographical exploration, due to a decision by the imperial court in 1430 (Mokyr 1990: 231).
A proximate form of differentiation is to modify elements while preserving the architecture in which they are connected (Henderson and Clark 1990). Next, one may re-arrange elements of an existing practice into novel versions for novel contexts. For this one may tap into memory of previous applications or experience with trials in the stage of consolidation. This is a process of problem solving, defined as seeking recourse to known ways of doing things (Holland et. al. 1989: 11). The potential and the success of this depend on what is available from previous experience in (organizational and personal) memory, on inventiveness in problem solving of the people involved, and on communication and co-operation between them.
A further, more 'distant' form of adaptation is to adopt elements from foreign practices encountered in the novel context. Their success and similarity indicate that they may be potential sources for this. Similarity entails having elements in common (inputs, outputs, ways of doing things), serving similar markets. Failures of the existing practice are compared with successes of the practices it has come in contact with, which yields insight into patterns of failure and potential alternatives. Speculations and experiments arise concerning promising adoption of elements from such neighbouring practices. Transfer can also go the other way: elements from existing practice are transferred to a foreign practice encountered in the new context. This transfer is called 'reciprocation'. Reciprocation is akin to metaphor in language: transferring an element from one concept to another; seeing something in the light of something else.
Differentiation and perhaps also reciprocation can be seen as 'incremental' innovations: variations upon a theme. But they may lead to more radically novel combinations.
In this stage of differentiation and reciprocation we see the entrepreneurship of people crossing boundaries of accepted practice. They need to convince others to join, or to accept, or the courage, strength and stubbornness to row against the stream. Here, the inertia of the integrated firm takes its toll. In multinationals there are battles between central office that wants to maintain coherence and company-wide standards and practices for the sake of exploitation and country subsidiaries that demand room for differentiation and reciprocation. The battle gets especially fierce when for the sake of novel combinations competencies are developed that are at odds with what is perceived as core competence, or alliances are sought with outside business units that are part of competing firms or consort with them.

While the entrepreneur in the stage of consolidation is primarily a socializer, here he is often the rebel and maladapted loner. Lack of acceptance may impel him to leave the firm and start up for himself.

Radical innovation

Recombination of elements from different practices in novel architectures can lead to 'accommodation' in the form of 'novel combinations' (Schumpeter), yielding 'radical' or 'large' or 'macro' innovations. Often this is 'competence destroying' for incumbent organizations, and outsiders are needed to make the break (Tushman and Romanelli 1985, Tushman and Anderson 1986, Romanelli and Tushman 1994). For Schumpeter such innovations were unexplained and random. The literature on punctuated equilibria (Gersick 1991) identifies 'punctuations' but does not explain where they come from. The great challenge is to specify a process by which they arise.

Innovation does not necessarily have to follow problem solving, and may precede it, or may even precede generalization. But it is generally inspired by a change of context (generalization), in an accumulation of perceived failure and hints for improvement by comparison with and transfer from other practices. Reciprocation between distant practices requires a leap of imagination. The role of chance increases: we are in the field of serendipity, but it is the serendipity of the prepared mind. The role of the principle of imperialism appears again: in exploring new directions one may hit upon opportunities for transfer that one was not looking for.

This is the 'King Saul effect' (Mokyr 1990: 286). Looking for a better dynamo for bicycle lights, Philips Company hit upon the development of an electric shaver. Gasoline at first was a useless by - product in the derivation of lubricants from crude oil, before it was developed into a fuel for the internal combustion motor. Bessemer invented his steel making process while trying to solve problems of a spinning cannon shell (Mokyr 1990: 116).

A radically novel combination is not easy to identify as an opportunity, since it literally does not make sense; it cannot be interpreted in terms of existing practices, and therefore extends beyond established meanings and corresponding categories. It has no recognizable identity. That is why it is more of a lonely, personal affair: it is difficult to have the hunch make sense even to oneself, let alone others. A handful of people stumbled upon X-rays, but only Madame Curie saw what it might mean, and what its implications and uses might be.

How, then, do novel combinations arise? As the area of application of an existing practice is expanded, problems accumulate in the ongoing process of differentiation and reciprocation. Ad hoc additions and modifications mess up the clarity and efficiency of the practice, and increase complexity, resulting in loss of efficiency and diminishing returns: it becomes increasingly difficult to make further additions or modifications while maintaining coherence. Duplication arises, with foregone opportunities for economy of scale. Unsolved failures to perform are accumulated. This provides an incentive to consider a clean-up by dropping rather than by only re-arranging elements, in novel structures, in Schumpeterian 'creative destruction'. Above all: existing architecture of the practice imposes limits on the novel elements brought in. That is needed to preserve systemic coherence, but it prevents realization of the true potential of new elements. Thus pressures build up to break down the architecture to realize the potential of novelty. Experience has accumulated as to which novel combinations of elements, gathered in reciprocation from a variety of old practices, might be successfully combined, and by which architectural principles. There is a basis for reasonable hunches. Such, I propose, is the process of abduction.

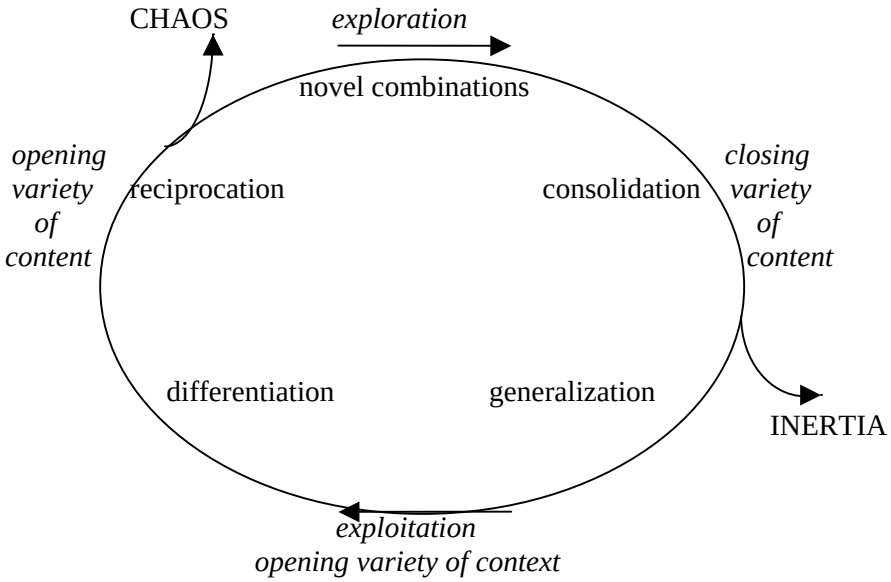
And when success in novel architectures emerges we are back at the beginning: the need for consolidation. But this also is not guaranteed: no new practicable synthesis may arise, and development may end in chaos.

Here, in the imagination and trial of novel combinations we find the Schumpeterian entrepreneur par excellence.

A cycle of discovery

The different stages together make up a cycle of discovery, as illustrated in figure 1. Nooteboom (1999) develops the cycle further by means of the notion of scripts to model the architecture of mental, organizational and industrial routines.

Figure 1: cycle of exploitation and exploration



The process can be characterized succinctly as an alternation of variety of content and variety of context. In consolidation variety of content is closed down to enable efficient production and to provide a clear paradigm, or prototype, as a platform for generalization. This opens up variety of context, which yields insight in misfits, in needs and opportunities for adaptation. Note that after consolidation development may end in inertia, due to lack of incentives or opportunities for generalization or differentiation. In the stage of novel combinations, in novel architectures, these may not settle down, and may get stuck in ongoing chaos of trials, errors and ongoing misfits that may lead to the development petering out or being dropped.

In a procedural sense the proposed 'logic' or heuristic of discovery is optimal: it provides exploration while maintaining exploitation; it minimizes destruction in the process of creation. It is not optimal in the substantive sense of resulting from the equation of marginal cost and revenue. That could not be because neither would be known. However, being optimal in some looser, procedural, sense, it need not yield a unique or optimal outcome. It allows for path dependence and suboptimal outcomes, and the path taken depends on context and coincidence. Different firms can develop different structures even in the same industry. As indicated before, 'logic' is put between quotation marks, because it is a heuristic rather than a logic in the sense of indicating a sequence of stages that is logically or epistemologically inexorable. It is a heuristic in the sense that it is generally the best answer to the problem of abduction, the best way of exploring while maintaining exploitation.

However, stages may overlap: there is generalization during consolidation, differentiation during generalization, exploration of novel combinations during reciprocation. Stages may even be skipped or reversed. The argument only indicates that then progress, in the form of successful renewal, is more risky. That is the issue of abduction. But it is certainly conceivable that one might hit upon successful novelty more directly, without one or more of the intervening stages. Innovation can occur less systematically, more randomly and spontaneously (Cook & Yanow 1993), when an obvious opportunity presents itself without much exploration. But as a general rule one needs to accumulate failures to build up the need for change, as well as hints in what directions to look: indications what changes could be made with some chance of success, and how. More random jumps would have the advantage of reaching the market faster, if they succeed, and to the extent that competition takes the form of races to the market, greater risks might be taken in more drastic leaps. Indeed, especially small firms do exhibit such reckless behaviour, and thereby they do contribute to the dynamic of economies. But in case of pure trial and error the risk of failure would be very high. Also, note that technological opportunities may affect the order and length of stages. For example, as indicated before, by simulating the performance of devices on computers rather than actually building prototypes and testing them, one may engage in virtual rather than actual generalization and differentiation, and in that sense skip those stages in the process of searching for viable novel combinations.

The process is not automatic: outside contingencies as well as organizational structure or culture, or lack of talent in people or teams, may block transition to a next stage. Consolidation may be limited due to alternatives persisting side by side. Generalization may be blocked due to a monopoly maintaining an exclusive hold, or due to lack of access to novel contexts (recall the case of stagnation of the Chinese empire). Differentiation and reciprocation may be blocked because there is insufficient motivation or capability to modify an existing practice. One may get stuck in inertia. There must be a basic interest in solving problems and making things work. While need is not a sufficient condition, it is often necessary. This corresponds with the notion in the literature on organizational learning that failures are needed to force a willingness to relax existing practice and explore variations or alternatives. In this way, as Schumpeter argued, crises help creative destruction. This brings in one of the contingencies: in markets with little competitive challenge the process may halt due to insufficient pressure.

The process of learning or discovery may not even be intended. Note that the process of exploration is triggered by the will to expand success, rather than the will to learn. But the experience accumulated in expansion in fact yields a basis for learning.

A cycle of (dis)integration

Some stages in the cycle of discovery require integration of activities, with strong ties, and others require disintegration, with loose ties among a variety of autonomous units. The connection between the cycle of discovery and the cycle of integration and disintegration depends on a number of conditions concerning market, technology and institutions.

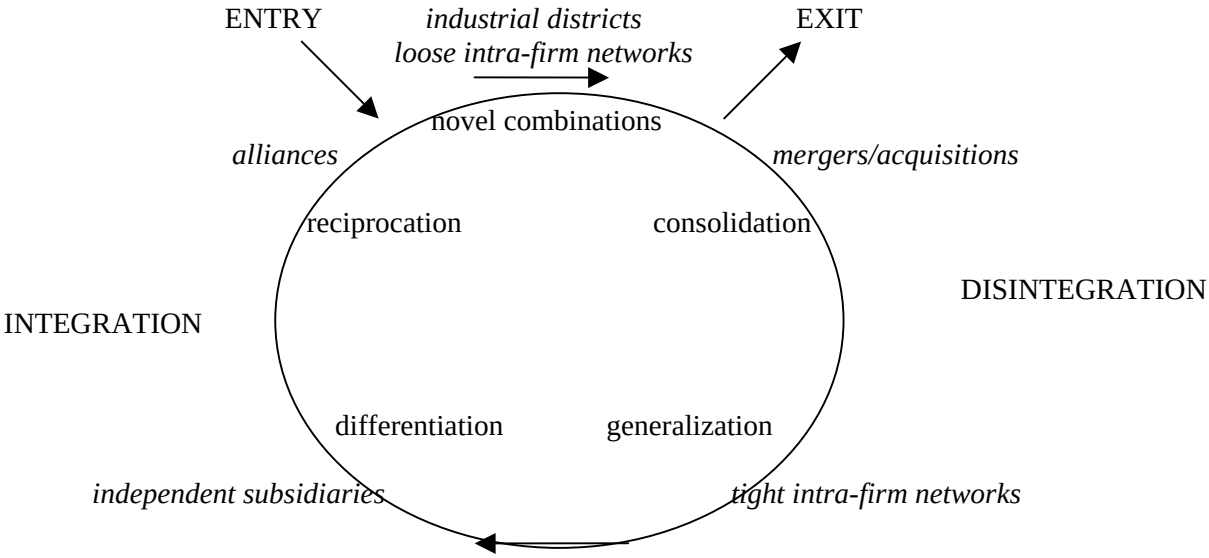
Radical innovation, with novel combinations, entails a redefinition and a reconfiguration of nodes into novel scripts, and hence requires a break-up of existing scripts (‘creative destruction’). This entails organizational disintegration. That may entail break-up of a firm, or decentralization into highly autonomous units. The connection between change and disintegration is in line with a long-standing tradition in the management and organization literature. It has been said long ago that stable, predictable environments require a ‘mechanistic’, bureaucratic structure, while volatile, unpredictable environments require a more loose, ‘organic’ structure (Burns & Stalker 1961, Emery & Trist 1965, Thompson 1967). More recently, Stinchcombe(1990) proposed that variety of information sources requires organizational disintegration. In the present discussion, ‘integrated structure’ is synonymous with ‘mechanistic’ and ‘bureaucratic’ structure, and ‘disintegrated’ structure is synonymous with ‘organic’ structure.

Note that I evade talk only of small versus large firms, because one can have connected firms in industrial districts and disconnected units within ‘virtual firms’. It is the degree of integration of activities that counts, in different forms of organization ‘between market and hierarchy’. The most extreme form of organizational disintegration is autonomous units, under separate ownership, who engage in pure, arms-length market transactions. Separately owned units can become more or less integrated, in the sense of losing autonomy of decision making and freedom of choice, by more or less constraining governance of inter - firm relations. These can entail more or less long-term, more or less detailed contracts; mutual dependence by dedicated investments or exchange of hostages, or other switching costs; routinization; building of trust. Next, units can become integrated under unified ownership, within a single firm. Within the firm, units can be more or less integrated in terms of centralization and hierarchical control. This depends on the tightness, rigidity and type of co-ordination. These more detailed aspects of (dis)integration go beyond the scope of this paper.

There still is a significant difference between large and small firms, but it concerns not so much technical efficiency as governance and management of meaning. As indicated in transaction cost economics, hierarchy yields opportunities to claim information for monitoring and possibilities for conflict resolution which exceed those among independent firms. As proposed earlier, the core function of a firm is to act as a ‘focusing device’ and to provide ‘shared meanings’; to align perceptions, interpretations and evaluations in order to achieve a common goal. However, both governance and common perception and understanding can also be achieved to a varying extent in various forms of organization ‘between market and hierarchy’.

The proposition now is that in industries the cycle of discovery is associated with a cycle of organizational integration and disintegration, as illustrated in figure 2.

Figure 2: cycle of integration and disintegration



Broadly speaking, the generation of novelty, in the stages of reciprocation and architectural innovation ('novel combinations'), requires more or less disintegrated structures, in highly decentralized firms, with a high degree of autonomy, or industrial districts of independent firms. Consolidation and generalization require more or less integrated structures, within firms or in tightly connected networks of firms. Differentiation requires an intermediate mode, with loosely co-ordinated networks or large firms with relatively independent subsidiaries. However, this is a broad generalization that is subject to many technological, organizational and institutional contingencies.
Both integrated and disintegrated structures may survive multiple turns of the cycle. That depends on the speed of product change relative to change of production, the degree to which production technology is inflexible and dedicated to specific products, the opportunity and need, e.g. from competitive pressure, to utilise economy of scale and the adaptation and differentiation of products. A large, integrated company can survive if economy of scale is large, products and production are systemic, and the opportunity and need to differentiate and change products frequently are small. Conversely, disintegrated structures, such as industrial districts, may survive if economy of scale is small, products and technology is stand-alone or modular and there is an ongoing need for differentiated and fast changing products.

A cycle of entrepreneurship
According to the cycle of discovery, without innovations of application (in differentiation, reciprocation) creative destruction (novel combinations) would not take place. Diffusion does not consist in a simple mechanical 'working out' of a single innovation. Generally, new contexts or new applications require adjustment or 're - invention'. Is this secondary innovation Schumpeterian or Kirznerian? The whole notion of equilibrium, and the distinction between equilibrating (Kirznerian) and dis - equilibrating (Schumpeterian) entrepreneurship becomes problematic. The point of the cycle is that in the combination of exploitation and exploration, in consolidation, generalization, differentiation, reciprocation, and novel combinations in novel architectures, diffusion lays the basis for the next innovation. What is supposed to be equilibrating at the same time is dis-equilibrating in the sense that it prepares for the next innovation. Entrepreneurship can be seen in both the creation and the realization of potential. The cycle of discovery entails that the realization of potential lays the basis for new creation of potential. Thus, along the cycle we find a combination of the two types, with the emphasis shifting from Schumpeterian to Kirznerian. There is not any single 'true' type of entrepreneurship, but a whole range of types, corresponding with the different stages of the discovery process (figure 1). Rather than being alternatives between which one must choose, these types are complementary: they build upon each other. In combination with the corresponding cycle of integration and disintegration illustrated in figure 2, this idea reflects the notion of 'dynamic complementarity', first proposed by Rothwell (1985, see also Rothwell 1989). According to this notion, small and large firms have different roles to fulfil in innovation, and are complementary to each other.

The stages of consolidation and generalization, with their shift to more systemic integration, increase of scale, division of labour and co - ordination would connect with Say's and Marshall's notions of entrepreneurship. Generalization entails the transfer to novel areas of application. For products this entails the entry into new markets. This reflects Mangoldt's notion of entrepreneurship, and was recognized also by Schumpeter. In differentiation practices are further adapted to differences in demand. It entails the realization of existing potential, but also entails learning and conceptual change, leading up to a next innovation, and this is part of Austrian entrepreneurship according to Menger and Hayek. Reciprocation, which has the logical structure of metaphor, is more Schumpeterian in that it explores elements for novel combinations. Schumpeterian entrepreneurship fully comes into its own (but goes beyond Schumpeter) in accommodation towards novel combinations in novel architectures, where existing structures of action (scripts) are broken down and from the debris novel practices are experimentally built up, to survive, die or be improved in the subsequent stage of consolidation.
But the point of the discussion is perhaps not to fit in existing notions of entrepreneurship without overlap and gaps, and thereby reduce the cycle of discovery to existing notions of entrepreneurship. The point is to provide a new perspective beyond existing notions of entrepreneurship, and to deduce types of entrepreneurship that were not recognized before. The following types of entrepreneurship then emerge:

In differentiation:

- Incremental innovation or adaptation of practices to a diversity of demand or available inputs, technologies and competencies, while maintaining the basic elements and architecture of existing practice. The need and opportunity for this derives from attempts at generalization to novel contexts. This requires some amount of perceptiveness, imagination, and resources, scope for initiative and the courage to use it and accept the risks involved. Organizationally, it requires a certain amount of decentralization. Here we need the inventiveness of the 'intrapreneur', and the ability of management to handle decentralization.

In reciprocation:

- Importation of elements from 'adjacent' practices that in novel contexts appear to be better in some respect of product or production, while maintaining the architecture of the practice at hand. The requirements from the previous stage apply to a higher degree: imagination to produce metaphorical ideas for novel combinations. In an existing firm, it requires an organizational structure and culture that allows for that. This can be very problematic and requires organizational ingenuity or innovation. How can one organize under disintegration? There is a need to balance integration of activities within the firm and collaboration with other firms, in alliances.

In accommodation:

- Recombination of elements from diverse practices in a new architecture. If the origin of ideas lay inside a large, integrated organization, this will often require a spin - off. This stage requires exceptional imagination, heterodoxy, courage, and organizational autonomy. There is need for a capability to act in networks of organizations, in the process of developing and testing novel combinations.

In consolidation:

- Trials of new combinations. This requires risk acceptance, determination, perseverance and charisma and leadership to bring other people along, including suppliers of capital.
- Efficient selection of failures. This requires sense of realism, judgement, or an efficient selection environment.
- Adapting existing systems of application to allow the innovation to achieve its fullest potential. It may require standardization, large - scale production, utilization of scope. This requires influence, resources, management, co - ordination.

In generalization:

- Further standardization, increase of scale, internationalization (export, foreign investment). A Chandlerian or Weberian marshalling and rational direction of coherent systems of specialized resources. This requires a variety of resources, including international experience and contacts, ability to co - ordinate.

Let us review how the process works, on the level of an industry. We need to show how firms seeking their own self - interest generate discovery in markets. On the industry level, if at any stage incumbents failed to utilize any opportunity produced by preceding stages, sooner or later some firm would enter from somewhere in the world to do it, if there are no entry barriers to prevent that. Note that when the logic of discovery is applied to the market, it is pervaded by competition. But shifts occur between different types of competition, and competition is seldom perfect. The drive behind competition is that entrepreneurs at all stages try to distinguish themselves from others, and thereby push profits above marginal costs. They do this by the following activities:

- differentiating their products (in the stage of differentiation)
- adding novelties in the form of features from other contexts (in reciprocation)
- coming up with novel combinations (accommodation)
- developing the most efficient form of a novelty (consolidation, substage 1)
- effecting wider systemic changes to utilize the full potential of a novelty (consolidation, substage 2)
- implementing scale, scope and efficient production
- carrying the novelty to new contexts by exports and foreign investment (generalization).

Competition does not take the form of everyone doing the same thing and pushing prices to marginal costs, but rather by replacing products and practices by ones that are better, in being more efficient, or satisfying preferences more closely, or generating novel perspectives for production or consumption.
A firm is not likely to survive and make a profit if it does not contribute to this process. To do so, it will have to offer the type of entrepreneurship which is appropriate to the stage to which it aims to contribute, as deduced above. It is not likely to succeed if it tries to organize large scale production before knowledge about it has become documented to provide the basis for division and co - ordination of labour. The risk of failure is large in carrying a practice to large scale and novel markets before it has proven its feasibility and worth. Novel combinations which are a leap in the dark, in random trial, may succeed but are less likely to do so than trials informed by experience. Such experience is derived from the failures of existing practices, insight in opportunities for variations in different contexts, and experiments with novel combinations of elements from practices that have similar elements or architectures.
When we survey the cycle as a whole, the central challenge for leadership is to combine exploitation and exploration and solve the corresponding paradox of combining integration and disintegration, or alternating between them. How does one arrange for the proper type of entrepreneurship, and the proper degree of (dis)integration, or mix of integration and disintegration, at the proper time? This leads on to a more detailed discussion of alternative modes of organizing to do this, which is beyond the scope of the present paper (see Nooteboom 2000).

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