Track 5
Evolution of global management knowledge

Globalization, Strategy, and Evolution: A Systemic Evolutionary Framework for Organizational Change

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- **Abstract**

The paper develops a formal evolutionary framework for organizational change. It argues that strategizing is part of a learning process that can be captured using evolutionary concepts illustrated by the example of globalization processes. These lead to entry and encounters of organizations of different fitness levels. New and established actors need to learn and adapt to new conditions. The argument is based on a model of systemic evolution that allows to consider the learning process of actors. The paper extends the evolutionary economic framework in two directions a) by supplying a micro-level concept superior to routines and b) by focussing on a systemic evolutionary school that is superior to Neo-Darwinian and Lamarckian approaches to (social) evolution. The power of the framework is shown by its ability to integrate relevant perspectives in the area of organization and strategy.

The paper is organized as follows: It discusses theoretical perspectives from strategy, economics, evolutionary biology and psychology at first. Then it builds a link between micro- and macro-levels of social systems based on an evolutionary conception of organizational change. The paper then links managerial actions and the evolution model to organizational performance outcomes, followed by a discussion of organizational development as evolutionary competitive process in globalization.

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1. Introduction

Globalizing markets and reduction of market entry barriers lead to intensified competition. This results in increased chances and risks as well as a paradox: An enterprise is not able to adapt to markets and to change corresponding to the transformation of society by increases in efficiency alone. In new situations, radical structural changes in ways of doing things are indispensable, thus the highly-aggregated level of strategic thinking and acting forms a core element of the enterprise strategy (Smith and Tushman 2005, Berndt 1998). Only through constant improvement of operational effectiveness, enterprises can reach and maintain profitability. Furthermore, enterprises are challenged not only by direct competitors, but increasingly also by related industries which may enter and offer substitutes (Allen 1999). This applies particularly to the situation of globalization, where companies face opportunities and threats from opening new markets, and to situations of (rapid) technological change, where new technologies offer new ways to enter markets and assault 'establised' players.

The increasing dynamics and globalization of business requires thinking in complex systems - in contrast to traditional economic thinking oriented at linear, deterministic thinking. This is also true for strategic management (Stacey 1993, Malik 1993). Enterprises are internally dynamic, networked systems, which are integrated into a large number of complex environments containing complicated feedback effects. They interact with partners such as customers, investors, retailers, interest and political groups in society, regulation and tax authorities, government, potential cooperation partners and competitors. Therefore, the principles of evolution and self-organization in natural systems can and need to be applied to typical management challenges: innovations and dealing with complexity and uncertainty (Alchian 1950, Nelson and Winter 1982, Kirsch

1997). Management needs to adapt situatively to the complexity of its tasks and challenges. This allows and requires to reduce complexity when situations and requirements are principally known and to increase complexity in situations of uncertainty and change, such as the development of new products and processes, entering new markets and facing new competitors. Ambidextrous management of exploitation and exploration is necessary (Smith and Tushman 2005). Management therefore should not be oriented at optimization, but at balancing, integrating and synthesizing different factors. Continuous development of the organization can be controlled via conditions and rules, needs to be reflected upon, and needs to be adapted to the requirements of a changing situation (Malik 1993). Despite their degree of complication, enterprises show patterns of order and follow certain rules of conduct. Therefore, Malik argues, evolutionary thinking is always thinking in systemic contexts.

The complexity of the market as well as the speed of the change requires enterprises to be always prepared to use new possibilities and deal with badly calculable risks. Enterprises which react to radical environmental change with revolutionary change are most successful, while those reacting with incremental change frequently lose their performance strength. In both cases, enterprises must continuously generate new competitive advantages and carry out permanent transformations to prevent falling behind the competition. They must develop a deep understanding of the dynamic generation and maintenance of competitive advantages. Enterprises are often facing 'hyper competition' (D'Aveni 1994), sometimes in order to attain strategic superiority by means of disruptive change (D'Aveni 1999). Thus competition under technological change and globalization can be described as accelerating competition over price, quality, market position, and perception of these characteristics of customers, which is heavily influenced by the evolution of the perception of managerial actors. However will this pressure of increasing change remain with us forever or will it recde again?

Whether the answer is yes or no in both cases an evolutionary framework to social processes an management is valuable. An evolutionary framework is naturally suited to changing environments and particularly to rapidly changing environments – in contrast to tools derived on the mindset of mechanistic, linear systems. Therefore an evolutionary approach allows to develop better tools to deal with evaluating threats and opportunities as well as balancing exploration and exploitation in changing environments. However, it even allows to incorporate the models build on mechanistic, linear analogies as special cases. Therefore one need not completely throw the old wisdom over board or operate in a black and white fashion. The reason is that the evolutionary framework allows to form a meta-perspective on change and shifts in speed of change based on systemic properties evolving entities. Systemic evolutionary approaches sustained by historical data can tell us something about the likelihood of facing further increasing or decreasing speeds of change.

The paper is organized as follows: section two presents the theoretical perspectives of strategy, neoclassical and evolutionary economics, evolutionary biology in its Neo-Darwinian and systemic versions and psychology as basis for dealing with actors' mental representations. Section three presents the core of the argument: an evolutionary characterization of organizations and an evolutionary model of organizational change driven by economic competition. Section four discusses the application to competition under globalization and presents some conclusions.

2 Theoretical Perspectives

2.1 Strategy

Strategy research has often - though not always - focussed on the connections between the elements of strategy, structure and performance (e.g. Chandler 1962, Rumelt 1974). This approach has been criticized because of the limited causal proof of the links between these elements (e.g. Miller 1979) and the emergent nature of strategy (e.g. Mintzberg

1994). Thus Rumelt (1991) has called for an evolutionary approach to the analysis of the development of industries. If such an analysis is not to stay on phenomenological levels just 'correlating' changes in several areas, one needs a causal micro-story of how strategy comes about. A potential perspective filling this need has been proposed by 'strategy-as-practice' researchers (Whittington 1996, Hendry 2000). The strategy-as-practice approach to strategy aims to develop a micro-perspective on strategy-making. Thus it operates on the micro-level of managerial actions. This perspective requires a complementary perspective on the mental representations of actors that influence managerial actions.

To make strategy amenable to an evolutionary analysis requires integration with an evolutionary perspective to economic behavior (Nelson and Winter 1982) and organizational ecology (Hannan and Freeman 1989). It is argued that the micro-level approach to strategy needs to be integrated with a cognitive perspective that 'controls' actions such that a 'learning-loop' results. Strategy is seen here as an evolutionary process of strategic action and re-action dependent on actors' perception, where novelty and emergent effects occur in social systems. This leads to (co-)evolutionary processes of change and adaptation in populations of intra-organizational actors and organizations.

2.2 Economics

Strategy research is often based on the theoretical perspective of neo-classical micro-economics, assuming rational utility maximizing actors. An evolutionary perspective to strategy needs to be build on (a modification of) evolutionary economics based on a cognitive perspective.

Neoclassical Economics focuses on the adjustment process between plans (decisions) and actions of self-interested, utility maximizing individual actors which act under scarcity in markets coordinated by an omniscient auctioneer. It builds on a metaphor derived ultimately from the thermodynamics of the late 19th century (Mirowski 1989). Neoclassical economics cannot claim to be able to cover and predict all of human behavior, but prediction of human behavior is possible for the rational part, which

requires the above utilitarian assumptions . The irrational part essentially cannot be predicted (Krugman 1999, Friedman 1996).

Evolutionary Economics aims to analyze particularly the developmental, dynamic aspect of economic processes based on a framework of evolutionary processes and assumes myopic, error-prone but learning, satisficing actors influenced by traditions, habits and norms (see e.g. Veblen 1898, Alchian 1950, Simon 1967, Nelson and Winter 1982). Evolutionary economics contrasts from mainstream economics by its focus on human characteristics, cultural, organizational and institutional contexts and endogenous factors of change.

On the one hand, evolutionary economics is largely wedded to a paradigm of blind (undirected, random) variation and selective retention, which dates at least back to Donald Campbell's article on evolutionary epistemology (Campbell 1960). Evolutionary economics is therefore largely characterized by a quest to transfer the conceptual structure of the Neo-Darwinian synthesis (henceforth NDS), which explains evolution as the outcome of blind mutation of the genotype and selection of fitter individuals according to their phenotypic characteristics. On the other hand, with Nelson and Winter (1982), evolutionary economics has tried to adapt to a Lamarckian conception of social change, which is logically at odds with blind variation. Thus the quest for analogues to the biological concepts has proven thorny, if not impossible. The reason for this may not lie in an inappropriateness of an evolutionary analogy as such, but in the inapplicability of Lamarckian and NDS models for social systems, because of their mutual inconsistencies. The explanatory structure of the Lamarckian and NDS models seem to be too undifferentiated and not fine grained enough for social systems. Moreover, the micro-level concept employed by Nelson and Winter, routines, has been defined in differing ways by the authors (cp. Hodgson 2003), suggesting a certain unease with the applicability of the concept by the originators themselves and has consequently been found hard to apply in social settings (Becker 1999).

The point is taken up in section three again: a modified evolutionary structure for social systems and a micro level element will be suggested. The next section lays out the evolutionary schools and personal construct theory.

2.3 Evolution

The Neo-Darwinian Synthesis NDS models can explain processes of differentiation (speciation) through competition, biogeographical niche development, and arms races. These types of models have trouble with analyzing and explaining system–transforming, structural changes. Conceptually this leads to the postulation of emergence (see Lorenz 1973, Mayr 1982) and sometimes even holistic explanatory schemes - or rather calls for these. The NDS model therefore probably does not constitute a sufficiently rich structure for explaining creative and social - possibly evolutionary - processes. Common arguments against a biological analogy include the importance of human foresight, design from intent, the functionality of artefacts and actions.

Systemic Evolutionary Biology Thus a number of related problems are not even addressed in the framework abve. Intent, design, and functionality questions are not tackled. In the biology area, these are constituent elements in human ethology, evolutionary psychology and morphology. These disciplines served probably consequently as the background against which a systemic approach to biology and evolution was developed by the 'Altenberger Kreis' (inter alia Konrad Lorenz, Wolfgang Wieser and Hans Hass, whose perspective was further extended by Rupert Riedl and investigated by Gunter Wagner, Walter Fontana, Leo Buss). Thus systemic evolutionary biology may serve as a further source of inspiration for theoretical structure and investigative tools.

This school of thought claimed for years the importance of selection processes internal to the organism (Riedl 1975), the relevance of functional interaction of (organic) systems and their parts for the evolution of adaptations (Hass 1970), the problem of

emergence (Lorenz 1973). These are the elements that come only now into the focus of social evolution researchers, having to cope with the selection of ideas and technologies in firms, the complex processes leading to financial success or demise of firms, as a building block of the problem of economic growth or the interrelated adoption and adaptation of fashions, beliefs and technologies in societies, subpopulations and peer groups.

A prevalent characteristic of systemic evolutionary biology is the trial to deal with feedback effects from 'the environment' on the medium that carries information over generations. These feedback effects are obvious in social systems but are usually rejected in evolutionary biology, with some notable exceptions (e.g. Riedl 1975, Wagner 1983). To prevent misunderstandings, it must be mentioned that they do not argue for a Lamarckian theory of evolution, but for a feedback effect on the level of the population via successfully selected structures and phenotypes and the effect this has on further selection.

Systemic evolutionary theory therefore does not reject standard NDS theory, but rather claims the NDS theory needs to be extended. The NDS is based on the assumption of undirected, random mutation on the genetic level, while systemic evolutionists argue that change is not completely random but constrained, if not 'directed' by the existing structural make-up (on the genetic and morphological level) of organisms and its limited freedom for change (for an overview of these issues see Riedl 1975, cf. also Szathmary and Maynard Smith 1995, who argue coming from a mainstream biology point of view).

2.4 Psychology

Ever since Thorstein Veblen's critique of economics' dealings with psychology, evolutionary / institutional economists need tools to operationalize and formalize the necessary psychological toolchest. Here is one possible way to get it.

A true evolutionary account of social phenomena requires the researcher to juxtapose the perception of actors with its effects in the real world over longer periods. Perception could play an analogous role to the biological genotype while the role of the phenotype is taken by artefacts, designs and documents. The cognitive landscape concerning a field of concepts of an actor could be seen the analogue to a chromosome. Such a conceptualization allows to capture the perception of an actor in a cognitive architecture, based on dichotomous separation between the defining characteristics of concept.

2.4.1 Personal Construct Psychology

One perspective from psychology that seems useful in an evolutionary characterization of social processes is personal construct theory (Kelly 1955, Addams-Webber 1979, Bannister 1985). It posits that humans perceive and structure their world mentally along dichotomous conceptual poles. These concepts can be seen as elements in cognitive maps describing the structure and content of actors' worldviews. This perspective manages to show the existence of a binary, hierarchical ordering of human concepts. It focusses largely on changes in this ordering and self-perception.

Kelly's personal construct theory forms the basis for cognitve mapping approaches to strategy that aims at building actors' mental representations of strategic issues, conditions, constraints and relationships in causal maps (Eden, Ackermann and Cropper 1992). Fiol and Huff have criticized these approaches in that they usually are disparate endeavours that lack integration and coherence (Fiol and Huff 1992). Furthermore, the method is largely descriptive, as it builds on the analysis of cases by interviews and observation, and it is interpretive in its conclusions on the basis of these materials. In order to facilitate further scientific analysis it needs a link to pattern identification and analysis across large samples.

The correlation between the mental structure of perceived attributes and the structure of real world phenomena can be measured over time - showing the process of individual and group learning. If the concept is transferred to groups of people one may be able to

identify different systems of belief between different groups of actors. By assigning numerical values to the degree of difference between these belief systems, empirical measures can be easily constructed. Likewise the evolution of such cognitive architectures - if sufficiently identifiable from historical documents - should allow the tracking of mental representations. Thus researchers should be able to relate changes in mental representations with effects in the real world over long periods. This theoretical structure would allow for the transfer of evolutionary theory to the social sciences as well as providing the necessary differentiation for social systems.

2.4.2 Gestalt Theory and Evolution

Blind variation: Campbell has argued that social evolution is a process of blind variation, based on the statement that innovations are derived from a large sample of trial and error 'events' by individuals (e.g. Campbell 1960). Campbell's blind variation is not the same as random variation in that certain properties of the statistic concept of randomness, i.e. equiprobability and statistical independence, need not be fulfilled. Nevertheless, most evolutionary arguments and particularly simulation studies, such as Nelson and Winter's and those building on them, employ the concept of random variation. Blind variation refers to the sampling of a large quantity of trials, where variations are independent of the environmental conditions of their occurrence, the occurrence of trials is individually uncorrelated with the solution and the variation subsequent to a trial does not involve a correction of previous trials or makes use of the direction of error of the previous trial (Campbell 1987[1960]).

Patterned variation: Schlicht (1997) and Kubon-Gilke and Schlicht (1998) argue that social evolution is patterned and essential changes are created by what they define as directed evolution. Directed evolution - to be understood without teleological connotations - refers to structured (or patterned) variation in the sense that regularities in the emergence of variation exist. These regularities are an important part of the process of evolution in creating novel features. In contrast, blind evolution (based on random

variation) leads to stabilization of existing characteristics in entities, since variation is often too far off a viable 'hit'. Existing characteristics are seen as residing at or near local optima in the fitness landscape, so that too large variations tend to lead away from a 'good' working organization of elements, while small variations may increase fitness values (until the peak is reached).

The argument runs as follows: variations are coupled in social evolution (as in biological evolution), since psychological regularities (gestalts) generate patterns in innovations, and complex organizations (and artefacts, the authors would like to add) are characterized by functionally correlated traits. Therefore variation must be kept within certain limits and is correlated, but not purely random. Since the structure and elements of an organism determine what variations are possible at all, the structure and elements of technical and social systems influence the type of variations that can occur in social evolution.

Directed variation can occur - in strong analogy to evolutionary biology - due to canalization by constraints, radiation and irreversibility (which occurs when existing entities enter new niches and adapt on the basis of their existing structure), functional shifts of an element, structural couplings and correlated variation, hitchhiking effects (if a characteristic is coupled to another in the inheritance 'code' or process).

Examples: Schlicht illustrates the assumed analogy between biological and social directed evolution by the following examples:

- Channelling by constraints: people act on the basis of strategies, rules and habits, and customs and laws acquired in the past.
- Hitchhiking: people act from reason and strategies, where similarities are treated similarly, which may lead to dysfunctional behavior, similar to a characteristic with positive selection value coupled to one with negative selection value. Examples include artefact features and technical standards.

- Irreversibility: new behaviors are developed by means of old behaviors, but if the old behaviors are forgotten the new ones cannot be reached again independently.
- Radiation: people learn by imitation, use analogies and try to cope with new problems by applying established strategies and procedures which are modified subsequently.
- Founder effects: first impressions influence later developments, actions, strategies.
- Functional shifts: insight is equivalent to restructuring a given problem.
- Evolutionary detours: teaching practices for example in music education.
- Punctuation: learning phenomena related to insight learning.

Thus the patterns of variation we should observe in processes of 'social evolution' are usually limited to local variations of existing themes that build on the existing mental structures of actors. Radical 'deviations' are possible in principle given humans' freedom to think, but unlikely given socialization processes and social pressure. This can explain inertial phenomena. The occurrence of novel concepts needs to be seen against this background. Thus measurement of novel, emergent patterns as described below is a relative enterprise.

3 Linking Micro-and Macro-Levels of Organizational Change and Performance

3.1 Micro-Organizational Dynamics: Perception and Systemic Evolution

To apply the cognitive learning perspective on evolution to social systems, it must be linked with decisions and actions. These are arguably controlled by the mind set and cognitive maps of actors. This allows to link the level of individual sequences of actions as focused on by strategy-as-practice and evolutionary perspectives. Structurally, the process looks like this:

$$MR / CM^{t} \rightarrow p_x{}^{t} \rightarrow D/A \rightarrow p_x{}^{t+1} \rightarrow MR / CM^{t+1} \quad (1)$$

with

MR: mental representation,

CM: cognitive map,

p: perception,

D / A: decision or action.

MR / CM: mental representation given a certain cognitive map

Thus social evolution is - much like biological evolution - a process of knowledge growth based on the interaction of hypotheses and the real world (cf. Riedl 1975, 2000). In the course of social evolution, a population of entities is perceived to be associated with certain characteristics which leads to decisions and actions. This affects the population of entities in terms of types of entities and the set of characteristics they comprise, as well as the perceptions of actors. So there are feedback effects from perception to entities that make up a population, the characteristics these entities possess and the decisions / actions that actors take. In turn, decisions / actions affect the population of entities and actors. This is what is argued to be behind the Lamarckian character of social development processes. However the process is not really Lamarckian, since mental representations supply us with a distinct unit of information storage that is necessary for differentiating Neo-Darwinian and Systemic evolutionary approaches from Lamarckian ones. Furthermore, we can define new generations on the basis of mental representations – equating every meaningful update of mental representations with the 'emergence' of a new generation. In so far the evolutionary view of social development and a learning perspectives merge 'in the limit' of infinitesimally small 'generations'.

There are two levels and areas in which the combination of an action oriented and an evolutionary (economic) approach to strategy comes to mind. The first one is the observation and measurement of emergent strategies a la Mintzberg (for which Goertzel's measure of emergence is used). Secondly, this concept is linking it into a larger process of evolutionary selection on the level of organizational populations. The latter can solve the problem of connecting the micro-level of strategy (e.g. in the strategy as practice perspective) and organizational performance, given enough fine-grained data. At first we contrast the neo-classical and the systemic evolutionary approach to organizational change and then we discuss the two cases introduced above.

3.2 Organizational Dynamics: Neo-Darwinian Evolution?

Social Evolution is conceptualised here as a process in which real world artefacts, actions, decisions and mental representations influence each other under the "limiting conditions" of an institutional environment. Institutional environment refers to cultural, legal and organisational characteristics as analyzed by List (1846) and Veblen (1898). In this process characteristics of artefacts and their configuration matter as well as mental representations and their structural ordering in cognitive maps. Cognitive maps and actions or decisions flowing from them, give rise to individual and organizations' competencies.

The set of competencies and the existing norms and values as well as the technological / tool-infrastructure are interrelated with the set of mental representations / personal constructs and organizational routines by which an organisation operates; the latter are thus rules of behaviour.

The separation between existing and available routines is logically possible, but more useful is a distinction according to the frequency of use, ease of use and ease of increase/decrease in frequency of use.

Routines (seen as combinations of actions) and associated mental representations, can be affected by the composition of the competence pool, by teaching or by 'hiring and

firing', which leads to addition or subtraction of an individual or groups of individuals. An example would be the following: consulting firm sends a specialist to a firm, to facilitate reorganisation by communication/moderating processes. The routines and tools or (technical) infrastructure give rise to organisations' capabilities. These capabilities enable the organisation to produce products and/or services.

In extreme consequence, this means that cultural/learning processes can be simplified to a Neo-Darwinian account at least in certain cases – e.g. those where (research of) competence introduction and development is not linked to a causal account of how it comes about. In this case, the introduction of competencies or capabilities is equivalent to the exogenous introduction of new competencies 'out of nowhere', as e.g. by mutations. Results from replicator dynamics models (Hofbauer & Sigmund 1984) can be carried over to social sciences in organisation studies and economics therefore (see e.g. Silverberg 1997). Socialization processes are one of the means by which social and cultural concepts are transmitted to younger generations in the social realm (see e.g. Kogut & Zander 1992, Pantzar & Csanyi 1991) and allow the replication of behaviours. Boyd & Richerson 1980, for instance, provide a simple model of cultural evolution including socialization processes applied to an economic problem. Together with stochastic influences, socialization is argued to be responsible for the inertial, path dependent character of organisations (Stinchcombe 1965, David 1994).

3.3 Emergence and Organizational Change

The explanation of novel features and novel structures is a prime target of evolutionary theories. In social science and biology this relates to the explanation of the development of specific characteristics in systems and the structural change of systems. One can certainly argue that random change in elements and random recombination of elements may lead by the sheer power of statistics to the emergence of novel characteristics and novel systems in the long run. This statement obviously does not specify a causal mechanism, but deals with the general possibility of observation of such novelties. It does

not explain how these novelties 'individually' come into being and whether - or to what extent - there are specific and general circumstances and mechanisms. Consequently, it does not allow to identify patterns in the emergence of novelties. One can argue that this should not be the concern of such a theory but of ongoing research in 'lower level' areas such as molecular biology and genetics respectively micro-sociology or psychology. However, the existence of a causal explanation allows consistency checks between adjacent levels of scientific disciplines.

One way to measure emergence is proposed by Goertzel (1992), who defines emergence on the basis of patterns, which serve as proxy for the size of the structure, or structural complexity of an entity. The structure denotes the set of all patterns in an entity , where only the incremental addition by a pattern in a list of patterns is considered. Therefore Goertzel defines emergence between two entities as fuzzy set:

$$Em(w,x) = S(w \cup x) - S(w) - S(x) \qquad (2)$$

This means emergence is defined as the set of patterns in the combined unit without those patterns that are patterns in one or the other entity individually. For technical details refer to Goertzel (1992) and references given therein. Given a sufficiently unambiguous definition of behavioural patterns and actions, theory and particularly observations of the strategy-as-practice approach can be used in measuring emergent strategies. Putting aside the problem of the precise characterization of change, Goertzel (1992) suggests to operationalize measurements of the evolutionary process on the basis of his definition of emergence. Let an ecosystem E, which contains entities that can be organized into classes L1,...Ln, where every entity in L1 is part of a certain entity in Li+1. These classes could denote chromosomes, organisms, populations, species (or in social systems, individuals, groups, organisations, industries or economic communities, national economies, the global economy). An indicator of fitness is the fit between an entity A and the ecosystem it is adapted to: Em(A,E-A). Let a characteristic evolvability

ev(Li), which is a measure of the correlation between structural fitness and survival rates of entities on a given level. Each entity y may be expressed as function of entities on lower levels as well as entities collectively called z (those which are possibly not included in the hierarchy of classes), giving y=(x1,...,xn,z). This gives rise to a 'holistic structural fitness' of y relative to the hierarchy L1,...Ln:

$$HSF(y) = Em(y, E-y) - Em(x_1, E-x_1) - \ldots - Em(x_n, E-x_n) \quad (3)$$

3.4 Organizational Evolution and Performance

Given that we have observed micro-processes of strategy over a sufficiently long time horizon we can not only observe patterns in (emergent) strategies but make a connection between (the changes in) the day-to-day actions of organizations, processes of aggregated change and finally performance outcomes. Organizations do not necessarily represent optimum bundles of resources and strategies, led by rational and foreseeing managers. Nor are they adapted in an optimum way to their environment (Kane 1996). Rather, they are more or less successful combinations of characteristics that work sufficiently to survive (Hunt 1997).

$$O_i\{C,R,S,A\} \Rightarrow F, L(O_i) \geq \{O_{j \neq i}\{C,R,S,A\}\} \Rightarrow F, L(O_{j \neq i}) \quad (4)$$

An Organization (O) is a set of competences and capabilities C - embodied in employees as well as - resources R and strategies S, that give rise to actions A which ensure inflow of financial resources and legitimacy such that it is viable relative to its competitors. Particularly in today's situation of change dynamic capabilities are required to stay competitive relative to competitors moving forward. This means there is a process of malthusian dynamics working on the fitness f of organizations. This is expressed here in a Fisher-type equation (cf. Silverberg 1997):

$$\dot{f}(L(O_i), F(O_i) \geq \dot{f}(L(O_{i \neq i}), F(O_{i \neq i})) \quad (5)$$

It is assumed here that both, financial resources and legitimacy, play roles in the (long-term) viability of organizations (market participants). The example of plant biotechnology in Germany shows that such types of projects are not viable because of their perceived potential health risks by the general public and political resistance. One could model this effect without legitimacy by setting sales at zero or very low levels. But sales are not necessarily the crucial factor. Expected sales might even be sufficiently high to allow for smaller companies to survive, but it is questionable, whether there will be investors and entrepreneurs willing to take the political risks involved. Considering legitimation explicitly allows to endogenize sales and capture an underlying 'iceberg' variable, which may become suddenly relevant if the cognitive structure of the general public changes. [1]

For starters, we can assume as first approximation that the speed of change (i.e. the second derivative) in f might be taken as a proxy measure of selection pressure P_s accounting for changes in organizations O_i. Although one might expect the first derivative to fulfil this role, theoretically the same level of fitness needs to be uphold at least to stay in competition. Therefore not change but the increasing or decreasing degree of change correlates with selection pressure. In social systems, differentiation, monopoly situations and collusion limit the impact of competition and allow for some leeway to lessen the impact of selection pressure.

In practice, the character of the dynamic development of the system is governed by more factors than O_i, such as changes in actors' perception, regulatory pressure, influx of new competitors, e.g. by opening national barriers to trade, changing market barriers, policies aimed at increasing the founding of new companies. This interactive nature of evolutionary processes among groups of actors in connected 'ecological' settings is often is captured by the term co-evolution (cp. e.g. Lewin and Volberda 2003). Formally, co-

evolution is already implied in the equations describing the process of evolution of populations of (partly) competing and competitors and otherwise interacting groups of organizations (O) under changing institutional conditions. This topic will be covered in more detail in another paper.

Herein also lie some interesting research questions of how to define the construct of selection pressure and how to measure it. In a causal account we need a function relating selection pressure Ps with the above mentioned factors:

$$P_S^{t\to t+1} \approx \ddot{f} \approx \Delta^{t\to t+1} Em\,(O_t, E - O_t) \qquad (6)$$

where E denotes the economic environment.

If fitness is seen as match between an organization's characteristics and its environments and competitiveness as a similar match between environmental, respectively customer demand and organizational characteristics, then the Goertzel measure also measures competitiveness. Biological fitness, and economic competitiveness are equivalent under this formulation. Both are seen as a relative measure of the ability to extract and use resources efficiently based on an organism's or organization's characteristics relative to characteristics of competitors and environmental conditions.

4. Linking back to Globalization and Implications

4.1 Globalization

We have presented an evolutionary framework to deal with changing environments. However, the process of change itself is not new. New are the specific internal and external elements, conditions and requirements of change, the resulting developments and

the intensity and speed of necessary change. This correlates with a decrease in certainty about where developments are going and the right thing to do. Much of what was real, machine-like, determined and objective became unpredictable, indefinable and subjective in the middle of the last century (Arthur 1999). The conditions for economic actors in a changing environment are doubly uncertain on the basis of ecologic uncertainties and inabilities to calculate and predict developments. The calculation and knowledge required for identifying the best alternative are beyond the possibilities of actors (Hayek 1945).

The forces of change are seen in the acceleration of communication, a tendency towards immateriality and networked organization, a higher fluidity of organizational boundaries, and an increasing autonomy of action in actors and enterprises (Schreyögg 2000). These changes increase the importance of innovation and the ability to innovate. The specific selection conditions and decisions in markets and society determines which inventions will prevail. Selection, therefore, is a key concept for institutional and cultural change (Burns and Dietz 1998). This requires better and more efficient forms of cooperation and control (Laszlo 1992).

Cultural and social systems themselves are subject to an increasing tension between integration and disintegration. Thus, the tension between economic 'global homogenization' and 'cultural differentiation' reflects a fundamental tension at the basis of both, small social systems and large societies. The tension of differentiation versus homogenization and maintenance of social order or integration thus seems to be a driving force at the basis of our life-world. Taking a larger perspective, one can argue that also social processes show evolutionary characteristics. The emergence of stable systems requires a balance between traditional structures and variation. A systemic evolutionary theory of economic processes may thus be able to better deal with the tension between homogenization and diversity than neoclassical economics alone. This theory can be used to inform strategy and management practice by putting emphasis on the historically shaped path-dependent character of social developments.

Globalization conforms to breaking down of barriers between formerly isolated 'habitats'and entry of new competitors. This process requires adaptation of entrants to new environments, as well as the adaptation of environments and established competitors to new competitors (cp. Volberda and Lewin 2003). In terms of the Fisher equations (4 and 5) it means that those competitors that are well below the level of fitness in terms of financial resources, dynamic capabilities and legitimation of their established or entering competition and which do not manage to adapt their characteristics quickly will either not suceed in defending their established market position or in attaining market entry. Managerial perception of these issues, involving learning of which characteristcs need to change and how to achieve these goals are the means to overcome a 'deterministic biological fate (of entities that cannot change)'. However, the historically evolved constraints of organizational and insitutional structures and individual perception may slow down or limit the impact of such learning processes. In turn, these constraints pose also opportunities for entrepreneurial actions by intrapreneurial managers and independent entrepreneurs who may manage to build enterprises to exploit new niches.

4.2 Conclusion

This paper focuses on the "ecological" dimension of transferring evolutionary models to economic processes exemplified by the micro-level of human behavior underlying strategic actions. This is highly important in that evolutionary approaches usually lack a micro-foundation that allows to link the evolustionary meso-level with psychological and social micro-processes. Depending on individual preferences and research goals various conclusions ranging from the call for an ethnographic program to adoption of models from biology are possible.

We have seen how an evolutionary framework can be used to capture the characteristics of an organization and its co-evolutionary development in the case of globalization. The evolution of economic competition and organizational competence pools, resulting capabilities and actions should enable the analysis of firms' fate on a

level of greater abstraction than reached in individual case-studies as well as the fate of industries by combining results on individual organizational/firm competence pools and capabilities.

Formally, the equations are able to capture interactive processes of evolution, often dubbed co-evolution. Further integration with the literature on that topic is required. Additionally , the approach outlined here requires behavioural micro-level empirical research on the characteristics of change and emergence in organizations. The precise form and effects of the change depends on the rules of perception and human actions, the laws of emergence, the technical opportunities and constraints operating in a society at time, and the attention problems receive.

Application and implementation of evolutionary approaches both require detailed field studies on the basis of firm definitions of behavioural patterns. The seeming similarity between economic performance and evolutionary fitness respectively indicate some intriguing formal isomorphy, which needs to be tested.

Nevertheless, the wide applicability of evolutionary mechanisms in economics, sociology as well as biology suggests that evolutionary theory bears some characteristics of a scientific paradigm and thus has a wider reach but is also less easily tested than "just" a theoretical system with its associated instruments. The tools to do drill down research along the lines necessary for evolutionary research in the social sciences are not readily available, but under development. This can explain part of the tension in social science between evolutionary approaches and those derived from the so-called hard sciences.

6 Literature

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