

The Meaning of Evolutionary Language in the Study of Organizations: Lost in Translation?

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Abstract

This paper explores the institutionalisation of key evolutionary terms in scientific discourse and how these impact the language concerned with the evolution of organizations. Evolutionary models in management and organization theory display a bewildering array of applications and interpretations so that the meaning of key terms such as "selection" and "co-evolution" is inconsistent, frequently confused and lost in translation. Through a comprehensive bibliometric and narrative analysis of an expanding literature we determine that "evolution" is a vague word. Often treating evolutionary terms as precise and meaningful, and "evolution" as a term upon which we are all agreed, we find broad and ambiguous terms often substitute in this literature for clear definition and precise explanation. In the interests of progress towards a more unifying evolutionary interpretive framework, we call for greater clarity and precision in the use of evolutionary language.

Keywords: Evolution, organizations, evolutionary language

1. Introduction

Terms and concepts have become institutionalised in scientific discourse. Yet their meanings are often unclear. For the social scientist seeking insights and understanding of the evolutionary approach in management and organization science they embark on a daunting journey. They are confronted with an expanding often overlapping variety of disparate models and positions. These in turn display a bewildering array of applications and interpretations so that the meaning of key terms such as "selection" and "co-evolution" is inconsistent, frequently confused and lost in translation. This paper explores the institutionalisation of key evolutionary terms and how these impact the language concerned with the evolution of organizations.

Accordingly, in a period witnessing continued growth of evolutionary approaches in the social sciences, this study explores the evolution of evolutionary language in academic journals, where any institutionalisation of language usage would expect to be found (Price 1965). Central to the investigation are the various meanings of the word "evolution" and its derivative, "evolutionary". It is clear that within and across the range of published evolutionary models in management, sociology and economics a variety of interpretations of "evolution" and key evolutionary terms are present. And, moreover, these multiple and varied meanings are becoming institutionalised and embedded in the literature. Scholars

and subsequent authors adopt particular meanings and these are replicated and perpetuated in the literature.

It is important to observe at the outset that the term “evolution” is extremely vague. There is no one definitive definition. The Oxford English Dictionary lists several meanings which include, “the gradual development of something”, “a pattern of movements or manoeuvres”, and “the process by which different kinds of living organism are believed to have developed from earlier forms during the history of the earth”. It is thought that Darwin himself avoided using the word “evolution” in *Origin of Species* (1859), because of its understanding at the time as a developmental or “unfolding” process which derived from the notion of “preformism” (Mayr 1970:3-4), and moreover, because of its unpalatable association with the notion of predestination.

Given the term’s elasticity it is perhaps understandable that prominent evolutionary accounts pursue interpretations of evolution that could be variously described as “emergent”, concerning “spontaneous order”, “Lamarckian”, “Darwinian” and “naturalist”, amongst others. What these approaches appear to have in common is the desire to explain significant change or change-over-time. But change itself is a broad and varied phenomenon. However, returning to the purpose of this study, confusingly, authors frequently do not specify or explain the “evolutionary” approach being adopted, and the meaning of key evolutionary terms is left similarly vague. A broad and vague term often substitutes for clear definitions and precise analysis. Additional confusion creeps in when there appears to be an overlapping of approaches. For example, while some authors promote an approach characterizing evolution as progressing ‘from within’, in the developmental or self-organizational sense, they actually address both endogenous and exogenous drivers of change. Thus, they end up conflating population processes¹ with developmental processes the “evo” with the “devo”.

To be sure, the term “evolutionary” is variously interpreted and applied with variable explanatory value to organizational issues from collaborative strategy and industry growth to policy making. Challenging the new-comer to the field, research avenues have multiplied in recent years into a disparate array of theories and specialisms (Hodgson et al, 2014). Ontological and epistemological positions vary markedly and conceptual confusion is rife. A pick and mix approach and inconsistencies in the application of concepts to different units and levels of analysis continue to generate confusion. Moreover, despite the frequent deployment of key evolutionary concepts, such as “selection”, “retention” or “coevolution”, with few exceptions, authors rarely attempt to explain how they understand and use such terms.

It is suggested here that vague and shallow applications coupled with a multiplicity of locally adapted uses has distorted meaning in the language and exacerbated fragmentation of evolutionary approaches in the literature.

Through an extensive bibliometric and narrative analysis of published evolutionary research in the management sociology and economics literature we probe how the minimal and shallow use of evolutionary concepts and terms has become institutionalised in the literature. We examine the diverse research streams to tease out key terms and in an iterative research approach use these terms to word search the narratives and interrogate their various meanings. An attempt is made here to map and characterize the prominent approaches and determine developing patterns or trends in the use and meaning of evolutionary terms. It is anticipated that findings will enable fellow researchers to better

¹ Typically selection process

navigate the literature and possibly perceive a route towards a more unifying evolutionary interpretive framework. In mapping the divergent usage of evolutionary terms, this study also advances understanding of the obstacles hindering progress by highlighting inconsistencies and underlining the importance of semantics for theory construction.

The study was prompted by the re-reading of an earlier interdisciplinary reflection on the state of the art. The year 2003 saw publication of Johann Murmann's upbeat symposium where together with leading evolutionary thinkers Sidney Winter, Howard Aldrich and Daniel Levinthal, they reflected on advances in theory and speculated about the more promising research avenues for evolutionary models in management and organization theory. In the current and much less buoyant climate where scholars are lamenting the increasing specialisation and fragmentation of evolutionary approaches (Witt 2008; Hodgson et al 2014; Winter 2014), this study contemplates the trajectories envisioned by these foremost scholars and explores how the language has evolved in evolutionary accounts published over last decade; including that deployed by each of the aforementioned.

The "lost in translation" of our title refers to the diminution or adulteration of meaning that occurs in the literature as a result of minimal or shallow usage of evolutionary terms. Analysis shows that failure to explicitly identify, explain or define evolutionary approaches and their associated terms leads to misunderstanding, misrepresentation and inconsistencies which are then perpetuated in the literature. Thus, while there is also evidence of clear exposition and consistent deployment of key terms as well as the replication of new and more refined terms, it is claimed here that the institutionalisation of some mutations and practices is impeding progress towards a commonly accepted evolutionary approach.

Section 2 below contextualises the study in a brief review of prior works. This is followed in section 3 by a discussion of the research design and bibliometric analysis deployed here. Section 4 presents the findings and analysis of highlighted cases, while section 5 offers a summary analysis. Section 6 concludes the paper.

2. Prior Work

The Evolution of Evolutionary Models

Rallied by the explosion of evolutionary research and on-going development of evolutionary ideas across the organization sciences, Murmann and colleagues (2003) reflect on origins and identify three key lineages. In the first "Darwinia" stream they sketch the roots back via Weick (1979) and Aldrich (1999) to Campbell's (1960; 1969) variation, selective retention (VSR) construct. In the second, selection-based stream, they sketch roots back via Nelson and Winter (1982) both to the routine-based models of organizational action presented by Cyert, March and Simon (Cyert and March 1963, 1992; March and Simon 1958) and to the economist Joseph Schumpeter (1934, 1942, 1950) and his conceptualisation of economic change as an evolutionary process. In the third, organizational ecology stream, which is also selection-based and overlaps with the systemic approach of Nelson and Winter, they trace these to Hannan and Freeman's (1977; 1984) work on population ecology.

Campbell's blind-variation-selective-retention construct (1960, 1969) and evolutionary epistemology (1974) was clearly inspired and directed by Charles Darwin's key principles of evolution by natural selection, variation, inheritance and selection (1859). Also explicitly embracing the Darwinian principles,

which he famously encapsulated in the notion of “cumulative causation”, was founding evolutionary and institutional economist, Thorstein Veblen (1898). Joseph Schumpeter (1934) on the other hand, notably rejected Darwin and any suggestion of importing ideas from biology. For their part meanwhile, organizational ecologists, Hannan and Freeman (1989), drew on biological sciences (Fisher, 1930; Wright 1968; Lewontin 1974) and openly acknowledged their Darwinian heritage in their early works.

Framing an agenda for future research, Murmann et al (2003), highlighted key areas for attention. This included evolutionary explanations for the emergence of novelty in the genesis, for example, of organizations, populations and communities and, exploration of evolutionary theory as an overarching framework for studies in organization. Enamoured by the concept of “selection”, they also speculated about the development of its explanatory potential through multilevel selection theory.

A decade later it is clear from the literature that there has been progress. However, not necessarily in directions symposium evolutionists may have anticipated. As previously noted, Winter (2014) and others have observed continuing proliferation of evolutionary approaches while lamenting its fragmentation and specialisation. In a study of the structure and evolution of evolutionary research in organization studies, which highlights the enduring and radiating influence of Nelson and Winter’s (1982) seminal work, Hodgson et al (2014) observe severe developmental problems which they suggest are due to the failure to develop an immediate cluster of general derivative theoretical work around this “nodal” publication. For Hodgson et al, who identify fourteen different evolutionary clusters, it is imperative that future work “shared a conceptual narrative and trans-disciplinary research questions, to promote conversation and synergy between diverse clusters of research”.

Witt (2008) similarly observes the lack of a unifying theory and signs of disintegration. Having noted Silva and Teixeira’s (2008) findings regarding the exponential growth of the word “evolutionary” as a key word between 1986-2005, Witt (548) goes on to stress that its increasing use “does not correspond with anything like growing coherence on what it is supposed to refer to”.

The contention here is that language use is a significant part of the problem – and solution. Vague and shallow usage of terms with inconsistencies in application to different units and levels of analysis continue to generate and replicate confusion, and seemingly, more hybrid approaches. The meanings of terms end up getting lost in translation.

Given the veritable explosion of “evolutionary” publications across the social sciences in recent decades it is remarkable how few authors actually define what they mean by the word “evolution”. As Witt (2008: 547) observes in relation to evolutionary economics, there continues to be “differing, and partly incommensurate, views on what specifically this means”. In evolutionary economic geography, Frenken and Boschma (2007: 2) make the same point about other studies in the field, noting that it is often not made explicit what is evolutionary about them. Elsewhere fellow geographers, Essletzbichler and Rigby (2007: 556), speculate whether such works are even consistent with evolutionary theory, appreciation without which the use of terms like “path-dependence” “selection” or “evolution” lose much of their veracity”.

Failure to clearly define or explain the use of key terms frequently leads to their subsequent and repeated misrepresentation and a confused understanding of the “evolutionary” approach adopted. Exacerbating this interpretive challenge and presenting additional challenges for the newcomer attempting to navigate this literature are marked differences in epistemological and ontological positions. Witt (2008) explains that there are typically fundamental differences in “evolutionary” approaches at the ontological, heuristic and methodological levels. Since these positions are frequently

not explicitly stated, it can be baffling to the reader unfamiliar with evolutionary theory. Also concerned with foundational principles we draw here on Witt's ontological and heuristic positions and adapt his framework as a diagnostic instrument for the models under study. The ontological level relates to basic assumptions made about the nature of reality. For example, some evolutionist will perceive economic phenomena as forming its own sphere of reality whereas others will perceive continuity between the natural and the social realms, with the latter influenced by interaction with nature's constraints and contingent on the human genetic endowment (2008: 548). The heuristic level is concerned with how problems are framed to induce hypothesis and conjectures, for example, the heuristic devices or concepts deployed in a theoretical framework, such as metaphors and analogies.

3. Research Design

Citation traces are the bibliometric fossils by which to measure the replication success of an idea. These fossil records permit an investigation of the relative success of an idea to influence other work.

Gittleman and Kogut (2003: 368)

As indicated the present research adopts the combined application of bibliometric methods and narrative analysis to understand the nature of evolutionary terms usage in recent publications in management and organizational sciences on evolutionary approaches. The starting point for both analyses was the creation of a dataset of information on articles.

3.1. Data set

The data set was built to be representative of the organizational evolution field. To have a more comprehensive collection, we used JSTOR, Business Source (EBSCO) and Web of Science (WoS), three major publication databases. In the searches, we used the parameters summarized below (see Table 4 in the Appendix for a complete list):

- a) Period: from 2003 to 2014 (for publications available in July).
- b) Disciplines: Economics, Management and Sociology.
- c) Search terms: combination of "organization", "organizational" or "firm", and "evolution" or "evolutionary"; or the terms "organizational evolution" or "organizational ecology".

The consolidated output of the searches rendered a large and widely diverse database of 1,418 articles, where large majority did not contain the term evolution in the context of management and organizations. The multifaceted nature of the terms is the most probable reason for this. In itself, this experience gave some signs supporting the direction of our concerns.

The insertion of more specific terms like "natural selection", "multilevel selection" or similar, could result in a leaner data. On the other hand, it could increase the risk of bias. Therefore, the extensive qualitative examination of abstracts of the full data was preferred in order to reduce the list to a subset compatible with the desired scope.

The subset resulting from the above procedure contained 145 articles, and would then serve as the dataset for the bibliometric study and to the narrative analysis in sequence.

3.2. Bibliometric Study

Bibliometrics have been used to study and map scientific work for more than a century, and applies mathematics and statistics to measure relations found in the academic publications of the discipline (Pritchard, 1981, Shapiro, 1992). Moreover, this type of study is seen as a valuable complement to narrative analysis (Tranfield et al., 2003).

The bibliometric study was developed with three objectives; (1) identify the origins and influences of the evolutionary terms in use, and (2) elect articles for the narrative analysis, and (3) map the research field language based on the occurrence of key terms in the publications. The bibliometric study aimed at guiding the narrative analysis, creating a systematic literature review. Here, we applied two methods: citation analysis and co-word analysis.

3.3. Citation Analysis

As explained by Constanza et al. (2004: 262), the influence of the ideas present in a publication is related to the number of researchers that read this publication and use the ideas that it proposes. Therefore, by counting the number of times a publication has been cited in subsequent work it is possible to assess its influence.

To address the previously stated objective of identifying the origins and influences of the evolutionary terms, the citation analysis of references used by the articles published in the data set was performed. Self-citations were excluded from the reference database, to improve the quality of measures (Rahm and Thor, 2005), and the remaining list of 11,706 citations was consolidated and ranked by author and publication. In section 4 of this paper, we present the most influential.

A second citation analysis was performed according to our second objective, ranking now the number of citations received by each article in our dataset, according to SCOPUS. There is no recipe known to us to draw a cut-off line for the selection of the most influential articles, but one citation per quarter summing to four citations per year provided a sensible split with a reasonably sized group of 33 articles (see Table 5 in the Appendix). In subsection 4.4., the evolutionary language in the narrative of these articles is analysed.

3.4. Co-Word Analysis

To pursue the third objective of the bibliometric study, we implemented a co-word analysis. This type of bibliometric analysis is one of the most common in management and organization theory, along with citation analysis (Zupic and Carter, 2013). It reveals the conceptual structure of the domain, using keywords of the documents to establish relationships. Thus, it is the only method that uses the actual content of the documents to construct a similarity measure.

The identification of the common themes in organizational evolution can be achieved in five steps as proposed by Cobo et al. (2011a):

1. Collect raw data – the full text of articles in the data set described in item 3.1 was obtained.
2. Selection of the type of item to analyze – authors, name of journals, descriptive terms or words can be used. In the present study, we selected the authors' keywords as the relevant items but only considered keywords that express evolutionary terms. We also discarded other keywords relative to management theory or practice.
3. Extraction of relevant information from the raw data – the co-occurrence frequency of keywords was obtained by searching the authors keywords in the database created with the dataset full text.
4. Calculation of similarities – a well-established measure for normalizing co-occurrence frequencies was used, the equivalence index: $e_{ij} = \frac{c_{ij}^2}{c_i \times c_j}$, where c_{ij} is the number of documents in which two keywords i and j co-occur and c_i and c_j represent the number of documents in which each one appears.
5. Clustering - locate the subgroups of keywords that are strongly linked to each other and can be considered centers of interests. Here, the software Gephi (Bastian et al., 2009) and the clustering algorithm Force Atlas 2 (Jacomy et al, 2014) were used. This algorithm applies an attraction-repulsion model to create a meaningful visualization of the nodes (in our case the key words or terms) based on its degree (number of co-cited words).

Figure 1 shows the resulting keywords network map. To avoid a situation where a large number of keywords with low co-occurrence frequencies could act through repulsion and create a map difficult to visualize, we have determined an equivalence index of 0.25 as a threshold for inclusions in the map.

In addition to the map, the analysis of measures of centrality can help to understand how the literature positions keywords in respect to other keywords in the field. The co-word study used the below three measures of centrality, commonly seen in this type of approach (Dolfsma and Leydesdorff, 2010):

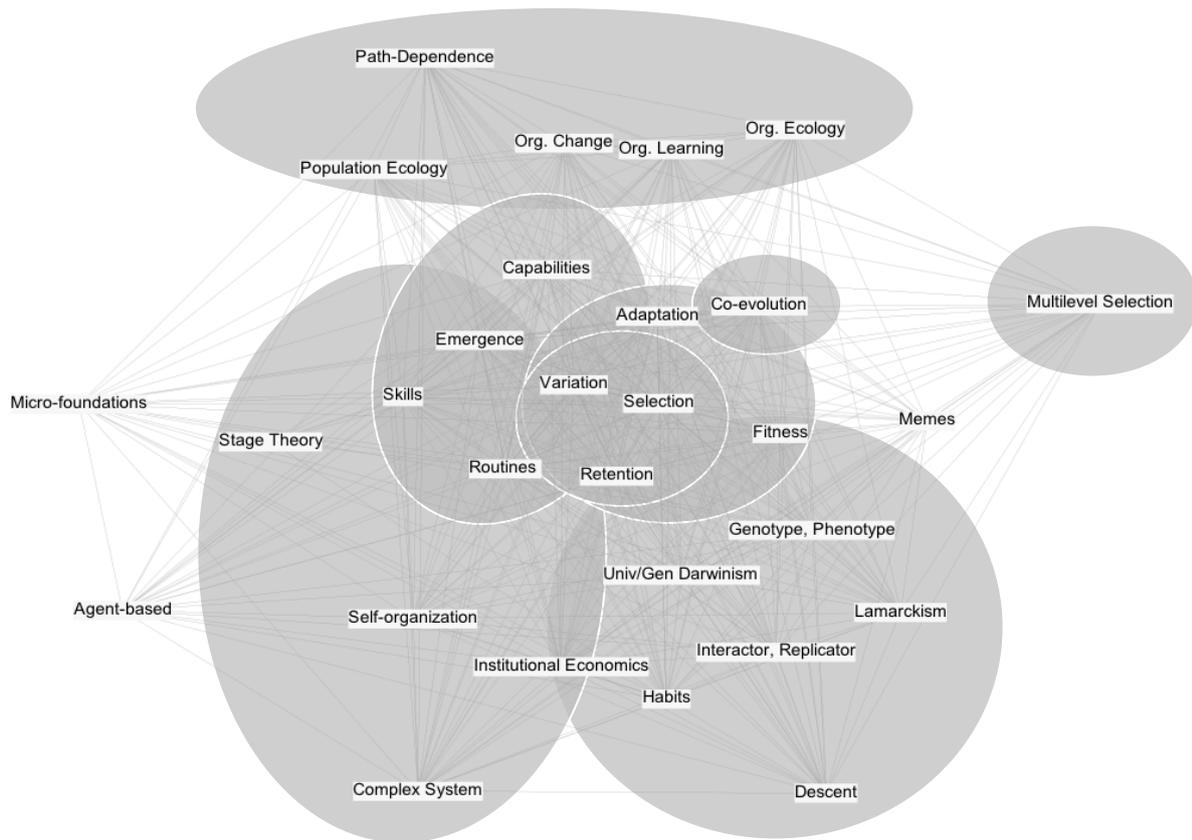
1. Degree: number of in and outgoing information flows from a node, representing the number of relations it has with other key works.
2. Closeness: the distance of an agent from all other agents in the network. In our case, the distance is a result of the co-occurrence frequency.
3. Betweenness: how often a node is located on the shortest path between any other pair of nodes in the network

4. Findings

4.1. Mapping the Evolutionary Language

The basic structure of the usage of evolutionary terms in the 145 articles of our dataset is revealed through the co-occurrence map below (Fig.1). Here, keywords that are frequently used in the same articles are attracted to be placed together, and pushed away from those that are rarely used together.

Fig.1 Evolutionary Terms Co-Occurrence Map in the Study of Organizations between 2003 and 2014 (until July)



The clustering process implemented brings to the centre of the map the terms that have higher degrees, i.e. terms that are connected to most of other key terms (see also Table 6 in the Appendix).

The first central cluster is composed of the terms of VSR (“variation”, “selection”, “retention”), the construct that represents the core mechanism of evolutionary theory. The VSR construct is orbited by terms like “adaptation”, “fitness” and “coevolution”, suggesting that these terms are rarely explored in the absence of VSR.

The second central cluster is formed by the terms “routines”, “capabilities” and “skills”, related and sometimes interchangeable terms for the unit of analysis in the organizational evolution literature (Augier and Teece, 2009; Becker, 2004, 2005).

The right lower corner of the map displays another cluster around the “Universal” or “Generalised Darwinism” approach (Hodgson and Knudsen, 2006a), with the key concepts and terms used here, being “habits”, “interactor” and “replicator” (Hodgson and Knudsen, 2004). This cluster is also closely associated with VSR, indicating the adoption of this construct.

Another cluster on the left of the map is formed by proximity of the concepts of “self-organization”, “emergence” and “complex systems”. This cluster is also linked to the above cluster of units of analysis, and shows some proximity to the VSR construct.

The group shown at the top of the map include keywords like “population ecology” and “organizational ecology”, terms that are often used interchangeably (Hannan and Freeman, 1977, 2005). Nevertheless, analysis shows these terms are placed together more because of the common distance from other terms in evolutionary language than to a high co-occurrence frequency. The measures of betweenness and degrees in Table 6 of the Appendix, support this observation.

Finally, we can observe terms that are in the left and right extremes respectively, “micro-foundations” and “multilevel selection”. These terms are linked to many other evolutionary terms, showing interest from different approaches in discussing these themes while they infrequently do so.

The co-word analysis expressed in the co-occurrence map illuminates the language associations that helped us to formulate an organized view of the field.

4.2. Origins of Evolutionary Theory in Management and Organization Theory

In order to help identify and categorise the prevailing evolutionary models it was considered important to investigate their theoretical and philosophical origins. We sought to trace the lineages through citation analyses. Close narrative analysis would then reveal the degree to which recent authors were remaining true to their conceptual antecedents or possibly introducing a “hybrid” interpretation. The citation analysis surfaced the most influential names and publications relevant for discussion here. These are listed in Table 1.

Table 1. Top 30 Most cited Authors in Data Set Articles 2003 -2014 (until July)

Author	Cites	Author(cont.)	Cites
Sydney G. Winter	192	Steven Klepper	51
Richard R. Nelson	175	Ulrich Witt	49
Geoffrey M. Hodgson	134	William P. Barnett	47
Michael T. Hannan	127	David L. Hull	39
Glenn R. Carroll	104	Oliver E. Williamson	39
James G. March	101	Kathleen M. Eisenhardt	38
Thorbjörn Knudsen	74	Donald T. Campbell	37
John Freeman	71	Richard Dawkins	37
Giovanni Dosi	70	Bruce Kogut	36
Daniel A. Levinthal	65	Arie Y. Lewin	33
David J. Teece	63	Bill McKelvey	30
Thorstein Veblen	59	Joseph A. Schumpeter	30
Howard E. Aldrich	59	Gary Pisano	29
Herbert A. Simon	56	Charles Darwin	28
Joel A. C. Baum	52	Karl E. Weick	27

As Table 1 shows, Sidney Winter and Richard Nelson continue as the most influential authors on current evolutionary approaches across the social sciences, with each attracting 192 and 175 citations per year respectively. Significantly, given the much more recent contributions to the field, is the appearance of Geoffrey Hodgson, Generalised Darwinism theorist, as the third most cited author who attracted 134 citations. This is just higher than Michael Hannan, leading organizational ecologist, who had 127 citations. Corresponding with the narrative analysis below, the citation analysis indicates ascendancy of

the “VSR” approach. Following the second organizational ecologists on the list, Glen Carroll (104), is eminent organizational learning scholar, James March (101) who is then followed by Hodgson’s frequent co-author, Thorbjorn Knudsen (74) who appears just ahead of foremost organizational ecologist, the late John Freeman (71). A close study of the top most cited authors reveals that the dominant theoretical influences are those of VSR and Organizational Ecology.

The citation analysis for the top 20 most influential publications for evolutionary approaches in the period 2003 to 2014 appear in Table 2 below. This also indicates dominance of the lineage back to Darwin’s three principles with nine of the twenty publications clearly associated with the influence of the VSR construct.² This compares with three publications by the organizational ecologists, Hannan and Freeman.

Table 2. The 20 Most Influential Publications for Evolutionary Approaches in period 2003 – 2014 (until July)

Title	Cites	Authors
An Evolutionary Theory of Economic Change (B)	65	Nelson R.R., Winter S.G.
Organizational Ecology (B)	27	Hannan M.T., Freeman J.
Dynamic capabilities and strategic management (A)	23	Teece D.J., Pisano G., Shuen A.
A behavioral theory of the firm (A)	21	Cyert R.M., March J.G.
Organizations Evolving (B)	20	Aldrich H.E.
The Population Ecology of Organizations (A)	19	Hannan M.T., Freeman J.
The Theory of the Leisure Class (B)	18	Veblen T.
Recent evolutionary theorizing about economic change (A)	17	Nelson R.R.
The Theory of the Growth of the Firm (B)	17	Penrose E.
The Selfish Gene (B)	16	Dawkins R.
On the Origin of Species by Means of Natural Selection (B)	16	Darwin C.
Absorptive Capacity: A New Perspective on Learning and Innovation (A)	15	Cohen W.M., Levinthal D.A.
Structural Inertia and Organizational Change (A)	15	Hannan M.T., Freeman J.
Exploration and exploitation in organizational learning (A)	15	March J.G.
Variation and selective retention in socio-cultural evolution (A)	14	Campbell D.T.
The Theory of Economic Development (B)	14	Schumpeter J.A.
Darwinism in economics: From analogy to ontology (A)	14	Hodgson G.M.
The Evolution of Institutional Economics: Agency, Structure and Darwinism in American Institutionalism (A)	13	Hodgson G.M.
The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields (A)	13	DiMaggio P.J., Powell W.W.
On the proper interpretation of 'evolution' in economics and its implications for production theory (A)	13	Witt U.

Note: (A) = Article, (B)=Book.

² In order of appearance on the list, these are; Nelson and Winter, Aldrich, Veblen, Nelson, Dawkins, Darwin, Campbell, Hodgson (twice).

4.3. Five Evolutionary Approaches

Following comprehensive bibliometric and narrative analysis, we identified five discernible types of evolutionary models persisting in the literature. In descending order in terms of prevalence, these evolutionary approaches are identified here as “variation-selective-retention (VSR)”, “unrolling”, “organizational ecology”, “coevolution” and “naturalist”. They are outlined in Table 3 below where variation of type, intellectual antecedents and epistemological and ontological differences are also indicated³. Within each approach type there is much variation and there are also degrees of overlap between approach types⁴. Allocation to approach type in one or two cases was rather arbitrary, usually because of the degree of vagueness, but was ultimately determined by dominance of one position over another in the narrative analysis and aided by close assessment of citations.

The first key finding was that the dominant three approaches discussed by Murmann et al. in 2003 still remained, albeit that their composition and relative prevalence may have altered. These are the streams associated with Donald Campbell (1965), Nelson and Winter (1982) and Hannan and Freeman (1989). Also, as Murmann et al. previously noted, works by March (Cyert and March, 1963; Levitt and March 1988), Cohen, Levinthal (Cohen and Levinthal 1990) and others, on organizational learning, not typically classified under the rubric “evolutionary theory” but with clear evolutionary associations, have continued to feature strongly.

Secondly, results show that the sphere of influence from these dominant models has broadened over time across the social sciences and confirm the enduring and radiating impact of Nelson and Winter’s (1982) seminal work (Hodgson et al, 2014). It is clear from the analysis that while they are at the centre of the largest evolutionary approach type, the “VSR” group, Nelson and Winter’s influence also strongly features in other groups. Scholars draw, for example, either on their Darwinian natural selection model⁵ or, for those in the “unrolling” type approaches, on the Schumpeterian ‘creative destruction’ model of competition. These influences are also seen in the more recent co-evolutionary models.

Thirdly, as indicated, there are varying degrees of overlap or deliberate integration between evolutionary approaches, what we might call ‘hybrids’, confirming previous research findings on fragmentation and specialisation of approaches (Witt 2008; Winter 2014; Hodgson et al 2014). Fourthly, there is an increase in approaches described as “coevolutionary” (Murmann 2013). Searches in WoS for “coevolution” returned 33 articles in the period between 1994 and 2003, and 95 articles in the period 2004-2013. Fifthly, there is an expanding group of evolutionary economic geographers. After 2006 when the term “evolutionary economic geography” first starts to appear in WoS the number of new authors publishing each year is significant. It grows particularly fast in 2012 and 2013.

³ Following assessment of model types determined by keyword and citation analysis, we drew on Witt’s (2008) ontological and epistemological descriptions as a diagnostic to assist classifications of approach types in the articles featured here. Given the vague use of key terms, some approaches were less easily categorised than others, and this was a useful analytical device in a field with so many overlapping positions.

⁴ The “hybrid” approaches, which are plentiful and more difficult to categorise, present an interesting analytic here. A co-evolutionary approach which builds on VSR foundations is not considered a hybrid (eg, Murmann 2013; Jacobides and Winter 2013) but an unrolling approach dealing with emergence of a firm while simultaneously discussing exogenous impacts like market competition or exchange (Frenken and Boschma 2007; Kogut and Zander 1993; Hite 2005), is a hybrid. This appears to conflate population processes with developmental processes.

⁵ Although described as Lamarckian, Nelson and Winter’s (1982) evolutionary theory features Darwin’s three principles of variation, inheritance (retention) and selection and, even if Lamarckian inheritance existed, it would more fully and more accurately be described as a Darwinian approach (Hodgson and Knudsen 2006b). Both authors later acknowledged the centrality of Darwinian principles (Nelson 2006; Winter 2014).

Finally, and particularly pertinent to our study, there is a notable and developing pattern of non-citation to original authors for evolutionary terms, for example, roughly just half the articles that use the VSR construct cite Campbell or Darwin. Observe their respective positions at 22 and 29 on the ‘Top Most Cited Authors’ list. This is a curious development given the growing use of evolutionary ideas linked with the lineage back to Darwin – a case of “Darwin by stealth”?

Table 3. Evolutionary Models in the Management, Sociology and Economics literature 2003-2013

<i>Model</i>	<i>Theoretical Antecedents</i> <i>Current examples</i>
1. Variation-selective-retention [Population ontology] VSR (heuristics)* VSR (heuristics) VSR (heuristics) VSR (heuristics) Generalised Darwinism (ontology)	Darwin (1859) Veblen (1898) Campbell (1965) Nelson & Winter (1982) Jacobides & Winter (2005) Essletzbichler & Rigby (2007) Mackinnon et al (2009) Hodgson & Knudsen (2006a; 2006b; 2010)
2. Unrolling / unfolding Emergence Developmental / stages Spontaneous order / complexity theory (heuristics)	Schumpeter (1934) Kaufman (1993) Birkinshaw et al (2008) Douglas and Craig (2011) Chiles et al (2004)
3. Organizational Ecology [Population ontology] Organizational ecology (heuristics) Organizational ecology (heuristics) Organizational ecology (heuristics)	Darwin (1859) Stinchcombe (1965) Hannan and Freeman (1989) Agarwal et al (2004) Hannan (2005)
4. Coevolutionary VSR-grounded coevolution VSR-grounded coevolution (population to single entity) Co-evolution	Darwin (1859) Campbell (1965) Murmann (2013) Cantwell et al (2010) Volberda and Lewin (2003)
5. Naturalist Multi-level selection theory (ontology) Naturalist theory (ontology)	Darwin (1859) Boyd and Richardson (1985) Johnson et al (2013) Stoelhorst and Richerson (2013)

*Ontological and epistemological framework adapted from Witt (2008)

As noted, informing the above approach types was textual analysis of the top thirty three evolutionary articles published in the last ten years, status and influence of which were determined by key terms and citations analysis. Extending aforementioned previous studies, the analysis here offers forensic examination of the nature of those influences on theory development and analysis of how such works

have in turn inspired subsequent evolutionary authors. A sample of case study findings which informed the approach types is presented below⁶.

4.4. Case Study Findings: What is Evolution?

4.4.1. *Variation-selective-retention (VSR)*

In the period investigated, the most frequently cited articles were those discussing VSR type evolutionary approaches or featuring its application. Fifteen cases were assessed as “VSR” or VSR was dominant in a ‘hybrid’ approach. These findings would appear to support Bickhard and Campbell’s (2003) view of the enduring influence and ubiquity of Campbell’s VSR construct.

Jacobides and Winter (2005): Featuring as the second most cited paper in the data set (22 citations per year), Jacobides & Winter present a theoretical framework to explain the co-evolution of transaction costs and capabilities. This could, however, be described as a hybrid approach, building a co-evolutionary approach on firm VSR principles; it offers a systems approach featuring population ontologies, endogenous firm-level changes (‘capability development’) and exogenous selection forces acting on ‘the capability pool in the industry’. However, while entirely consistent with its principles, the VSR construct is not made explicit in the paper; it is not mentioned in the explanation of the evolutionary approach and neither is Campbell or Darwin cited.

Essletzbichler and Rigby (2007): Explicitly adopting the VSR heuristic in the development of an evolutionary theory are evolutionary economic geographers, Essletzbichler and Rigby, whose paper is cited eight times per year. Evidently inspired by the Generalised Darwinism approach of Hodgson and Knudsen, and the latter’s intellectual antecedents, these authors generally replicate accurately evolutionary explanations and the meanings of terms. However, one misconception that appears to have become institutionalised in some of the literature, and is repeated here, is the idea that Generalised Darwinism cannot deal with the emergence of novelty.

Mackinnon et al (2009): Averaging sixteen citations per year, in an influential theoretical paper presented by evolutionary economic geographers, Mackinnon et al. similarly explicitly pursue the VSR evolutionary approach following a line from Darwin through Nelson and Winter to Hodgson and Knudsen. However, in an echo of aforementioned concerns expressed by evolutionary economists, these authors observe the importation of different models (Nelson and Winter’s evolutionary economics, Darwinian ideas and those from complexity science) and worry about theoretical fragmentation in the field of economic geography.

Frenken and Boschma’s (2007) article averages nine citations per year. These evolutionary economic geographers appear to offer a hybrid, VSR and unrolling approach. A system level approach, with the firm as unit of analysis they discuss a branching process with regard to product innovation which at times

⁶ Space naturally limits the number of cases included for detailed discussion here. We have given more space to the most cited articles in each evolutionary approach category and aimed for as wide a range of cases as possible for illustrative purposes.

reads more like unrolling type evolution, “propose a framework that specifies the process of economic development as an evolutionary branching process of product innovations”. Informed by Kauffman, Nelson and Winter and Generalised Darwinists they generally represent self-organization and VSR well. However, they could help the reader with clearer expression of their blended evolutionary approach.

Hodgson and Knudsen (2004; 2006a; 2006b) are leading protagonists of Generalised Darwinism with three articles featuring this approach in the data set. Generalised Darwinists express a naturalist ontological position, perceiving ontological communality between the social and biotic realms. Within a Darwinian meta-theoretical framework that accommodates auxiliary explanations such as self-organization and “Lamarckian” inheritance, they promote adoption of the generalised interactor-replicator terms (Hull, 1988) to conceptualise evolutionary mechanisms and processes. They are consistent in the definition and use of terms and explicit about Darwinian origins. Analysis shows that these authors are now major influencers in the VSR approach; Hodgson appears third in top twenty most cited authors list (134 citations), while Knudsen appears seventh (74 citations). Hodgson also has two books in top twenty most influential publications list (at 18 and 19).

4.4.2. Unrolling

The unrolling approach was the second most prevalent approach type with seven cases in this category. Associated with Schumpeter (1934) and latterly with Stuart Kauffman (1993) this approach is variously represented in the literature as “emergent”, “spontaneous order” and “self-organization”. Unlike the Darwinian VSR approach that explains endogenous adaptation and exogenous selection effects, the unrolling approach explains the evolutionary process as an endogenous, unfolding or unrolling process progressing from within. Scholars are typically concerned with explaining emergence of novelty and innovation. However, despite frequent suggestions to the contrary, i.e., that evolution is “from within” many such approaches address both endogenous and exogenous change and display inconsistency in their own terms, because they conflate population processes with development processes. This was the next largest group of evolutionary approaches.

Birkinshaw et al (2008) was the highest cited paper with an average 25 citations per year. Seeking to explain how management innovation “transpires” they present an approach described here as a hybrid “unrolling and VSR”. Short of a clear explanation of the evolutionary approach and associated terms, this categorisation is deduced by other explanations and description in the text. Drawing on Burgelman (1991), Schumpeter and Campbell, Birkinshaw et al. describe an approach using VSR at the “intrafirm level” where selection and retention is expressed in the form of internal choice (like Nelson and Winter’s notion of “search”), and where a VSR-type *exogenous* selection process is not expressed. Citing Burgelman and Campbell they state, (834-5) “Invention refers to either random or planned variation in management practices, some of which subsequently are selected and retained by the organization”. In a different take on the Darwinian inspired VSR selection model, the focus is on internal dynamics while any external ‘forces’ are limited to external agents like consultants, academics or gurus (i.e., not ‘the market’).

Julie Hite’s (2005) article is next highest cited in unrolling approach category (11 per year). Concerned with explaining “evolutionary processes and paths of relationally embedded network ties in emerging entrepreneurial firms”, Hite presents an ‘emergent’ approach which simultaneously appears to present a co-evolutionary story about network ties and emerging firms. Elsewhere network ties are presented as

external forces and there is discussion of “market exchange mechanisms”. There is no definition of evolution but the word is used interchangeably with “process” to refer to a sequential process or development from within. The “object” of evolution becomes confused.

Chiles et al (2004) present the next most cited paper (7 per year) where they explicitly “conceptualise evolution in terms of emergence” and “propose a self-organising logic drawn from complexity theory”. This is later justified in an explanation of their rejection of the prevailing Darwinian approaches, because, citing Kauffman (1993) they “did not consider selection as a source of order”. In the institutionalisation of another myth⁷, Chiles et al replicate another misrepresentation of the Darwinian approach, “the received VSR model is not strongly suited to take up the ongoing emergence of novelty”⁸. In the same article the authors also misquote Hodgson (1997:401), so that it appears that the latter advocates reductionism, “the idea that all aspects of a complex phenomenon must be explained in terms of one level”. There are three important meanings getting lost in translation via this paper.

Douglas and Craig (2011), (4 per year), present international market expansion as an “evolutionary process”, through a developmental or stages view of evolution. They state that “strategy evolves” but discuss the firm as the object of evolution. Apart from Andersen’s (1993) influence from a complexity theory perspective, the intellectual lineage is not entirely clear. Tracing their references, through Contractor (2007), it would seem that the Nelson and Winter compatible approach of Kogut and Zander (1993: 640)⁹ which implicitly acknowledges selection and inheritance processes¹⁰, has morphed into a ‘stages-type’ evolution under Contractor then Douglas and Craig. In the later we have an interpretation of “evolution” closer to a developmental or “unfolding” approach. In each case scholars would benefit their peers by being a more explicit about their “evolutionary” approach and its origins.

4.4.3. Organizational Ecology

Organizational ecology represents the third approach type in the data set with four cases appearing in the data set. A selectionist account with a population ontology, researchers here typically seek to explain organizational diversity and industry dynamics. Architects, Hannan and Freeman (1989), acknowledged biological and Darwinian roots of the theory in their seminal work whilst also acknowledging the lack of an inheritance mechanism in the theory. Later works published by both authors and their followers notably include less explanation of theory and discussion of intellectual heritage (See Hannan 2005) seemingly content to leave this to others (Reydon and Schultz 2009, 2013; Lemos 2009; Dollimore 2014a; 2014b; Hodgson 2013).

Agarwal et al (2004), present the fifth most cited paper in the data set (17 per year). This evolutionary approach appears to offer an organizational ecology VSR hybrid. Citing many organizational ecologists, as well as Nelson and Winter, Klepper and Simon (2001) and several resource-based and capabilities

⁷ See Hodgson (2002) where Darwinism and its relation to self-organisation are clarified.

⁸ See Hodgson (2002) where Darwinism and novelty are also discussed.

⁹ Kogut and Zander (1993: 642) claim they expand on Nelson and Winter’s ideas in the context of firm knowledge and evolution of the firm “from its national origins to spanning across borders”. For them, “the notion of the firm as specializing in the transfer and recombination of knowledge is the foundation to an evolutionary theory of the multinational corporation”.

¹⁰ Kogut and Zander (1993: 640) “The limiting factor on their growth is not only the competitiveness of other firms and the demand of the market, but also the extent to which their advantage can be replicated more quickly by themselves rather than through imitation by competitors”

theorists, Agarwal et al. are keen to address gap in literature around knowledge transfer, and they seemingly integrate inheritance with the traditional selectionist account of organizational ecology. While the VSR approach is implicit in much of the text with talk of “knowledge inheritance”, “spin-out generation”, “exit” and “survival”, Campbell is not cited and the Schumpeterian influence is strong. A theoretically well-grounded paper, it is nonetheless difficult to determine the “evolutionary” type here.

Hsu and Hannan (2005) penned the seventh top-cited paper (12 per year). Co-authored by one of the architects of organizational ecology there is brief coverage of the evolutionary approach where it is explained that change in the world of organizations “changes by selection in the sense of differential selection”. The impact of change in technological, social and economic structures on firm survival is highlighted. Addressing long held theoretical concerns about organizational ecology’s inadequate specification of meaningful population boundaries, the focus here is on issues relating to the emergence and persistence of identities - of organizational forms.

4.4.4. Coevolutionary

Although an increasing approach type only three articles featuring a coevolutionary approach appeared in the data set.

Murmann’s (2013) very recent article is 30th in the data set (4 citations per year). It is exemplary in terms of explanation and definition of terms, and in consistency of approach. This is a coevolutionary approach dealing with clearly defined coevolving populations (synthetic dye industry and discipline of chemistry) and built on clearly explained VSR foundations. We note, however, that VSR is mentioned several times before it is linked to Campbell (1969). Otherwise explanation and replication of meaning is sound.

Cantwell et al (2010) appear sixth in the dataset (15 citations per year). “Evolution” is not defined but explaining the approach they state (2010: 567) “at a general level our arguments follows the wider principles articulated in various strands of the recent literature, which proposed that firms coevolve with their environments...” and cite many organizational ecologists, alongside Nelson and Winter and other economists and scholars working on innovation systems and institutional change. They acknowledge VSR but have insufficient space to discuss. It is implicit in their explananda which suggests a coevolutionary approach built on VSR. The coevolving entities are identified as MNEs and their institutional environments. In places they appear to conflate evolution with coevolution. Elsewhere adaptation and selection are presented as coevolution.

Volberda and Lewin’s (2003) influential paper is sixth highest cited article in the data set (12 per year). The term “coevolution”, however, is presented inconsistently. In places co-evolution is portrayed as reciprocal feedback responses between entity and environment, in others portrayed as an adaptation and selection dynamic. And Campbell’s blind-variation-selective-retention construct is described as “naïve adaptation and selection” with the misleading message conveyed that Darwinian selection does not account for intentionality.

4.4.5. Naturalist

The naturalist approach is the smallest evolutionary type featuring in the data set with just one case study. In an echo of Witt's remarks (2008: 549), "the challenge of a naturalistic, Darwinian world view on the economy is usually ignored, if not rejected, at the ontological level". Although recent publications may indicate a resurgence of interest (Johnson et al 2013; Stoelhorst and Richerson 2013; Gowdy et al, 2013)¹¹ the only case study to appear in the data set was that of Tooby et al.

Tooby et al (2006) averaged four citations per year. Concerned with the evolutionary roots of organizational behaviour these evolutionary psychologists use "knowledge of what natural selection would have favoured during human evolution to guide the empirical mapping of the computational architecture of the human mind/brain". Discrediting out-dated notions of "homo economicus", and drawing on what they call "ecological rationality" and economic game theory they form broad inferences about human preferences and behaviour. Despite four references to "natural selection" and its obvious intellectual lineage there are no references to Darwin in the paper.

4. 5. Summary Analysis

Contrary to a supposition propagated in the literature, that general agreement exists on the meaning of the word "evolution", analysis shows that it is in fact a vague term. This contention is underscored here in the identification and analysis of the different evolutionary approaches behind usages of the word.

Narrative analysis bears testimony to the institutionalisation of imprecise usage of key evolutionary terms where authors frequently fail to specify what they mean by "evolution"¹² and where inconsistent and ambiguous meanings are presented within and across evolutionary approach types.

Terms and constructs like "selection", "coevolution" and "VSR" are often presented without explanation or reference to original authors on the assumption that there is a generally understood meaning with which the reader is aware. As demonstrated through case analysis, because of this imprecision in language usage, the level of application, the object(s) of evolution, and the processes and mechanisms involved, are often difficult to discern¹³. Some of these broad interpretations and shallow definitions are perpetuated in the literature. The situation is exacerbated when 'original' authors are vague about their

¹¹See "Evolution as a General Theoretical Framework for Economics and Public Policy" (2013) a Journal Special Issue edited by D S Wilson, J Gowdy and J S Rosser and published by *Journal of Economic Behaviour and Organisation* Volume 90S June 2013

¹² In 145 publications only 50% of authors defined or explained what they meant by "evolution".

¹³ Coevolution is variously presented to mean feedback and reciprocal relations between internal and external forces; adaptation and selection means coevolution; populations and or entities impact each other. Selection is variously interpreted to mean deliberate choice, differential or market selection, subset or successor selection (See Hodgson and Knudsen 2010). Some approaches proclaim a Schumpeterian endogenous evolution 'from within' while simultaneously implying exogenous population level selection processes. There is much conflation of processes and inconsistency in meaning, even within individual approaches.

theoretical underpinnings or antecedents. Original or intended meanings are sometimes misinterpreted or misrepresented; these are similarly replicated in the discourse and meaning becomes lost in translation.

The contention here is that the issue of ambiguity and imprecision in the use of evolutionary language hinders progress towards the development of a unifying evolutionary interpretive framework. It contributes to the fragmentation and specialisms in the literature.

That said, analysis also shows tentative signs of development in the direction of greater clarity and convergence of evolutionary approaches. There are exemplars amongst the case studies, for instance, in terms of elucidation, precision and consistency in the use of terms (Essletzbichler and Rigby 2007; Hodgson and Knudsen 2004; 2006a; 2006b; Murmann 2013). Also, there are indications of the ascendancy of the VSR approach type, albeit in many forms. For example, domination of the VSR approach in the top 30 cited papers (over 50%) which is mirrored in the clustering and volume of associated terms, and high citation rates of leading authors promoting this approach together with their presence in the list of top 20 most cited publications in the field over last decade. Featuring at the top of this list is Nelson and Winter's (1982) *Evolutionary Theory of Economic Change*. As previously observed, these authors both now explicitly endorse the Darwinian VSR construct that is implicit in this work¹⁴.

5. Conclusion

What explains the observed vagueness in the use evolutionary language in the study of organizations? We venture to reappraise one possible cause.

Commenting on the approach of organizational ecology, Michael Hannan (2005:51) observes resistance in fellow sociologists to the use of ideas from biology; "reliance on ideas from biology troubles many sociologists even if, as in this case, no reference is made to any biological mechanism". The same point has been discussed at length by Hodgson (2004) who suggests that social scientist have been inoculated against the use of ideas from biology or Darwin because of misguided associations with, amongst other things, "Social Darwinism", eugenics, genetic determinism and biological reductionism.

It is suggested here that in some cases scholars pursue a deliberate strategy of purging the text of any 'provocative' biological terms or references to Darwin. It is noticeable, for example, that many accounts in organizational ecology now make few if any references to the word "evolution". Moreover, as observed in the preceding analysis, many authors who deploy the variation, selective retention construct fail to attribute this to Darwin, or even Campbell. Evidently, for researchers seeking to apply an evolutionary approach it is not easy to navigate the literature, trace the intellectual lineage and establish current thinking. This paper maps the territory and offers an outline of current approaches.

¹⁴ As expressed by Nelson (2006:493), it offers, "...a very powerful source of understanding regarding human cultural exchange...". And more recently by Winter (2014), "... in evolutionary economics, the fundamental theoretical commitments are at the system level and are very general. It is fundamental that economic evolution, like biological evolution, is a time-consuming dynamic process involving sub-processes of variation, inheritance/replication and selection".

For a common evolutionary interpretive framework to materialise in the social sciences evolutionary scholars clearly need to be speaking the same language. In pursuit of such a framework we call upon fellow researchers to be more precise; to specify what they mean by the term “evolution” and define their key evolutionary terms. This way, we propose, there is less chance of meaning getting lost in translation and greater opportunity for refinement of terms and integration of evolutionary approaches across disciplines.

References

- Aldrich, H. (1999). *Organizations evolving*. London: Sage.
- Andersen, O. (1993). On the internationalization process of firms: a critical analysis. *Journal of international business studies*, 209-231.
- Agarwal, R., & Franco, A. M. (2014). Knowledge Transfer through Inheritance: Spin-out Generation, Development, and Survival. *The Academy of Management Journal*, 47(4), 501–522.
- Augier, M., & Teece, D. J. (2009). Dynamic Capabilities and the Role of Managers in Business Strategy and Economic Performance. *Organization Science*, 20(2), 410–421.
- Bastian, M., Heymann, S., & Jacomy, M. (2009). Gephi: an open source software for exploring and manipulating networks. *ICWSM*, 8, 361-362.
- Becker, M. C. (2004). Organizational routines: a review of the literature. *Industrial and Corporate Change*, 13(4), 643–678.
- Bickhard, M. H., & Campbell, D. T. (2003). Variations in variation and selection: The ubiquity of the variation-and-selective-retention ratchet in emergent organizational complexity. *Foundations of Science*, 8(3), 215-282.
- Birkinshaw, J., Hamel, G., & Mol, M. J. (2008). Management Innovation. *Academy of Management Review*, 33(4), 825–845.
- Bradley, S. W., Aldrich, H., Shepherd, D. a., & Wiklund, J. (2011). Resources, environmental change, and survival: Asymmetric paths of young independent and subsidiary organizations. *Strategic Management Journal*, 32(5), 486–509.
- Breslin, D. (2011). Reviewing a Generalized Darwinist Approach to Studying Socio-economic Change. *International Journal of Management Reviews*, 13(2), 218–235.
- Burgelman, R. A. (1991). Intraorganizational ecology of strategy making and organizational adaptation: Theory and field research. *Organization science*, 2(3), 239-262.
- Campbell, D. T. (1960). Blind variation and selective retention in creative thought as in other thought processes. *Psychological Review*, 67, 380-400.

- Campbell, D. T. (1965). Variation and selective retention in socio-cultural evolution. *Social change in developing areas: A reinterpretation of evolutionary theory*, 19, 26-27.
- Campbell, D. T. (1969). Variation and selective retention in socio-cultural evolution. *General Systems*, 14, 69-85.
- Campbell, D. T. (1974). Evolutionary epistemology. P. A. Schilpp, ed. *The Philosophy of Karl Popper*. Open Court, La Salle, IL, 413–463. Campbell,
- Cantwell, J., Dunning, J., & Lundan, S. (2010). An evolutionary approach to understanding The co-evolution international business activity : environment of MNEs and the institutional. *Journal of International Business Studies*, 41(4), 567–586.
- Carroll, G. R., Harrison, J. R., & McKendrick, D. G. (2012). Selection and variation in organizational evolution. *Industrial and Corporate Change*, 21(1), 217–243.
- Cattani, G. (2005). Organization Science inf jHHE Preadaptation , Firm Heterogeneity , Performance : A Study on the Technological Evolution of Fiber Optics , 1970-1995. *Organization Science*, 16(6), 563–580.
- Chiles, T. H., Meyer, A. D., & Hench, T. J. (2004). Organizational Emergence: The Origin and Transformation of Branson, Missouri’s Musical Theaters. *Organization Science*, 15(5), 499–519.
- Cobo, M. J., López-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2011). An approach for detecting, quantifying, and visualizing the evolution of a research field: A practical application to the fuzzy sets theory field. *Journal of Informetrics*, 5(1), 146-166.
- Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative science quarterly*, 128-152.
- Costanza, A., Stern, D., Fisher, B., He, L., Ma, C. (2004), Influential publications in ecological economics: a citation analysis, *Ecological Economics*, Volume 50, Issues 3–4, 1 October, Pages 261-292.
- Cyert, R. M., & March, J. G. (1992). *A behavioral theory of the firm*. Cambridge, MA: Basil Blackwell. (Original work published in 1963)
- Dachs, B., Roediger-schluga, T., & Widhalm, C. (2001). Mapping Evolutionary Economics A Bibliometric Analysis. In *EMAE 2001 Conference Vienna University of Economics and Business Administration*, (Vol. 43). Vienna, Austria.
- Darwin, Charles R. (1859). *On the Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life*. Murray, London.
- Dolfsma, W., & Leydesdorff, L. (2010). The citation field of evolutionary economics. *Journal of Evolutionary Economics*, 20(5), 645–664.
- Dollimore, D. E. (2014a). Untangling the conceptual issues raised in Reydon and Scholz’s critique of organizational ecology and Darwinian populations. *Philosophy of the Social Sciences*, 44(3), 282-315.

- Dollimore, D. E. (2014b). Darwinism and Organizational Ecology: A Reply to Reydon and Scholz. *Philosophy of the Social Sciences*, Vol 44. No 3. June 2014 pp375-382
- Douglas, S. P., & Craig, C. S. (2011). Convergence and Divergence: Developing a Semiglobal Marketing Strategy. *Journal of International Marketing*, 19(1), 82–101.
- Essletzbichler, J., Rigby, D. L. (2007). Exploring evolutionary economic geographies. *Journal of Economic Geography*, 7(5), 549–571.
- Fisher RA (1930) The genetical theory of natural selection. Clarendon Press, Oxford.
- Frenken, K., & Boschma, R. a. (2007). A theoretical framework for evolutionary economic geography: industrial dynamics and urban growth as a branching process. *Journal of Economic Geography*, 7(5), 635–649.
- Gittelman, M., & Kogut, B. (2003). Biotechnology Knowledge ? Logic of Citation Evolutionary. *Management Science*, 49(4), 366–382.
- Gruber, M., Shah, S., & Dencker, J. (2009). Pre-Entry Knowledge, Learning, and the Survival of New Firms. *Organization Science*, 20(3), 516–537.
- Hannan, M. T. (2005). Ecologies of Organizations: Diversity and Identity. *Journal of Economic Perspectives*, 19(1), 51–70.
- Hannan, M. T., & Freeman, J. (1977). The population ecology of organizations. *American journal of sociology*, 929-964.
- Hannan, M.T., & Freeman, J.H.(1984). Structural inertia and organizational change. *American Sociological Review*, 49, 149-164.
- Hannan, M. T., & Freeman, J. (1989). Organization ecology. Harvard University Press, Cambridge, MA
- Hite, J. M. (2005). Evolutionary Processes and Paths of Relationally Embedded Network Ties in Emerging Entrepreneurial Firms. *Entrepreneurship, Theory and Practice*, (January), 113–144.
- Hodgson, G. M. (2004). The evolution of institutional economics. Routledge.
- Hodgson, G. M. (2014) Darwinin Coevolution of Organizations and the Environment. *Ecological Economics*. 69 (2010) 700 - 706
- Hodgson, G. M., & Knudsen, T. (2004). The firm as an interactor: firms as vehicles for habits and routines. *Journal of Evolutionary Economics*, 14(3), 281–307.
- Hodgson, G. M., & Knudsen, T. (2006a). Why we need a generalized Darwinism, and why generalized Darwinism is not enough. *Journal of Economic Behavior and Organization*, 61(1), 1–19.
- Hodgson, G. M., & Knudsen, T. (2006b). Dismantling Lamarckism: Why descriptions of socio-economic evolution as Lamarckian are misleading. *Journal of Evolutionary Economics*, 16(4), 343–366.
- Hodgson, G. M., & Knudsen, T. (2010). *Darwin's conjecture: The search for general principles of social and economic evolution*. University of Chicago Press.

- Hodgson, G.M., Järvinen, J. and Lamberg, J.-A. (2014) The Structure and Evolution of Evolutionary Research: a Bibliometric Analysis of the “Evolutionary” Literature in Management, Economics, and Sociology. *Journal of Institutional Economics*.
- Hsu, G., & Hannan, M. T. (2005). Identities, Genres, and Organizational Forms. *Organization Science*, 16(5), 474–490.
- Hull, D. L. (1988). *Science as a Progress. An evolutionary account of the social and conceptual development of science*. Chicago.
- Jacobides, M. G., & Winter, S. G. (2005). The Co-Evolution of Capabilities and Transaction Costs: Explaining the Institutional Structure of Production. *Strategic Management Journal*, 413(July), 395–413.
- Johansson, T., & Kask, J. (2013). On the promise and premises of a Darwinian theory in research on business relationships. *Industrial Marketing Management*, 42(3), 306–315.
- Johnson, D. D. P., Price, M. E., & Van Vugt, M. (2013). Darwin’s invisible hand: Market competition, evolution and the firm. *Journal of Economic Behavior & Organization*, 90, S128–S140.
- Kauffman, S. (1993). *The origins of order: Self-organization and selection in evolution*. Oxford university press.
- Klepper, S. (2001). Employee startups in high-tech industries. *Industrial and Corporate Change*, 10(3), 639-674.
- Kogut, B., & Zander, U. (1993). Knowledge of the firm and the evolutionary theory of the multinational corporation. *Journal of international business studies*, 625-645.
- Kogut, B., & Zander, U. (2003). Knowledge of the Firm and the Evolutionary Theory of the Multinational Corporation: 2003. *Journal of International Business Studies*, 34(6), 516–529.
- Lemos, J. (2009). In Defense of Organizational Evolution A Reply to Reydon and Scholz. *Philosophy of the Social Sciences*, 39(3), 463-474.
- Levitt, B., & March, J. G. (1988). Organizational learning. *Annual review of sociology*, 319-340.
- Lewin, A. Y., & Volberda, H. W. (2011). Co-evolution of global sourcing : The need to understand the underlying mechanisms of firm-decisions to offshore. *International Business Review*, 20(3), 241–251.
- Lewontin R C (1970) The units of selection. *Annual Review of Ecology and Systematics* 1: 1–18.
- Mackinnon, D., Cumbers, A., Pike, A., Birch, K., & McMaster, R. (2009). and Adaptation. *Economic Geography*, 85(2), 129–150.
- March, J. G., & Simon, H. A. (1958). *Organizations*. New York: Wiley.
- Martin, X., & Salomon, R. (2003). Tacitness, Learning, and International Expansion: A Study of Foreign Direct Investment in a Knowledge-Intensive Industry. *Organization Science*, 14(3), 297–311.

- Mayr, E. (1970). *Populations, species, and evolution: an abridgment of animal species and evolution*. Harvard University Press.
- Murmann, J. P. (2013). The Coevolution of Industries and Important Features of Their Environments, 7039, 1–21.
- Murmann, J. P., Aldrich, H. E., Levinthal, D., & Winter, S. G. (2003). Evolutionary Thought in Management and Organization Theory at the Beginning of the New Millennium A Symposium on the State of the Art and Opportunities for Future Research. *Journal of Management Inquiry*, 12, 22–40.
- Nelson, R.R., Winter, S.G., (1982). *An Evolutionary Theory of Economic Change*. Harvard University Press, Cambridge, MA
- Pritchard, A. (1981). *Bibliometrics: A bibliography and index*. Watford, Herts.: ALLM Books.
- Price, D. J. de Solla (1965). Networks of scientific papers. *Science*, 149, 510- 515.
- Rahm, E., & Thor, A. (2005). Citation analysis of database publications. *ACM Sigmod Record*, 34(4), 48-53.
- Reydon, T. A., & Scholz, M. (2013). Darwinism and Organizational Ecology: A Case of Incompleteness or Incompatibility?. *Philosophy of the Social Sciences*, 0048393113491634.
- Schumpeter, J. (1934). *The theory of economic development*. Cambridge, MA: Harvard University Press.
- Schumpeter, J. A. (1950). *Capitalism, socialism and democracy*. New York: Harper & Row. (Original work published 1942)
- Shapiro, F. (1992). Origins of bibliometrics, citation indexing, and citation analysis: The neglected legal literature. *Journal of the American Society for Information Science*. Volume 43, Issue 5, pages 337–339, June.
- Silva, S. T., & Teixeira, A. a. C. (2008). On the divergence of evolutionary research paths in the past 50 years: a comprehensive bibliometric account. *Journal of Evolutionary Economics*, 19(5), 605–642. doi:10.1007/s00191-008-0121-9
- Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *British Journal Of Management*, 14(3), 207-222.
- Tooby, J., Cosmides, L., Price, M. E., Managerial, S., Economics, D., Psychology, E., Park, N. (2006). Cognitive Exchange : of Organizational for w-person Adaptations The Evolutionary Roots Behavior. *Managerial and Decision Economics*, 27(2), 103–129.
- Volberda, H., & Lewin, A. (2003). Co-evolutionary Dynamics Within and Between Firms : From Evolution to Co-evolution. *Journal of Management Studies*, (December).
- Weick, K. E. (1979). *The Social Psychology of Organizing*, 2nd ed. Reading, MA: Addison-Wesley Publishing Company.
- Wilson, D. S., & Gowdy, J. M. (2013). Evolution as a general theoretical framework for economics and public policy. *Journal of Economic Behavior & Organization*, 90, S3-S10.

Winter, S. W. (2014). The future of evolutionary economics: can we break out of the beachhead? .
Journal of Institutional Economics, available on CJO2014. doi:10.1017/S1744137414000277.

Witt, U. (2008). What is specific about evolutionary economics ? *Journal of Evolutionary Economics*, 18,
547–575.

Wright, Sewell. (1968). *Evolution and the Genetics of Populations*. Vol. 1. Chicago: University of Chicago
Press.

Zupic, Ivan, Cater, Tomaz (2013). Bibliometric Methods in Management and Organization: A Review.
Academy of Management Proceedings, January.

Appendix

Table 4. Data set Search Terms and Parameters

Database	Search Term 1	Pos	Search Term 2	Pos	Disciplines
JSTOR	Organization(Organization)	AB	Evolution	AB	Business; Business and Economics; Economics; Management and Organizational Behavior; Marketing and Advertising; Sociology
JSTOR	Organizational(Organizational)	AB	Evolution	AB	Business; Business and Economics; Economics; Management and Organizational Behavior; Marketing and Advertising; Sociology
JSTOR	Organization(Organization)	AB	Evolutionary	AB	Business; Business and Economics; Economics; Management and Organizational Behavior; Marketing and Advertising; Sociology
JSTOR	Organizational(Organizational)	AB	Evolutionary	AB	Business; Business and Economics; Economics; Management and Organizational Behavior; Marketing and Advertising; Sociology
JSTOR	Organizational(Organizational) Evolution	FT			Business; Business and Economics; Economics; Management and Organizational Behavior; Marketing and Advertising; Sociology
JSTOR	Organizational(Organizational) Ecology	FT			Business; Business and Economics; Economics; Management and Organizational Behavior; Marketing and Advertising; Sociology
JSTOR	Firm	AB	Evolution	AB	Business; Business and Economics; Economics; Management and Organizational Behavior; Marketing and Advertising; Sociology
JSTOR	Firm	AB	Evolutionary	AB	Business; Business and Economics; Economics; Management and Organizational Behavior; Marketing and Advertising; Sociology
WOS	Organization(Organization)	TI	Evolution	TI	Business Economics; Public Administration; Sociology
WOS	Organization(Organization)	TP	Evolutionary	TP	Business Economics; Public Administration; Sociology
WOS	Organizational(Organizational)	TI	Evolution	TI	Business Economics; Public Administration; Sociology
WOS	Organizational Evolution	TP			Business Economics; Public Administration; Sociology
WOS	Organizational Ecology	TP			Business Economics; Public Administration; Sociology
WOS	Firm	TP	Evolutionary	TP	Business Economics; Public Administration; Sociology
WOS	Firm	TP	Evolution	TP	Business Economics; Public Administration; Sociology
Bus Source	Organizational(Organizational)	AB	Evolution	AB	All

Bus Source	Firm	AB	Evolutionary	AB	All
Bus Source	Organization(Organization)	KW	Evolution	KW	All
Bus Source	Organization(Organization)	FT	Evolution	FT	All
Bus Source	Organization(Organization)	FT	Evolutionary	FT	All
Bus Source	Organizational Ecology	AB			All
Bus Source	Organization(Organization)	AB	Evolution	AB	All

Note: AB=Abstract; FT=Full Text; TI=Title; AU=Author; KW=Keyword; TP=Topic

Table 5. Selected Case Studies

Authors	Year	Title	Citations*	Citations per Year
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Birkinshaw, J.; Hamel, G. & Mol, M. J.	2008	Management Innovation	180	25.71
Jacobides, Michael G. & Winter, Sidney G.	2005	The Co-Evolution of Capabilities and Transaction Costs: Explaining the Institutional Structure of Production	222	22.20
Becker, M. C.	2004	Organizational routines: a review of the literature	239	21.73
Agarwal, R.; Echambadi, R.; Franco, A. M. & Sarkar, Mb	2004	Knowledge Transfer through Inheritance: Spin-out Generation, Development, and Survival	192	17.45
MacKinnon, D.; Cumbers, A.; Pike, A.; Birch, K. & McMaster, R.	2009	Evolution in Economic Geography: Institutions, Political Economy, and Adaptation	97	16.17
Cantwell, J.; Dunning, J. H & Lundan, S. M.	2010	An evolutionary approach to understanding international business activity: The co-evolution of MNEs and the institutional environment	75	15.00
Ahuja, G. & Katila, R.	2004	Where Do Resources Come from? The Role of Idiosyncratic Situations	162	14.73
Gittelman, M. & Kogut, B.	2003	Does Good Science Lead to Valuable Knowledge? Biotechnology Firms and the Evolutionary Logic of Citation Patterns	169	14.08
Hsu, G. & Hannan, M. T.	2005	Identities, Genres, and Organizational Forms	125	12.50
Volberda, H. W. & Lewin, A. Y.	2003	Guest Editors' Introduction Co-evolutionary Dynamics Within and Between Firms: From Evolution to Co-evolution.	150	12.50
Hodgson, G. M. & Knudsen, T.	2006	Why we need a generalized Darwinism, and why generalized Darwinism is not enough	105	11.67
Hite, J. M.	2005	Evolutionary processes and paths of relationally embedded network ties in emerging entrepreneurial firms	116	11.60
Frenken, K. & Boschma, R. A.	2007	A theoretical framework for evolutionary economic geography: industrial dynamics and urban growth as a branching process	79	9.88
Augier, M. & Teece, D. J.	2009	Dynamic Capabilities and the Role of Managers in Business Strategy and Economic Performance	59	9.83
Hodgson, G. M. & Knudsen, T.	2004	The firm as an interactor: firms as vehicles for habits and routines.	107	9.73
Essletzbichler, J. & Rigby, D. L.	2007	Exploring evolutionary economic geographies.	68	8.50
Chiles, T. H.; Meyer, A. D. & Hench, T. J.	2004	Organizational Emergence: The Origin and Transformation of Branson, Missouri's Musical Theaters	78	7.09
Boschma, R. & Frenken, K.	2009	Some Notes on Institutions in Evolutionary Economic Geography	40	6.67
Martin, X. & Salomon, R.	2003	Tacitness, Learning, and International Expansion: A Study of Foreign Direct Investment in a Knowledge-Intensive Industry	76	6.33

Shen, W.	2003	The dynamics of the CEO-board relationship: An evolutionary perspective	73	6.08
Kogut, B. & Zander, U.	2003	Knowledge of the Firm and the Evolutionary Theory of the Multinational Corporation: 2003 Decade Award Winning Article	67	5.58
Dencker, J. C.; Gruber, M. & Shah, S. K.	2009	Pre-Entry Knowledge, Learning, and the Survival of New Firms	32	5.33
Hodgson, G. & Knudsen, T.	2006	Dismantling Lamarckism: why descriptions of socio-economic evolution as Lamarckian are misleading.	44	4.89
Audia, P. G.; Freeman, J. H. & Reynolds, P. D.	2006	Organizational Foundings in Community Context: Instruments Manufacturers and Their Interrelationship with Other Organizations	44	4.89
O'Reilly, C. A., III; Harreld, J. B. & Tushman, M. L.	2009	Organizational Ambidexterity: IBM and Emerging Business Opportunities	29	4.83
Breslin, D.	2011	Reviewing a Generalized Darwinist Approach to Studying Socio-economic Change.	19	4.75
Jacobides, M. G. & Winter, S. G.	2012	Capabilities: Structure, Agency, and Evolution	14	4.67
Nelson, R.	2006	Evolutionary social science and universal Darwinism.	41	4.56
Hannan, M. T.	2005	Ecologies of Organizations: Diversity and Identity	45	4.50
Douglas, S. P. & Craig, C. Samuel	2011	Convergence and Divergence: Developing a Semiglobal Marketing Strategy	18	4.50
Tooby, John; Cosmides, Leda & Price, Michael E.	2006	Cognitive Adaptations for n-Person Exchange: The Evolutionary Roots of Organizational Behavior	40	4.44
Cattani, Gino	2005	Preadaptation, Firm Heterogeneity, and Technological Performance: A Study on the Evolution of Fiber Optics, 1970-1995	44	4.40
Murmann, Johann Peter	2013	The Coevolution of Industries and Important Features of Their Environments	8	4.00

Table 6. Measures of Network Centrality by Term – Ranked by Weighted Degree

Terms	Degree	Closeness Centrality	Betweenness Centrality
Selection	18.65	1.04	0.51
Variation	18.50	1.04	0.51
Retention	16.98	1.04	0.51
Adaptation	16.45	1.00	6.51
Routines	15.49	1.00	6.51
Capabilities	15.26	1.00	6.51
Emergence	14.62	1.00	6.51
Co-evolution	13.33	1.00	6.51
Universal Darwinism	13.26	1.04	0.51
Fitness	12.00	1.04	0.51
Genotype, Phenotype	11.44	1.04	0.51
Skills	11.27	1.00	6.51
Habits	10.80	1.00	6.51
Organizational Change	10.15	1.04	0.51
Interactor, Replicator	9.73	1.04	0.51
Organizational Learning	9.43	1.04	0.51
Institutional Economics	9.35	1.04	0.51
Lamarckism	8.82	1.07	0.26
Self-organization	7.73	1.04	0.51
Memes	7.72	1.11	-
Organizational Ecology	7.35	1.07	0.26
Population Ecology	6.66	1.04	0.51
Descent	6.53	1.04	0.51
Path-Dependence	5.77	1.04	0.51
Complex System	4.78	1.04	0.51
Multilevel Selection	2.67	1.11	-
Agent-based	2.39	1.14	0.08
Micro-foundations	2.30	1.14	0.08
Stage Theory	0.23	1.75	-