Proceedings of the International Conference on Industrial Engineering and Operations Management
Paris, France, July 26-27, 2018

Outsourcing and (Theoretical) Evolutionary Biology

Rob Dekkers
Adam Smith Business School
University of Glasgow
Glasgow G12 8QQ, Scotland
rob.dekkers@glasgow.ac.uk

Abstract

Outsourcing, possible originating in the make-or-buy decision, has been investigated from a number of theoretical perspectives, such as transaction cost economics and the resource-based view; however, the use of these canonical theories has insufficiently accounted for its long-term effects, the risks associated with the decision and the phenomenon of backsourcing. To include these long-term effects, this paper presents a complementary view informed by a (theoretical) evolutionary biological perspective that counteracts some controversies raised in literature. This perspective leads to an outline of an evolutionary framework that could inform further research into the effectiveness of decision making on outsourcing.

Keywords
Decision making, evolutionary models, mutations, outsourcing

1 Introduction

Whereas the conceptualisation of outsourcing decisions has often been related weakly to theories in studies (Dekkers et al., 2017), one possible avenue has been insufficiently explored: evolutionary models. Particularly, Mahnke (2001, p. 373) has advocated the role these evolutionary models could play for managerial decision making, although he did not expand the conceptualisation; note that he places the evolutionary processes in the context of searching, learning and capability development. In addition to his propositional paper, some other papers have referred to sources that propagate evolutionary models; a case in point is Doh (2005) referring to the work of Nelson and Winter (1982), but then connecting it to the resource-based view (Doh, 2005, p. 699). Another strand views the evolutionary process as staged development (e.g. Mirani, 2006). Nonetheless their referral to evolutionary models and processes, these studies are hardly linked to evolutionary models derived from (theoretical) evolutionary biology. Using these (theoretical) evolutionary models could lead to reference models for outsourcing and has the potential for developing more effective methods for decision making on outsourcing; this is what this paper seeks to explore.

1.1 Objectives of Paper

Before going into more detail about reference models derived from (theoretical) evolutionary biology, it should be noted that Mahnke (2001) relates the evolutionary perspective to a number of works that have taken this approach in a somewhat different manner. By way of illustration, he (ibid., p. 358) mentions the work of Teece et al. (1997). The work of Teece et al. relies on the resource-based view for forming the perspective of dynamic capabilities. However, Priem and Butler (2001) have mentioned the inadequacy of the resource-based view based on their argument that its conceptualisation is relevant to competitive heterogeneity and not suitable for other topics. Its inadequacy for outsourcing is proven by Dekkers (2011, p. 959), albeit based on case studies, because it does not account for long-term effects. Although the dynamic capability perspective building on the resource-based vie among other theoretical constructs for firms is relatively newer, works (e.g. Ellonen et al., 2009; Vogel and Güttel, 2013) are propositional and refer to outsourcing in the context of this perspective (e.g. Ellonen et al., 2009, pp. 757, 760; Vogel and Güttel, 2013, pp. 434, 437) rather then developing models or methods for decision making. This implies that the potential of a perspective from (theoretical) evolutionary biology has been untouched, even in the context of dynamic capabilities.

Although the dynamic capabilities perspective integrates the temporal dimension, the long-term perspective is missing in other canonical theories used for outsourcing. For example, Dekkers (2011, p. 959) finds that transaction cost economics, the resource-based view and the conceptualisation of core competencies are providing inadequate descriptions for long-term effects of outsourcing. The inclusion of the long-term perspective is necessary, because

Kinkel et al. (2008) show that some German companies backsource as regret for the preceding decision to outsource. Also, the studies cited in Fratocchi et al. (2014) demonstrate this interest in bringing back manufacturing that was previously internationally outsourced or captive offshored. This means that theories used for outsourcing should cover the long-term effects, but existing theoretical conceptualisations should also be considered inadequate.

Therefore, the central question of this paper is whether and how models and methods for decision making on outsourcing derived from theoretical evolutionary biology will yield insights that encompass long-term effects, associated risks and reduce the probability of backsourcing. This theoretical stance leads to the following questions:

- How can a perspective based on (theoretical) evolutionary biology inform decision making on outsourcing?
- And to what extent, can models and methods derived from this perspective lead to mitigating some of the risks and the long-term effects associated with outsourcing?
- How can this evolutionary perspective inform future research?

1.2 Scope and Outline of Paper

To introduce the perspective of (theoretical) evolutionary that may result in more effective models and methods for decision making on outsourcing, it explores models from evolutionary biology and their relevance to outsourcing. Hence, it addresses the gap that has been noted for building adequate theory for outsourcing (Dekkers et al., 2017; Busi and McIvor, 2008, p. 193). Furthermore, it extends the conceptualisation beyond evolutionary models based on replication of organisational routines (Nelson and Winter, 1982). Finally, although some (e.g. Mahnke, 2001; Tate et al., 2009) have referred to evolutionary processes, these have been limited to distinguishing phases and learning. This means that the perspective adds possibly insight that has not yet been embedded in extant academic literature.

The first step in the development of this complementary insight is discourse about appropriateness of models from (theoretical) evolutionary biology for organisations; this will be related to making decisions on outsourcing in this second section. The third section discusses briefly implications of this theoretical framework to inspire further research. A discussion of findings and a concluding section complete the paper.

2 Appropriateness of (Theoretical) Evolutionary Models for Outsourcing

The use of evolutionary biological models for outsourcing assumes an analogy between firms and organisms. According to Hodgson (1993, pp. 18–19), analogies and metaphors are not just literary ornaments but their use implies approaching reality from various perspectives and should be used with utmost care. Of course, studies should always remain open to the possibility that they are misleading, incomplete, inaccurate or even inappropriate (Morgan, 1997, p. 5). An analogy in microeconomic theory that is persistent and widely accepted is that firms, industries or even countries as a whole behave like individuals (at the level of firms enforced by the acknowledgement of a corporation as a legal entity (Bakan, 2004)). This may be an appropriate analogy for understanding certain aspects of economic decision-making, but as a general model may suffer from serious shortcomings. However, some, such as Nelson and Winter (1982, p. 11), denounced pursuing biological analogies for their own sake or for the purpose of developing a general evolutionary theory applicable to both natural and social sciences. Keeping this latter thought and the limitations in mind, this section explores the application of models from theoretical evolutionary biology to the domain of organisations, particularly outsourcing.

2.1 Analogy of Evolutionary Mechanisms

This application of theoretical evolutionary biological models based on the analogy only becomes possible when sufficient similarities exist (see Dekkers (2008, pp. 50–51) for more detail):

- Selection acts on mutations of entities, whether they are organisations or organisms. Biological evolution is characterised by the generation of a variety of phenotypes and the environment selects beneficial phenotypes. Such a process exists also for organisations where the selection process finds itself in the competition for the customer base, the acquisition of resources and the changes in the ecological system.
- Organisations and organisms are both structurally closed. The relationships between the internal components determine how the entity absorbs perturbations by the environment; organisations constitute allopoietic systems (Dekkers, 2005, p. 148; Minger, 1989) and organisms autopoietic systems (Maturana and Varela, 1980).
- Organisations have the possibility of self-cognition and learning, which is also found for organisms: the 6th and 7th level of Boulding (1956) (see Figure 1). The latent changes are present in the structure of the entity and the environment may induce these changes. Learning becomes possible because both organisations and organisms will deploy a set of sensors to acquire information about their behaviour (see de Geus (1999) and (Senge, 1992)

for organisational applications), although self-reference limits the possibilities to detect all changes and perturbations in the environment.

- Developmental pathways seem to exist for both organisations (Teece et al., 1997, pp. 522–523) and organisms (e.g. Maynard Smith et al., 1985, pp. 265–266). Organisms can increase their fitness by undertaking an adaptive walk in a fitness landscape (Kauffman, 1993, pp. 36–67), in which selection acts on beneficial phenotypes; note that Geritz et al. (1997, p. 2027) refer to many models as being only one-dimensional and encapsulating an equilibrium population density, Kauffman's (1993, pp. 36–67) fitness landscapes should be rendered limited in this respect. Within this thought of adaptive walks, organisations can create (beneficial) mutations and commence an adaptive walk.

Nevertheless, also some differences can be found, thus calling for caution when applying models from evolutionary biology to the domain of organisations (Dekkers, 2008, p. 51):

- Organisations viewed as allopoietic systems do not have the possibility for self-reproduction through recombination in contrast to living entities. For living entities reproduction through recombination has very positive effects on finding fitness peaks in the adaptive landscapes as demonstrated through the NK-model (Kauffman, 1993, pp. 40–54); N indicates the number of genes and K the links between genes. Thus, the unabridged deployment of genetics to the domain of organisations carries the danger that the study might end up as a metaphor rather than an analogy.
- Organisations have the capability for foresight, which is already latently present at the 6^{th} level and present at 7^{th} level (Figure 1), but can exert teleological interventions in their processes, structures and interactions with the environment. Through senses organisms acquire information about the effects of actions and have the capability to learn by self-reference embedded in their structure. However, the evolution of organisms depends on the creation of mutations and selection of these by the environment. For organisations it becomes possible to generate perceived beneficial mutations and to influence the behaviour of other organisms, thus incorporating foresight in evolutionary processes.
- Organisations have fuzzy boundaries in contrast to organisms. Organisms as autopoietic systems not only reproduce, they also retain a boundary to the environment, they consist of components that compose a total functional entity, and they are structurally closed. Through these boundaries, the environment can only induce changes that are already present in the composition and structure of the entity. Organisations have boundaries, too, but have the capability to shift these (for example, through mergers or outsourcing).

Whereas these differences exist, conceptual models derived from biological models for adaptation to the environment can be used for organisations based on the noted similarities, while accounting for these differences.

More specifically, organisations can be considered allopoietic systems in an evolutionary sense, subject to selectional forces (a thought supported by van den Bergh (2003, p. 3)). Developments in evolutionary biology allow an integral approach to the evolutionary process, connecting the generation of variation to selectional forces (e.g. fitness landscapes (Kauffman, 1993) and adaptive dynamics (Geritz et al., 1997)). This means that the predictive power of these models can be extended to the field of management science, accounting for the similarities and differences between organisms and organisations. To this purpose, a reference model describes the interaction between organisation and environment (see Figure 2), consisting of two intertwined cycles: the generation of variation and the selection by the environment. Note that this reference model differs from the popular but simplified evolutionary model by Campbell (1969), which only distinguishes variation, selection and retention; from a contemporary standpoint this should be rendered incomplete, even though it used regularly in business and management studies (for example, McCarthy, 2003, pp. 738–739; Zollo and Winter, 2002, p. 343). Thus, organisations as allopoietic systems undertake adaptive walks in fitness landscapes subject to selectional forces.

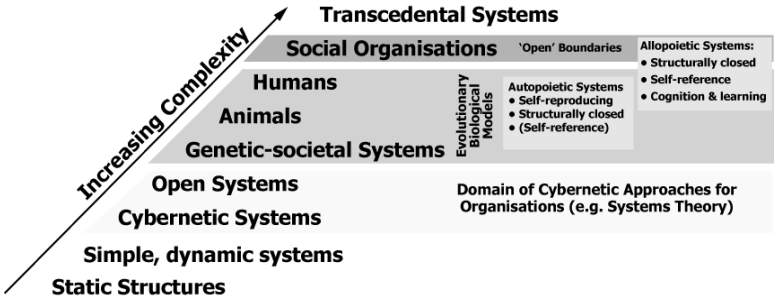

Figure 1: Organisations as allopoietic systems in the systems hierarchy of Boulding.

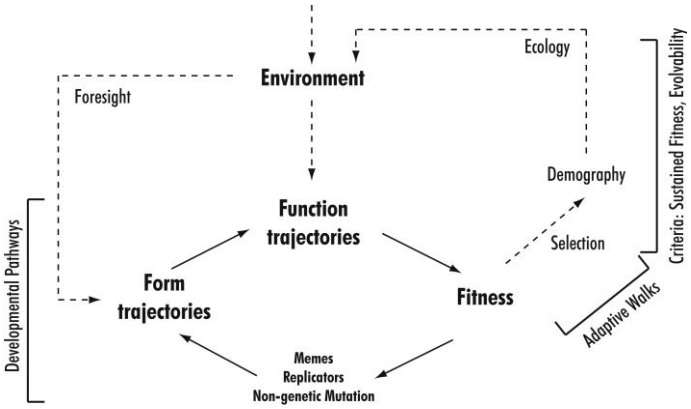

Figure 2: Evolutionary Mechanisms for Organisations Based on Biological Concepts.

Taking the reference model as starting point, the question is what is the equivalent of genes (and alleles) as building block for evolutionary models in the case of organisations. One possible view concentrates on the division of an organisation in departments, groups, individuals, etc.; Morgan (1997) did propose such when introducing the image of an organisation as an organism. Another perspective would be looking at organisations as a collection of resources with skills and knowledge, expressing itself in the form of capabilities (these manifest in function trajectories); such does Nakane (1986). This perspective aligns with the notion of dynamic capabilities (Teece et al., 1997). A third angle is looking at the replication of organisational routines (Nelson and Winter, 1982), which takes recurrent processes and practices as implicit base for genes and alleles; note that Nelson and Winter (ibid., p. 11) denounced pursuing biological analogies for their own sake or for the purpose of developing a general evolutionary theory applicable to both natural and social sciences. Note that the perspective of capabilities and organisational routines are closely aligned. This means that mutations in the form of changes in hierarchical structure, processes and capabilities are subjected to selectional forces. According to Figure 2 the notable difference between organisms and organisations is the presence of foresight; whereas organisms principally propagate through random mutation – ignoring group selection –, organisations have the capability to generate perceived beneficial mutations and to influence the behaviour of other organisms. Therefore, mutations in hierarchical structures, processes and capabilities of organisations are in principle teleological, but will be subjected to selectional forces and environmental changes.

2.2 Outsourcing as Mutation

Returning to what outsourcing means as teleological change for companies, this is often acknowledged as changing the boundary of the firm. In the context of strategic outsourcing, some works (Espino-Rodríguez and Padrón-Robaina, 2006, p. 50; McIvor, 2009, p. 45) refer to shifting the boundary of the firm. Mahnke (2001, p. 355) calls it the vertical boundary choice. In the spirit of the previous subsection, outsourcing concerns hierarchical structures (e.g. Barthélemy and Geyer, 2005; Cooke et al., 2005), recurrent processes (i.e. organisational routines) (Espino-Rodríguez and Rodríguez-Díaz, 2008, p. 330; Spithoven and Teirlinck, 2015; Wilson and Zhang, 2002, p. 52; Windrum et al., 2008) and capabilities (Espino-Rodríguez and Rodríguez-Díaz, 2008, p. 37; Espino-Rodríguez and Gil-Padilla, 2005; Spithoven and Teirlinck, 2015; Wilson and Zhang, 2002, p. 52); in this sense, all three equivalents for genes and alleles are present in studies, but none to evolutionary mechanisms beyond Nelson and Winter (1982). Note that some works (e.g. Espino-Rodríguez and Rodríguez-Díaz, 2008; Spithoven and Teirlinck; Wilson and Zhang, 2002) blend organisational routines and capabilities without providing a rationale for this specific conceptualisation from an evolutionary perspective. Furthermore, organisational routines and capabilities have been linked to learning in the context of outsourcing (e.g. Windrum et al., 2008, pp. 216–217; Verwaal et al., 2008]); note that this is called self-reference in an evolutionary context. These works confirm that outsourcing firm can be viewed as a mutation – a change in hierarchical structures, capabilities and recurrent processes; however, none of these works relates outsourcing to the context of (theoretical biological) evolutionary models.

This also means that outsourcing as mutation is subject to developmental pathways for increasing fitness and to evolutionary forces caused by population dynamics and ecological changes, according to the evolutionary mechanisms for organisations in Figure 2. It should be mentioned that few studies exist that consider pathways. For example, Broedner et al. (2009, p. 130) refer to path dependency but only investigate the impact of productivity

(perhaps a partial interpretation of fitness). And Mirani (2006) proposes three stages in the development of buyer-vendor relationships and applies these to a case study; however, this study does not draw on any evolutionary theory. In addition to developmental pathways as evolutionary mechanism, works (Billi et al., 2004; Güth and Kliemt, 1998) that draw on populations dynamics (particularly, the writings by Hannan and Freeman 1977; 1984) use limitedly evolutionary models that are available. Some (e.g. Shortell, 1997) support the notion and the suitability of population ecology, but again do provide little detail. This all means that the potential of evolutionary mechanisms, such as developmental pathways and population ecology, has been tapped into, but not exploited in terms of using (formal) models derived from (theoretical) evolutionary biology.

2.3 Implications for Evaluating Outsourcing Decisions

When outsourcing is considered a mutation of an allopoietic system (i.e. a firm) by shifting its boundary, then the so-called boundary zones must be shifting, too. In systems theories, these zones Miller and Rice (1967) imply discontinuities for a set of resources that are controlled by mechanisms. These mechanisms can be found in the steady-state model (Dekkers, 2017, Ch. 7); see Figure 3. Because of the shifting of the boundary, the set of resources for the processes in a firm is divided in a new internal set and a new external set. Consequently, this

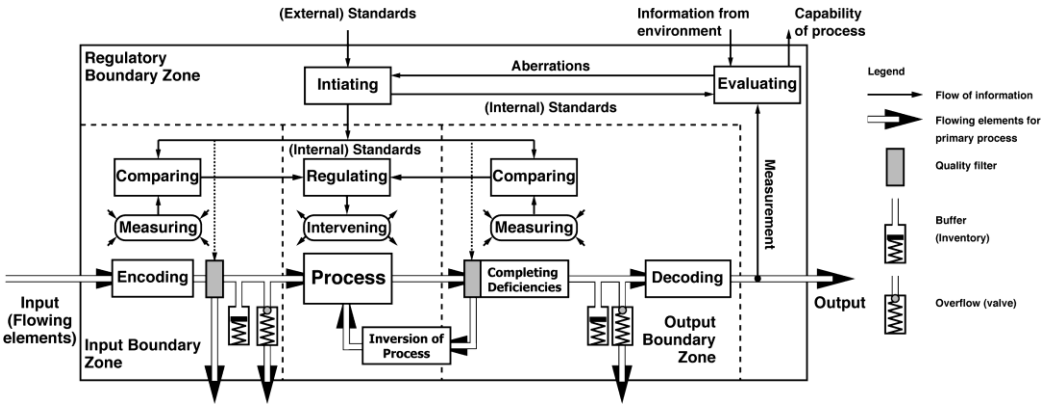

Figure 3: Steady-State Model for Boundary Zones and Related Control Mechanisms.

impacts the exchange relationships and the collaboration in a supply network; see Dekkers and Kühnle (2012, p.1095) for the collaboration model for the value chain (Figure 4). In an evolutionary perspective, the changes in the boundary firm are part of developmental pathways and learning processes (firms as allopoietic systems), the latter in the spirit of Mahnke's (2001, p. 373) proposition.

What the reference model adds to Mahnke's (2001) view is that outsourcing should be considered a mutation, related to foresight and strategic intents, subject to selection. Traditionally, this is equated to competitive (and corporate) strategies (e.g. Espino-Rodríguez and Padrón-Robaina, 2006; McIvor, 2009). The question is then whether outsourcing as a teleological mutation related to strategic intents contributes to fitness. Note that in evolutionary biology fitness is a central concept, but not defined in terms of variables. Often fitness for decisions on outsourcing is equated to enhancing manufacturing capabilities (e.g. Dabhilkar and L. Bengtsson, 2008). The manufacturing capabilities could be reflecting fitness, but also other facets could be taken into account. However, that manufacturing capabilities and other factors are not always adequately evaluated by companies when making the outsourcing decision is manifest in the work of Kinkel et al. (2008) about backsourcing and the study of Broedner et al. (2009) on productivity effects of outsourcing; their studies among others (e.g. Dekkers, 2011) point out that decisions have not appraised all relevant aspects of decisions, which lead later to 'regrets' or to backsourcing. Thus, the results of some studies indicates that fitness of organisations as a result of decision making on outsourcing needs to be considered from an integral perspective, but this may need further definition.

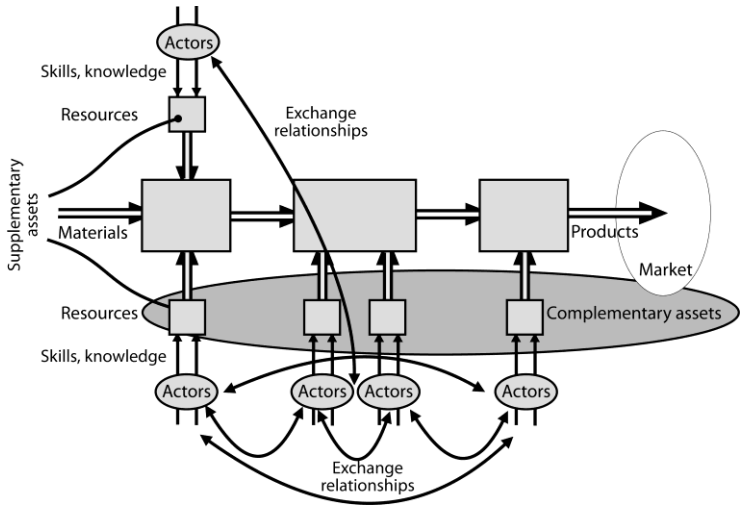

Figure 4: Collaborative Model for the Value Chain.

Because, the step for outsourcing by a single firm affects its individual fitness, the competitive fitness landscape changes, too. This dynamic view about population ecology lacks in current studies. In this perspective, the concept of dynamic capabilities is directed at the pathway of individual firms rather than how the competitive positions of individual firms are changing relative to each other as consecutive actions and interventions. In the case of outsourcing, the changed fitness of individual firms influences how others compete. A successful strategy can be mimicked by other firms (mimetic isomorphism (Shortell, 1997, p. 29)[1]) and this could lead to fixing (for example, by following the principles of adaptive dynamics for [in]stability in a population); in such a case, one company in a sector outsources some activities, this is perceived as beneficial, and other companies in this sector follow suit. The only study to take this into account is the one by Loh and Venkatraman (1992), albeit that they do not study underlying mechanisms. Or outsourcing could provoke other responses by firms to seek alternative markets or sectors, to pursue alternative technologies, etc. in order to avoid tit-for-tat. Thus, the improved fitness of a firm through outsourcing activities should be considered not only from a cross-sectional view, but also from a longitudinal perspective. Current longitudinal studies on outsourcing are directed at a single company (e.g. Ciravegna and Maielli, 2011; Fisher et al., 2008; Willcocks et al., 1999), are looking at a specific aspect, such as risk (Willcocks et al., 1999) and organisational learning (Ciravegna and Maielli, 2011; Fisher et al., 2008), but do not contemplate population dynamics, except for competitive pressures on cost (Ciravegna and Maielli, 2011; Fisher et al., 2008, pp. 168, 171). This means that evolutionary (stable) strategies and criteria for stability, as commonly found in theoretical evolutionary models (Geritz et al., 1997; Meszéna et al., 2001), have not been incorporated in models to explain outsourcing in a population of firms.

Finally, following these thoughts on evolutionary models for outsourcing, the mutation also is affected by the changes in the environment. It could lead to invade other market domains, the vulnerability of the population of other firms entering the market domain, environmental 'disasters', etc. Thus, the fitness is not only related to a population of firms, but also how these firms in such a population evolve on the long-run in response to exogenous events.

3 Extending Existing Research on Outsourcing

The preceding deliberations means that from an evolutionary perspective outsourcing should be viewed as a purposeful mutation, which means (a) the inclusion of foresight and learning into the decision-making process, (b) the impact of changes in the boundary zone including exchange relationships on fitness of individual firms, (c) the contribution of outsourcing to fitness of firms, and (d) the impact on population ecology and related dynamics (incl. mimicking and coercive isomorphism); these four mechanisms for looking at the outsourcing decisions by firms from an evolutionary perspective will provide a substantial extension of existing research. In terms of Zahra and

[1] Note that Shortell (1997, p. 29) also talks about coercive isomorphism (for example, the influence of shareholders).

Newey (2009, pp. 1069–1070), this proposition for the inclusion of evolutionary aspects based on the analogy with evolutionary biology potentially transforms the core of theories for outsourcing. Whereas one of the four mechanisms (boundary control and exchange relationships) is present in current literature but not fully investigated and another weakly (fitness), particularly the impact of outsourcing decisions on population ecology in industrial sectors or economies has not been considered. This also means that outsourcing has been insufficiently set off against the criteria for evolution; the stability criteria of adaptive dynamics (Geritz et al., 1997) could serve as starting point. Note that the complex adaptive systems as described by Kaufmann's (1993) fitness landscapes – a popular approach in business and management studies – and the criteria for sustained fitness and evolvability encapsulated in this model are insufficient, because the fitness space is one-dimensional and static (in his description populations move on this landscape). Thus, this evolutionary perspective presents an integral view by considering short-term and long-term effects.

However, with regard to these effects it should be noted that outsourcing could hardly result in bifurcation. Bifurcation applied to firms would mean a shift to a new business model or tapping into new markets; this means that outsourcing is probably at best an evolutionary stable strategy (Meszéna et al., 2001, pp. 200–201). This assertion can only be established by research looking into population ecology related to outsourcing decisions in industrial sectors. Simulation models using semi-empirical data could also establish such. This strand of research would corroborate existing studies on whether outsourcing constitutes a beneficial or detrimental mutation and under which conditions.

Particularly of interest in this integral view is not only the decision, but also the temporal dimension. For the outsourcing decision, it is the impact that the mutation will have; this is related to the capability of foresight. And for the evolutionary perspective, the longitudinal view should be considered: how the outsourcing by firms influences the dynamics in a specific population of firms on the long term; this calls for game theories, such as adaptive dynamics (Geritz et al., 1997; Meszéna et al., 2001), to be integrated into decision making. But it also extends to how the capabilities of an individual firm evolve to increase its sustained fitness and whether it pursues viable evolutionary strategies. Thus, the temporal dimension is reflected in the development of fitness of the individual firm, the population ecology and the resilience of a population of firms.

4 Discussion of Implications

Based on the four proposed mechanisms in the second section and the dynamics derived from (theoretical) evolutionary biology in the third section, this paper has presented a more complete reference model to describe evolution of companies for the application to decisions on outsourcing. This description became more complete by integrating the concepts of fitness landscapes and adaptive dynamics into the intertwined cycles of the generation of variation and selection by the environment. Thus, it extends beyond the more commonly used model of variation, retention and selection (Campbell, 1969).

4.1 Limitations of Evolutionary Models for Outsourcing

Nonetheless the potential for building evolutionary theory related to outsourcing, this analogy that informs the modelling has four major limitations. First, organisations should be viewed as allopoietic systems, whereas organisms are autopoietic systems; some studies in the context of outsourcing (e.g. Alaa, 2009) see organisations as autopoietic systems, which means they do not see mutations as self-reproduction, the essential characteristic of allopoietic systems. Even those (e.g. van der Linden, 2011, p. 1196) that refer to the organisations in the context of outsourcing seem to discard that organisations should be classified as allopoietic systems. The subtle difference implies that not all evolutionary mechanisms from (theoretical) evolutionary biology may apply. However, in this propositional paper only relevant evolutionary mechanisms to allopoietic systems have been considered. Second, the focus in the deliberation has been on firms that are focusing a single product-market combination. In reality, some firms may be part of a conglomerate and, therefore, mutations may be subject to corporate strategy and not just to competitive strategies (which would aim at increasing fitness in a specific product-market combination, the population). This impact of this limitation is more difficultly to be addressed by evolutionary models, perhaps Stackelberg game should complement the modelling based on adaptive dynamics; Chen et al. (2011) investigate industry dynamics in this fashion, but not by inclusion of evolutionary processes. Third, the term fitness, which is already difficult to assess in evolutionary biology, is seen as valid for the domain of organisations, too. In the case of outsourcing, fitness should at least describe manufacturing capabilities and product differentiation. This means that fitness is not mono-dimensional, for example in the complex adaptive systems as described by Kaufmann (1993, pp. 39–67), but should be represented in models with multi-dimensional fitness, such as found in adaptive dynamics (Meszéna et al., 2001). Fourth, decision making is seen as rational and based on foresight; in practice this

is not necessary the case, although Güth and Kliemt (1998) make the case that even subjective preferences are subject to processes for adaptation. Except for the second limitation – corporations versus firms focusing on specific product-market combinations – the limitations seem to have minimal impact on the proposition made here that models derived from (theoretical) evolutionary biology may provide insight beyond those based on canonical theoretical perspectives for outsourcing.

4.2 Potential Implications for Managerial Practice

Consequently, the four proposed mechanisms have a profound impact on the way a decision on outsourcing should be made. Not only should the decision consider the performance objectives, it should also look at the impact of the change of the boundary on the population and the long-term effects. Whereas some of these points have been noted in preceding research, they have not been articulated and put into an integral perspective. This means that the evolutionary perspective may also be helpful for actual decision making, though it needs to be formalised into methods akin van Aken and Romme's (2009) thoughts on management science as a design science.

The thoughts encapsulated in this paper should lead to managers not only taking into account the immediate effects of outsourcing, particularly, the cost of products and services, but also how their decision will affect the competitive landscape. If one company decides to outsource, others might follow and potentially wipe out the competitive advantage. Then, benefits are not achieved as originally envisioned for the firm and further interventions may follow, which could include outsourcing of more activities to reduce cost. Separate from the fact that the decisions on outsourcing may backfire as evidenced by Kinkel et al. (2008), these decisions are multi-dimensional, meaning comprising of multiple performance measures and not cost alone; the overreliance on cost is also found in Dekkers et al. (2017). Evolutionary models will add a view that integrates better the evolutionary strategies by other firms and the impact on population dynamics.

4.3 Agenda for Research

To achieve better insight into the long-term effects of outsourcing, the points raised in this paper should be translated into models that can explain and predict decision making by firms on outsourcing. This is based on the premise that evolutionary game theory will include long-term effects; for example, Vincent and Vincent (2000, p. 22) state that in evolutionary games the focus is on strategies that may persist through time, as opposed to classical games that seek optimisation for individual players. For the domain of outsourcing, this paradox between optimisation and evolutionary strategies has been noted implicitly by several studies, including Dekkers (2011) and Kinkel et al. (2008). When it is possible to model evolutionary strategies for outsourcing, ultimately, these models could serve also as basis for methods to support decision making on outsourcing. However, this requires the evolutionary mechanisms for outsourcing to be integrated by considering the following:

- Mathematical models describing evolutionary strategies and population dynamics derived from adaptive dynamics (Geritz et al., 1997; Meszéna et al., 2001). These models should cover the effects of mimicking, coercive isomorphism and responses by firms, such as tit-for-tat. Moreover, the models should be developed, because it is not possible to directly apply the models used in theoretical evolutionary biology to the domain of management science and economics. This is caused by the population size in industries being different from those in biological systems. Generally, population sizes in industries may vary from a few to thousands firms, whereas population sizes in evolutionary biology are hundred and above. In addition to population sizes being smaller, the models for adaptive dynamics are based on Malthusian growth models. These models do not necessarily apply to firms, but could be related to the products or services they provide. This may mean that there are two related populations: the market domain as a population subject to the Malthusian growth model and the firms competing in a market as population. Perhaps, the models of adaptive dynamics need to be complemented by models based on the Stackelberg game to make this possible; whereas this link is implicitly mentioned in works (e.g. Vincent and Vincent, 2000), it has not yet been connected in modelling. Consequently, whereas the potential of applying models derived from adaptive dynamics seem beneficial to advancing theoretical understanding of the impact of outsourcing on population dynamics and evolutionary strategies for firms, developing actual models will require overcoming some fundamental challenges in mathematical modelling.
- Modelling of manufacturing capabilities in terms of a fitness space. The expression of fitness should be related to the competitive position of a firm in the specific market domain. This implies that the fitness should be multi-dimensional, because competition between firms is through offerings of products and services, performance criteria, etc. Within the domain of manufacturing the competitive position is denoted through the concept of manufacturing capabilities. The mechanism for how manufacturing capabilities are achieved is

debated in literature. Some advocate the trade-off model (e.g. Da Silveira and Slack, 2001; Ferdows and de Meyer, 1990) and others see it as a cumulative process (Größler and Grübner, 2006; White, 1996). By analysing results from the evolutionary models proposed here for outsourcing, it may become apparent which one of these two approaches to manufacturing capabilities holds more validity, perhaps related to industrial context and characteristics of the market domain; this will add outcomes of a theoretical perspective to underpin this on-going discussion.

- Integration of the intertwined cycles of generation of mutations through outsourcing and selectional processes. Whereas the suitability of adaptive dynamics and matrix games (e.g. Geritz et al., 1997; Meszéna et al., 2001) – using a multi-dimensional space for fitness and describing population dynamics – justifies using these models for theoretical evolutionary models to describe the effects of outsourcing, these do not describe alleles. The NK-model of Kauffman (1993, p. 42) uses genetic mutations, but does not incorporate a multi-dimensional space for fitness and the modelling of population dynamics. Therefore, one challenge is how adaptive dynamics and matrix games can be better combined with descriptions of alleles with regard to outsourcing.
- In addition to such methods offering a more complete picture informing the outsourcing decision, these methods should be compared with other methods and theories; this is commensurate with Dekkers et al.'s (2017) notion that such studies are lacking.

Also, some of the mechanisms mentioned in the second section may also require separate studies before results can be integrated; this is particularly the case for:

- The modelling of how outsourcing affects the boundary zone (control mechanisms, organisational structures and exchange relationships). There is no precedent that this matter has been investigated system systematically, even though the impact of outsourcing on the interaction between the outsourcer and the outsourcee is acknowledged.
- The modelling of manufacturing capabilities as fitness related to outsourcing (see previous paragraph). Whereas criteria, such as cost, flexibility, lead-time and quality, are guiding the outsourcing decision, albeit not every study takes this into account, evolutionary models extend the criteria to those that are long-term directed. More studies akin Kinkel et al. (2008) and Loh and Venkatraman (1992) are necessary to this effect, but not necessarily limited to their approaches.
- The dynamics caused by outsourcing in a population (industrial sector or economy). Whereas Chen et al. (2011) and Loh and Venkatraman (1992) study population dynamics for outsourcing, they do so in a limited way and not accounting for evolutionary process; it should be noted that Chen et al. (2011) use game theory limited to optimisation rather than evolutionary strategies. More research is necessary to look at how competing firms mimic outsourcing strategies by others and what effect these had on population dynamics.

However, such studies focusing on specific mechanisms could incorporate the reference model as point of departure.

5 Concluding Remarks

Whereas there is evidence that the view of academics on outsourcing has been subject to progressive insight, the incorporation of models from (theoretical) evolutionary biology has lagged; this is a missed opportunity since no equivalent in management science exists of theory-based ecology (e.g. Pásztor et al., 2016). This paper has presented a way forward based on this very different perspective; moreover, the framework and the related reference model potentially address some setbacks of outsourcing noted in the literature. Therefore, this work also presents a route to progress academic insight in an evolutionary manner: building theory for outsourcing as mutation!

References

Aken, J. E., van,, & Romme, G. (2009). Reinventing the future: adding design science to the repertoire of organization and management studies. *Organization Management Journal, 6*(1), 5–12. doi:10.1057/omj.2009.1

Alaa, G. (2009). Derivation of factors facilitating organizational emergence based on complex adaptive systems and social autopoiesis theories. *Emergence: Complexity and Organization, 11*(1), 19–34.

Bakan, J. (2004). *The Corporation: The Pathological Pursuit of Profit and Power*. London: Constable.

Barthélemy, J., & Geyer, D. (2005). An empirical investigation of IT outsourcing versus quasi-outsourcing in France and Germany. *Information & Management, 42*(4), 533–542. doi:10.1016/j.im.2004.02.005

Billi, J. E., Pai, C.-W., & Spahlinger, D. A. (2004). Strategic Outsourcing of Clinical Services: A Model for Volume-Stressed Academic Medical Centers. *Health Care Management Review, 29*(4), 291–297.

Boulding, K. E. (1956). General Systems Theory. *Management Science, 2*(3), 197–208. doi:10.1287/mnsc.2.3.197

Broedner, P., Kinkel, S., & Lay, G. (2009). Productivity effects of outsourcing: New evidence on the strategic importance of vertical integration decisions. *International Journal of Operations & Production Management,*

29(2), 127–150. doi:10.1108/01443570910932020
Busi, M., & McIvor, R. (2008). Setting the outsourcing research agenda: the top-10 most urgent outsourcing areas. *Strategic Outsourcing: An International Journal, 1*(3), 185–197. doi:10.1108/17538290810915263
Campbell, D. T. (1969). Variation, selection and retention in sociological evolution. *General Systems, 14*( ), 69–85.
Chen, Y., Dubey, P., & Sen, D. (2011). Outsourcing induced by strategic competition. *International Journal of Industrial Organization, 29*(4), 484–492. doi:10.1016/j.ijindorg.2010.10.001
Ciravegna, L., & Maielli, G. (2011). Outsourcing of New Product Development and the Opening of Innovation in Mature Industries: A Longitudinal Study of Fiat during Crisis and Recovery. *International Journal of Innovation Management, 15*(1), 69–93. doi:10.1142/S1363919611003088
Cooke, F. L., Shen, J., & McBride, A. (2005). Outsourcing HR as a competitive strategy? A literature review and an assessment of implications. *Human Resource Management, 44*(4), 413–432. doi:10.1002/hrm.20082
Da Silveira, G., & Slack, N. (2001). Exploring the trade- off concept. *International Journal of Operations & Production Management, 21*(7), 949–964.
Dabhilkar, M., & Bengtsson, L. (2008). Invest or divest? On the relative improvement potential in outsourcing manufacturing. *Production Planning & Control, 19*(3), 212–228. doi:10.1080/09537280701830144
de Geus, A. (1999). *The Living Company*. London: Nicolas Brealy.
Dekkers, R. (2005). *(R)Evolution, Organizations and the Dynamics of the Environment*. New York: Springer.
Dekkers, R. (2008). Adapting Organizations: The Instance of Business Process Re-Engineering. *Systems Research and Behavioral Science, 25*(1), 45–66. doi:10.1002/sres.857
Dekkers, R. (2011). Impact of strategic decision making for outsourcing on managing manufacturing. *International Journal of Operations & Production Management, 31*(9), 935–965. doi:10.1108/01443571111165839
Dekkers, R. (2017). *Applied Systems Theory* (2nd ed.). Cham: Springer.
Dekkers, R., Barlow, A., Chaudhuri, A., & Saranga, H. (2017). *Theory Informing Decision Making on Outsourcing: A Review of Four 'Five-Year' Snapshots Spanning 47 Years*. Paper presented at the 24th International Conference on Production Research, Poznan.
Dekkers, R., & Kühnle, H. (2012). Appraising interdisciplinary contributions to theory for collaborative (manufacturing) networks: Still a long way to go? *Journal of Manufacturing Technology Management, 23*(8), 1090–1128. doi:10.1108/17410381211276899
Doh, J. P. (2005). Offshore Outsourcing: Implications for International Business and Strategic Management Theory and Practice. *Journal of Management Studies, 42*(3), 695–704. doi:10.1111/j.1467-6486.2005.00515.x
Ellonen, H.-K., Wikström, P., & Jantunen, A. (2009). Linking dynamic-capability portfolios and innovation outcomes. *Technovation, 29*(11), 753–762. doi:10.1016/j.technovation.2009.04.005
Espino-Rodríguez, T. F., & Gil-Padilla, A. M. (2005). Determinants of information systems outsourcing in hotels from the resource-based view: an empirical study. *International Journal of Tourism Research, 7*(1), 35–47. doi:10.1002/jtr.518
Espino-Rodríguez, T. F., & Padrón-Robaina, V. (2006). A review of outsourcing from the resource-based view of the firm. *International Journal of Management Reviews, 8*(1), 49–70. doi:10.1111/j.1468-2370.2006.00120.x
Espino- Rodríguez, T., F., & Rodríguez- Díaz, M. (2008). Effects of internal and relational capabilities on outsourcing: an integrated model. *Industrial Management & Data Systems, 108*(3), 328–345. doi:10.1108/02635570810858750
Ferdows, K., & De Meyer, A. (1990). Lasting improvements in manufacturing performance: In search of a new theory. *Journal of Operations Management, 9*(2), 168–184. doi:0.1016/0272-6963(90)90094-T
Fisher, J., Hirschheim, R., & Jacobs, R. (2008). Understanding the outsourcing learning curve: A longitudinal analysis of a large Australian company. *Information Systems Frontiers, 10*(2), 165–178. doi:10.1007/s10796-008-9070-y
Geritz, S. A. H., Metz, J. A. J., Kisdi, E., & Meszéna, G. (1997). Dynamics of Adaptation and Evolutionary Branching. *Physical Review Letters, 78*(10), 2024–2027. doi:10.1103/PhysRevLett.78.2024
Größler, A., & Grübner, A. (2006). An empirical model of the relationships between manufacturing capabilities. *International Journal of Operations & Production Management, 26*(5), 458–485. doi:10.1108/01443570610659865
Güth, W., & Kliemt, H. (1998). The indirect evolutionary approach: Bridging the gap between rationality and adaptation. *Rationality and Society, 10*(3), 377–399. doi:10.1177/104346398010003005
Hannan, M. T., & Freeman, J. (1977). The Population Ecology of Organizations. *American Journal of Sociology, 83*(4), 929–984. doi:10.1086/226424
Hannan, M. T., & Freeman, J. (1984). Structural Inertia and Organizational Change. *American Sociological Review, 49*(2), 149–164. doi:10.2307/2095567

Hodgson, G. M. (1993). *Economics and Evolution - Bringing Life Back into Economics*. Cambridge: Polity Press.

Kauffman, S. A. (1993). *The Origins of Order: Self-Organization and Selection in Evolution*. New York: Oxford University Press.

Kinkel, S., Lay, G., & Maloca, S. (2008). Patterns of internationalization of German SMEs: surveying manufacturing offshoring. In L. P. Dana, I. M. Welpe, M. Han, & V. Ratten (Eds.), *Handbook of Research on European Business and Entrepreneurship* (pp. 246–262): Edward Elgar.

Loh, L., & Venkatraman, N. (1992). Diffusion of Information Technology Outsourcing: Influence Sources and the Kodak Effect. *Information Systems Research, 3*(4), 334–358. doi:10.1287/isre.3.4.334

Mahnke, V. (2001). The Process of Vertical Dis-Integration: An Evolutionary Perspective on Outsourcing. *Journal of Management and Governance, 5*(3–4), 353–379. doi:10.1023/A:1014003229386

Maturana, H. R., & Varela, F. J. (1980). *Autopoiesis and Cognition – The Realization of Living*. Dordrecht: Reidl.

Maynard Smith, J., Burian, R., Kauffman, S., Albergh, P., Campbell, J., Goodwin, B., . . . Wolpert, L. (1985). Developmental Constraints and Evolution: A Perspective from the Mountain Lake Conference on Development and Evolution. *The Quarterly Review of Biology, 60*(3), 265–287. doi:10.1086/414425

McCarthy, I. P. (2003). Technology management - a complex adaptive systems approach. *International Journal of Technology Management, 25*(8), 728-745. doi:10.1504/IJTM.2003.003134

McIvor, R. (2009). How the transaction cost and resource-based theories of the firm inform outsourcing evaluation. *Journal of Operations Management, 27*(1), 45–63.

Meszéna, G., Kisdi, É., Dieckmann, U., Geritz, S. A. H., & Metz, J. A. J. (2001). Evolutionary Optimisation Models and Matrix Games in the Unified Perspective of Adaptive Dynamics. *Selection, 2*(1–2), 193–210. doi:10.1556/Select.2.2001.1-2.14

Miller, E. J., & Rice, A. K. (1967). *Systems of Organisation: Task and Sentinent Systems and their Boundary Control*. London: Tavistock Institute.

Mingers, J. (1989). An introduction to autopoiesis - Implications and applications. *Systemic Practice and Action Research, 2*(2), 159–180. doi:10.1007/BF01059497

Mirani, R. (2006). Client-Vendor Relationships in Offshore Applications Development: An Evolutionary Framework. *Information Resources Management Journal, 19*(4), 72–86. doi:10.4018/irmj.2006100105

Morgan, G. (1997). *Images of organization*. Thousand Oaks: Sage Publications.

Nakane, J. (1986). *Manufacturing Futures Survey in Japan: A Comparative Survey 1983-1986*. Tokyo: Waseda University.

Nelson, R. R., & Winter, S. G. (1982). *An Evolutionary Theory of Change*. Cambridge, MA: Belknap Press.

Pásztor, L., Botta-Dukát, Z., Magyar, G., Czárán, T., & Meszéna, G. (2016). *Theory-Based Ecology: A Darwinian approach*. Oxford: Oxford University Press.

Priem, R. L., & Butler, J. E. (2001). Is the Resource-Based "View" a Useful Perspective for Strategic Management Research? *Academy of Management Review, 26*(1), 22–40.

Senge, P. M. (1992). *The Fifth Discipline*. Kent: Century Business.

Shortell, S. M. (1997). Commentary. *Medical Care Research and Review, 54*(1), 25–31. doi:10.1177/107755879705400102

Spithoven, A., & Teirlinck, P. (2015). Internal capabilities, network resources and appropriation mechanisms as determinants of R&D outsourcing. *Research Policy, 44*(3), 711–725. doi:10.1016/j.respol.2014.10.013

Tate, W. L., Ellram, L. M., Bals, L., & Hartmann, E. (2009). Offshore outsourcing of services: An evolutionary perspective. *International Journal of Production Economics, 120*(2), 512–524. doi:10.1016/j.ijpe.2009.04.005

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities and Strategic Management. *Strategic Management Journal, 18*(7), 509–533.

Teece, D. J., Rumelt, R., Dosi, G., & Winter, S. (1994). Understanding corporate coherence. *Journal of Economic Behavior & Organization, 23*(1), 1–30. doi:10.1016/0167-2681(94)90094-9

van den Bergh, J. C. J. M. (2003). Firm Behaviour and Organisation from an Evolutionary Perspective. In H. L. F. Groot & P. Nijkmap (Eds.), *Entrepreneurship in the Modern Space-Economy*. Cheltenham: Edward Elgar.

van der Linden, B. (2011, 13–15 Sept.). *Innovation within Outsourcing Relationships: Contemplation of Luhmann's Theory.* Paper presented at the 18th International Conference on Management Science & Engineering, Rome.

Verwaal, E., Verdu, A. J., & Recter, A. (2008). Transaction costs and organisational learning in strategic outsourcing relationships. *International Journal of Technology Management, 41*(1–2), 38–54. doi:10.1504/ijtm.2008.015983

Vogel, R., & Güttel, W. H. (2013). The Dynamic Capability View in Strategic Management: A Bibliometric Review. *International Journal of Management Reviews, 15*(4), 426–446. doi:10.1111/ijmr.12000

White, G. P. (1996). A meta-analysis model of manufacturing capabilities. *Journal of Operations Management,*

14(4), 315–331.

Willcocks, L. P., Lacity, M. C., & Kern, T. (1999). Risk mitigation in IT outsourcing strategy revisited: longitudinal case research at LISA. *The Journal of Strategic Information Systems, 8*(3), 285–314. doi:10.1016/S0963-8687(00)00022-6

Wilson, N., & Zhang, H. (2002). Do organisational routines in manufacturing inform contracting choices in distribution? *Management Decision, 40*(1), 50–57. doi:10.1108/00251740210413352

Windrum, P., Reinstaller, A., & Bull, C. (2008). The outsourcing productivity paradox: total outsourcing, organisational innovation, and long run productivity growth. *Journal of Evolutionary Economics, 19*(2), 197–229. doi:10.1007/s00191-008-0122-8

Zahra, S. A., & Newey, L. R. (2009). Maximizing the Impact of Organization Science: Theory-Building at the Intersection of Disciplines and/or Fields. *Journal of Management Studies, 46*(6), 1059–1075. doi:10.1111/j.1467-6486.2009.00848.x

Zollo, M., & Winter, S. G. (2002). Deliberate Learning and the Evolution of Dynamic Capabilities. *Organization Science, 13*(3), 339–351.

Biography

Rob Dekkers is a Reader in Industrial Management at the Adam Smith Business School (University of Glasgow). He holds a doctoral degree and master's degree from Delft University of Technology. Before joining Delft University of Technology in 1992 he has worked as internal management consultant, production manager and senior project manager. From 2006 he was employed at the University of the West of Scotland and from 2014 at the University of Glasgow. He has (co-)authored more than 150 interdisciplinary contributions about innovation and technology management, industrial networks, manufacturing strategy, operations management and system theories. Furthermore, he is actively engaged in the provision of doctoral workshops, particularly the IFPR Early Career Researchers and Doctoral Training Programme.