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# Mendel in the C-Suite: Design and the Evolution of Strategies

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**Abstract.** A “Mendelian” executive is proposed as an image of strategy making that lies intermediate between the godlike powers of intentional design of rational choice approaches and a Darwinian process of random variation and market-based differential selection. The Mendelian executive is capable of intentional design efforts in order to explore possible adjacent strategic spaces. Furthermore, the argument developed here highlights the role of intentionality with respect to the selection and culling of strategic initiatives. The firm is viewed as operating an “artificial selection” environment in contrast to selection as the direct consequence of the outcome of competitive processes. Examining the nature of the processes generating these experimental variants and the bases of internal selection, and how these selection criteria may themselves change, is argued to be central to the formation of strategy in dynamic competitive environments.

**Keywords:** organizational evolution • organizational learning • strategy formulation

## 1. Introduction

The question of “where do good strategies come from” is arguably a subset of the broader question of why things are the way they are. At its most basic level, as with respect to the question of life on planet earth, we have two general classes of answers: one invoking some form of intentional design and the other invoking a Darwinian process of descent with variation and a contested selection process. The argument developed here tries to set forth a middle-ground perspective of a Mendelian executive. This “Mendelian executive” operates with a degree of intentionality; but, unlike the conception of rationality in neoclassical economics, this intentionality is limited. Furthermore, the emphasis is more on the design of experimental processes than on the design of specific paths forward. While circumscribed, this intentionality and design sets this Mendelian executive apart from a pure Darwinian process. Both orientations highlight the role of path dependencies. However, the intentionality of the Mendelian executive allows for the conscious exploration of adjacent “spaces” rather than the happenstance of random variants. Furthermore, the argument developed here highlights the role of intentionality with respect to the selection and culling of strategic initiatives. The firm is viewed as operating an “artificial selection” environment in contrast to selection as the direct consequence of the outcome of competitive processes. While these outcomes may inform the artificial selection process, the two criteria need not be the same.

Mendel did not in some deterministic manner specify the attributes of each generation of lineage of peas, but rather he created some conscious manipulations of the stochastic reproductive process. In the modern

parlance of lean start-ups, we might think of him as specifying a series of “A/B” trials, running fairly controlled experiments of local modifications and observing their effect. In this spirit, the Mendelian executive offers a perspective as to how we might possibly link the images of godlike design on the one hand with evolutionary dynamics on the other hand. While not controlling these processes, perhaps to some degree we can engage in some intentional engineering of these evolutionary processes. Consider, for instance, the frequently discussed need for organizations to balance processes of exploration and exploitation (Holland 1975, March 1991). Such manipulation is unlikely to be a precise engineering of the evolutionary process, but rather a reflection of a broad awareness of the effect of alternative organizational policies on the dynamics of firm evolution, as these policies tilt the “needle” of the exploration/exploitation balance in one direction or another.

Before developing further the broad contours of the Mendelian executive, it is useful to situate it a bit with respect to existing approaches. An important dichotomy in arguments regarding the specification of business strategies is the degree to which action is identified a priori as a result of “offline” reasoning and consideration versus an ex post assessment of “online” trials (Gavetti and Levinthal 2000). In this regard, it is important to note that a Darwinian process is one extreme of online trials. The Mendelian executive straddles both online and offline forms of learning and strategy identification. The experimental variants are not random acts but rather conscious choices of potentially promising initiatives. Furthermore, the Mendelian view melds an offline sensibility with regard to the ex post evaluation

of online trials. A purely evolutionary or Darwinian mechanism operates through a contestation of relative fitness and what is fundamentally a myopic selection process (Levinthal and Posen 2007). By contrast, the Mendelian executive may make conscious choices of what might constitute the dimensions of merit by which initiatives are evaluated. Furthermore, that calculus of evaluation may constitute forward-looking indicators of merit. The ultimate value of the contemporaneous realization of any initiative is inevitably speculative, but speculation is conscious and explicit.<sup>1</sup>

From an evolutionary perspective, there are two basic mechanisms at work: processes of variation and selection.<sup>2</sup> We can consider the work of the Mendelian executive with respect to both of these processes. We tend to associate variation as the consequence of some stochastic process, but variation may have considerable elements of planning and intentionality. Variation may be considered from the perspective of individual ideation; the internal ecology of initiatives within the firm; and the role of path dependence, “pivots,” and adjacencies.

With respect to selection processes, interpretation of outcomes was not problematic for Mendel, with the qualities of height, color, and seed size being self-evident. Yet, in the Mendelian perspective developed here—situated between classic images of design and intentionality and a Darwinian process of random variants and contested selection—the interpretation of experimental outcomes plays a prominent role. It is common to contrast learning processes with processes of selection. Our typical conceptions of learning processes are based on notions of reinforcement learning in which the proclivity to engage in a particular act is reinforced or diminished as a consequence of the association between that act and an observed outcome. However, in the strategy context, outcomes in terms of an ultimate consequence of a strategic action are typically rather distant in time from the “act.”<sup>3</sup> Given this “distance,” the time between initiating a new product, mode of competing, entry into a new geography or market space, and the ultimate feedback regarding the wisdom of such an effort, interim judgments play a critical role in any adaptive efforts.

In considering how an “engineering” of evolutionary dynamics might operate given these challenges, it is useful to consider the line of work in machine learning starting with the pioneering work of Samuels (1959, 1967) on credit assignment, later built on by Holland (1975), as well as more contemporary work on “actor-critique” models (Sutton and Barto 1998, Singh et al. 2010), in which reinforcement is based on a value function that constitutes a learned reward function. In Samuel’s early work on developing machine learning algorithms for playing checkers, the key insight was that using as a reward the final outcome of a win or loss

was a very poor basis for learning an effective strategy. Such a reinforcement mechanism does not provide a direct means of identifying the value of interim “stage-setting” moves such as controlling the center of the board. He introduced the notion of credit assignment that was later built up on by Holland (1975), whereby moves that lead to states that are viewed as valuable would themselves be reinforced.

In this sense, when organizations define milestones and metrics around key success factors, they are constituting an artificial selection environment that guides the cultivation of initiatives within the firm (Levinthal and Warglien 1999). The virtue of such shaping rewards (Elfwing et al. 2008) is that they may substantially speed up the feedback process relative to the feedback from the environment as to whether a given action or strategy is pushing forward along a promising track. In this same light, the valuation of these interim outcomes can help counter the myopic tendencies of direct reinforcement learning processes (Levinthal and March 1993).

However, there remains an important question as to what constitutes the unit of selection in such a process. A strategy is generally taken to be a holistic perspective on the way in which a firm competes, with a “parts-whole” sensibility being central from early writings such as Andrews (1971) as well as more current authors (Porter 1996). In that regard, an experimental approach appears problematic. An “experiment” of repositioning an overall enterprise is a “bet the company” move, not a “trial.” It is certainly true that an experimental approach lends itself more naturally to the development of technologies, products, and novel services than does an overarching strategy. However, as Bower (1970) argues, strategy making is to a large degree enacted by the resource allocation across competing initiatives within the enterprise, a process in turn guided by the criteria for resource allocation and the overarching decision premises (Simon 1947) put forth by top management. In that light, as Andrews (1971) suggests strategy can be viewed as a pattern of decision making and resource allocation. This “pattern” is identifiable as a result of a reasonably stable logic and set of decision criteria guiding these processes. The logic may be guided by a well-posed activity system or a more diffuse sense of leveraging capabilities and resources into adjacent spaces.

In this regard, the firm adapts at fundamentally two different levels. At a lower level, products, technologies, and markets served change in response to experimentation and to the feedback received in response to these initiatives not only directly from the market but also, importantly, as evaluated by the criteria of the firm’s internal selection processes. A higher-level, generally slower process is the change in these criteria themselves. In this spirit, Adner and Levinthal

(2008) characterize exploration not as a distance in the underlying behavior from current action, but rather as changes in the dimensions of merit by which initiatives are judged. This nested system of adaptation is analogous to the process of “deep learning” or “representation learning” in contemporary work on machine learning, in which not only are the parameters at a given level tuned through experiential learning but a nested hierarchy of higher-level constructs emerges within the learning process (LeCun et al. 2015).

Both processes can lead to profound changes in the firm over time. For instance, we might view Apple as having had a fairly stable high-order strategy since 1997, when Steve Jobs returned to a leadership position, to the present, if we view its strategy as a set of high-order values and premises. Yet the firm has changed in fundamental ways in the subsequent 20 years in terms of its products and services. Burgelman’s (1994) account of Intel’s change from its focus on memory products and process technologies to a firm “vectorized” around the development of ever more powerful microprocessors has elements of both change within the context of a given internal selection system and a shift in the selection criteria. While the firm had conceived of itself as a memory company driven by advances in process technologies, the allocation of products among the firm’s fabrication facilities was based on the profit margins that could be realized on a given product line. This allocation rule shifted the firm’s product activity to the microprocessor even though its technology strategy privileged memory devices. Ultimately, the firm reconceived its overall strategy, reconstituted itself around logic devices, and reoriented its research efforts and market developments accordingly. Clearly, however, this higher-order shift in strategy in terms of the firm’s resource allocation processes was not independent of the unanticipated outcomes of the prior process that begat the shift to the microprocessor.

## 2. Variation

With regard to processes of variation, on occasion, our Mendelian executive will have ideas. These ideas may stem from personal aha moments, observations of others, and recommendations—high-priced or unsolicited—of others. Vacuums are generally not fertile settings for interesting insights.<sup>4</sup> Thus, individual differences in strategy “variants” may reflect the distinctive prior and current contexts to which executives have been exposed (Cohen and Levinthal 1990, Shane 2000). This may be exposure to particular sets of actual or potential customers, thought leaders from diverse fields, prior related businesses, and so on. As network theorists highlight (Burt 2004), these links need not be based on one’s direct experience but may be indirect experiences mediated by other individuals with whom

one is connected. There is a vast literature on individual creativity that speaks to the birthing of hopeful variants. For the current purposes, it is sufficient to simply note that there are times that individuals, both those in large corner offices and those in smaller cubicles, have novel ideas and that there are some suggestions in the literature as to mechanisms that might shift the probability distribution over the quality of these ideas in a way that favors more promising ones.

To an important degree, variants are a by-product of ongoing efforts to address issues of existing customers and solving associated technical and nontechnical challenges. However, per the self-conscious guidance of such dynamics of our Mendelian executive, the identification of potential new domains for existing lines of development is not a matter of chance or happenstance. Schumpeter (1934) characterizes entrepreneurial action as creative recombination of products, technologies, and markets. The fact that these are “recombinations” is indicative that these entrepreneurial actions entail the movement into adjacent spaces—the market opportunities that might be pursued given the firm’s existing set of capabilities, its market position, and the competitive and market context that it faces. In considering such recombinations from the perspective of a Mendelian executive, it is important to recognize the intentionality underlying such efforts. There is a lookahead to alternative strategic opportunities. But the imagery of recombination suggests that this lookahead is not to distance future states nor entail whole-cloth conceptions of products, business systems, and markets. However, while the individual “moves” may be recombinations and in that sense constitute “adjacencies,” the consequence of such changes can be quite substantial.

In this regard, many instances of dramatic strategic change or success can be understood at a fine level of granularity as being relatively incremental in the space of action. Levinthal (1998), building on Bassela (1988), makes an argument that seemingly rapid technological change is the consequence of fairly incremental moves in technological space, with the seemingly discontinuous change stemming from a shift of the technology to a new niche or application domain. In a similar vein, Cattani (2005), examining Corning’s development of fiber optics, makes an argument for the important role of exaptation—how a lineage of development in one context, or niche, may be repurposed for application in a new domain. The role of user-based innovations that become mainstream commercial products (Von Hippel 1988) and the emergence of general-purpose technologies that have their origin in one specific application domain (Rosenberg 1963) are important instances of such dynamics, whereby local problem solving proves to offer more general solutions.



Experimentation, however, does not obviate the need for *ex ante* choices—a consideration that the literature tends to neglect. Not all candidate experiments can be carried out. The lean start-up approach takes an extreme view on this and postulates that only one experimental trial should be carried out at any moment. Real options approaches encourage a plurality of efforts and the subsequent culling of this potentially large set. However, options are not costless, and a firm will need to restrict itself up front to some modest set of possibilities. Thus, while the analytical distinction between *ex ante* cognitive bases of evaluation and *ex post* experimental approaches is quite important, even *ex post* experimental approaches require some degree of up-front assessment of appropriate initiatives.

### 3. Selection

The Mendel executive makes a conscious selection among alternative possibilities and does not merely rely on the result of a Darwinian process of contested market selection. There then arises the question of when to engage in this selection and what criteria to use for the “culling.” This issue of timing and criteria are clearly related. To the extent that selection is more *ex post*, then measures of financial outcomes in the market place can be more useful in evaluating the merit of alternative strategies. By contrast, as the timing of evaluation becomes closer to the onset of the initiative, then interim metrics, such as test markets and milestones, become more relevant, and in the limit, an *ex ante* evaluation must rely on beliefs of possible merit.

In this context, it is again important to keep in mind the distinction between efforts to develop novel technologies and business strategies. Technological progress can be tested in the lab. Edison’s search for a viable filament did not require manufacturing or marketing. One can speculate about a business strategy, but feedback about its value can ultimately only be evaluated *in situ*. However, it is important to recognize that such feedback is, in general, ambiguous (Adner and Levinthal 2004). Thus, persistence, faith, and psychological commitment are critical elements in terms of how an actor will respond to such ambiguous feedback. Just as a vector in physics is characterized by both momentum and direction, so too does a strategist’s vision have both elements of psychological commitment and a point of view regarding directionality.

The issue of “directionality” is not simply a point of view regarding the most promising trajectory for a strategic initiative to take but an implicit or explicit perspective on the criteria by which such a trajectory should be evaluated. Indeed, the notion of an “artificial selection” environment opens up the possibility of a loose coupling between the firm’s current “natural” environment of product market competition and financial market valuation processes. Ideas, business

plans, off-sites, and design efforts do not themselves directly receive rewards from the market. Firms as a whole receive profits and losses; but, the firm, in turn, is able to mediate how these environmental outcomes are projected onto underlying elements of the organization. Individuals only receive awards as mediated by an organization’s accounting system and reward structure. This loose coupling allows for discretion. Given the myopic nature of selection processes (Levinthal and Posen 2007), this loose coupling allows for the possibility of foresight—for engaging in initiatives whose merit is not self-evident based on current circumstances. Of course, it also allows for the possibility of stubbornness and foolishness (March 1994).

Selection processes run the risk of not only being myopic with respect to their temporal perspective but also being excessively narrow with regard to the possible dimensions of merit. Agreement and clarity of opinion regarding a desire to maximize long-run profits says relatively little about the basis of evaluation of a novel strategy. Particularly early on, financial indicators may not be of much use in assessing the question of whether a strategy is working and what sorts of modifications might be called for. Nonfinancial indicators of market feedback may be useful surrogates. One important facet of possibly contested selection criteria is what constitutes the relevant market segments. This context effect is a critical element of Christensen’s (1997) argument regarding disruptive technological change in the disk drive industry, as the established firms’ existing customers reacted unfavorably to a new class of drives, which were strongly favored by an alternative, latent market segment.

While organizations of any scale or scope can generally sustain a wide variety of initiatives, it is more difficult to sustain a variety of selection criteria. As Levinthal (2017) suggests, to the extent organizations are hierarchical systems, the selection criteria will tend to reflect the beliefs of those at the apex of that hierarchy. As a result, for plurality of beliefs to drive in a meaningful manner the allocation of resources, there generally needs to be some decentralization in the resource allocation process. Structural decomposition of a firm’s activity can facilitate adaptation and identification of new strategies (Siggelkow and Levinthal 2004, 2005). Organizational slack allows for greater degrees of search and innovation (March and Simon 1958). Thus, as part of effective design, the Mendelian executive creates structures that will allow novel variants some opportunity to express themselves and to avoid screening with a singular lens.

It is also important to note the linkage between processes of selection and the degree of selectable variety the organization is able to sustain. Experiments, tentative business models, new products, and market entry

are not costless. Given a finite set of resources, exiting or forgoing one option frees up the energy and resources for another option. Thus, the level of variety across a given time frame, the extent to which these variants are given resources to express their latent potential, and the timing and intensity of selection are closely linked elements in a Mendelian dynamic.

Recent work points to the possibility and importance of strategic efforts to influence the bases of selection of the external environment, what Teece (2007) terms “shaping” strategies and what Gavetti et al. (2017) develop further as a process of “niche construction.” Firms strive to influence standard bodies, create ecosystems, and legitimate new organizational forms. Such efforts go well beyond the basic marketing function of attempting to influence consumers’ perceptions and preferences to influencing the very economic forces in which the firm operates. Thus, while the idea of an “artificial” selection environment has been put forth to characterize the potential loose coupling between the bases of selection within the enterprise, in contrast to the immediate selection pressure of the firm’s competitive environment, the notion of niche construction invites an element of a “design” consideration with regard to the external environment.<sup>5</sup>

Emergence need not imply a lack of foresight and intentionality. Effective strategic leaders are very mindful of potentially attractive adjacent market spaces into which they could move (Zook and Allen 2003). In addition to the quite conscious refinements and modifications of the leaders’ existing strategic trajectories, there is a local rationality and creativity that takes advantage of historical circumstances, characteristic of both the firm and the external environment in which these leaders are operating. As characterized by Gavetti and Menon (2016), a process of preadaptation with agency is useful to consider.

The Mendel executive is mindful (Weick and Roberts 1993). She is engaged in one course of action but cognizant of other possibilities. She is alert to indicators of both failure and success. The Mendel executive has both the boldness and imagination to design novelty but, at the same time, the humility to understand the inherent limitations of any effort of design and the nearly universal need for refinements and modifications of a given trajectory. The Mendel executive is aware of multiple possible “worlds” in which strategic actions can be enacted. There are the current markets and customers, but there are other markets and customers who might be reached by changes to a product, mode of distribution, or shifts in means of value capture. Boldness, imagination, and humility are not generally observed as co-occurring traits; but, when jointly present, they offer the possibility of identifying valuable and novel strategic initiatives.

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## Endnotes

<sup>1</sup>Winter (1987) refers to this as the imputation problem in the context of a dynamic programming framing of the strategy problem. Outside of the most trivial problem contexts, this imputation will inevitably be based on an imperfect cognitive representation or evaluation heuristic (Levinthal 2011).

<sup>2</sup>Campbell’s (1965) seminal work offers a tripartite framework of variation, selection, and replication. However, in the present context of a focus on conscious acts of design by a “Mendelian” executive, replication to some degree is not conceptually distinct from a process of selection. The persistence of an initiative through time is reflective of a selection process (i.e., the initiative not being selected out). Of course, persistence need not imply that the pattern of behavior is inert (Birnholtz et al. 2007). However, while the initiative might experience change over time, to the extent that the change is not at the impetus of the Mendelian executive, it can be considered as a form of variation from her perspective, variation driven by intentional acts of organizational participants as well as random drift.

<sup>3</sup>Indeed, the contrast between “strategy” and “tactics” to an important degree hinges on the time scale being considered.

<sup>4</sup>The idea of a “vacuum” as in a setting devoid of context should be recognized as distinct from opportunities of quiet and reflection. Reflection allows one to remove oneself from immediate distractions to process various mental fragments from prior experiences and insights; but, in contrast to a vacuum, reflection does not imply the absence of some “fodder.”

<sup>5</sup>In this regard, it is interesting to note some contemporary revisiting of Mendel’s original data (Nissani 1994) that suggests that Mendel may have misrepresented his results to enhance the theoretical argument he was putting forth. Nissani’s assessment of Mendel’s work suggests that Mendel had an externally oriented “shaping” sensibility as well as his generally understood experimental design of evolutionary dynamics: To achieve these goals, his work had to be understood. In comparison to his theories, of whose validity he was sure, the data were of no significance whatsoever. His task was not the one faced by the normal scientist addressing a sympathetic and competent audience, but that of a revolutionary who must break through the cognitive paradigms and social prejudices of his audience. If this larger goal could be best achieved by simplification/deliberately omitting some observations from his report and adjusting others to make them more palatable to his audience/could not such a step be justified” (Nissani 1994, p. 194).

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