Valuing Human Capital Career Development: A Real Options Approach

Published Version:
Valuing Human Capital Career Development: A Real Options Approach / Francesco Baldi; Lenos Trigeorgis. - In: JOURNAL OF INTELLECTUAL CAPITAL. - ISSN 1469-1930. - STAMPA. - 21:5(2020), pp. 781-807. [10.1108/JIC-06-2019-0134]

This version is available at: https://hdl.handle.net/11585/947087 since: 2023-10-31

Published:

DOI: http://doi.org/10.1108/JIC-06-2019-0134

Valuing Human Capital Career Development:

A Real Options Approach

This article shows how real options theory can be applied to a company's career development program to increase its ability to create and capture value. It provides a prescriptive framework for adopting a more flexible, sequential human capital strategy under uncertain environments, and explores its theoretical and empirical implications through the dual use of theoretical modeling and multi-case study of ten Fortune companies. Its relevance to managerial practice is shown through guidelines on how a company like Google might use the real options methodology.

Keywords: Career Development; HR Flexibility; Human Capital Value; Real Options; Strategic Human Resource Management

Introduction

This article shows how to quantify the value of a company's sequential (staged) career development program under uncertainty using real options methodology. There has been a long controversy in the literature on assessing the value of human capital –-a long-sought but elusive and challenging task.[1] The ability to quantify flexible human capital (FHC) has been a shortcoming in extant literature. We make a meaningful contribution by showing how real options (RO) methodology can be used to quantify FHC and providing complementary case study evidence from Fortune 500 "best companies to work for" that the value of employee career development is higher in more volatile sectors in line with real options theory (ROT). The article is innovative in containing recent data on career path on Fortune 500 firms that allow to *quantify* the value of human capital's contribution to corporate value

1. For early efforts on the measurement and valuation of human capital, see e.g., Flamholtz (1971); Sadan & Auerbach (1974); Boudreau & Ramstad (1997). Regarding its impact on firm performance, see e.g., Huselid (1995); Becker & Gerhart (1996).

creation along the whole career path and providing objective evaluation in the context of organizational career development programs.

The paper builds upon and advances long-standing and ongoing debates in the management field concerning the organizational view of career development programs (Iles & Mabey, 1993; Herriot et. al. 1994), flexible human resource management and its link to performance evaluation (e.g., Martin-Alcazar et al. 2008; Whyman et al. 2015), as well as the use of real options decision flexibility addressing the tradeoff between flexibility and commitment, previously applied in the context of equity ownership vs. acquisitions (Dalziel 2009; Ahammad et al. 2017). This paper aims to value a sequential investment process in a different organizational context involving human resource (HR) career development programs.

Few past attempts to apply ROT to the HR context have been qualitative and limited in scope, primarily addressing the issue of HR practices either individually e.g., HR training (Berk & Kase, 2010) or collectively (Bhattacharya & Wright, 2005). The literatures on ROT and HR flexibility are reviewed in the next section. ROT has been used more broadly in finance and strategy to improve strategic decisions, e.g., in valuing sequential problems such as R&D viewed as compound options or in governance choices e.g., between flexible equity ownership and committed acquisitions mode (Dalziel 2009; Ahammad et al. 2017). Naturally there is a need, and value added, to use a similar framework to improve decisions as to how we manage people's career development.

The paper illustrates an innovative application of real options methodology to the domain of strategic human capital management (SHRM), specifically how to quantify the value of an organization's flexible HC career development program to increase its ability to create and capture value. As such, it provides a prescriptive RO methodology for adopting a more flexible, staged SHRM organizational perspective suitable for uncertain environments, and explores its theoretical and empirical implications through the dual use of real options modelling and multi-case study data involving ten Fortune 500 companies. The case study approach is aimed at creating managerially relevant knowledge (Eisenhardt, 1989; Yin, 1994; Eisenhardt & Graebner, 2007; Gibbert et al., 2008).

In this vein, the article combines the RO methodology with the case study approach in an effort to apply and extend ROT to the SHRM context with specific focus on employees' career development from the organization's perspective. It provides guidance on how a company like Google might use the RO approach to inform its staged career development program to create and capture value.

Our ROT framework is well suited to address a recent call by Kryscynski & Ulrich (2015) "for the field to ground itself in practical phenomena so that its insights moving forward can be both academically rigorous and practically relevant." Noting that in the academic literature they do not find "much about how a company can redirect the actions and behaviors of its critical human capital to deliver on the changing demands of the external marketplace" (p. 357), they encourage "new conceptual frameworks and assumptions by bridging the theory practice gap" (p. 359) and recommend to "tie theoretical explanations to observable phenomena" using theory to help explain interesting phenomena (p. 367). They note that executives want to know how to take what we know about HR policies to affect selection that will maximize the value of the total HC resource to affect organizational outcomes. Our RO approach applied to the career development program helps rationalize the common practice among many organizations to be more "open" and flexible in the initial career development stages but exercise the option not to promote or to discontinue employment based on interim performance and evolving company needs. We also help address a research challenge posed by Mahoney & Kor (2015) regarding how firms' investments in human capital can be identified and measured. A flexible perspective on HC offers HR scholars valuable direction as to how to value human resources as staged processes that enhance the firm's ability to create and capture value. In this regard, we give flesh to Housel & Bell's (2001) assertion that employees are not only the primary generators of costs but also "the primary generators of value" in the knowledge economy.

Our RO approach for valuing and managing HC has significant implications for management. It helps better manage sequential HR decisions concerning where, when and how to invest in or redeploy human capital, accounting for the tradeoff between HR commitment and flexibility. This novel perspective allows us to assess the value of HC flexibility embedded in the staged HC career development or internal promotion process. We illustrate how to estimate the career development option value (CDOV) for a company like Google and confirm it is more prevalent for HR flexible firms in more volatile sectors in line with ROT.[2]

Our main focus is on valuing the flexibility to stage decisions in an HR context (as multi-stage compound options). A prominent example of this is an organization's internal career development (promotion) process. This process can be viewed as a multi-stage (compound) option involving various types of HC uncertainty, HC options and associated HR practices, as shown in Figure 1.[3] We assert that staging processes and learning practices, as part of an adaptive HR organizational capability, can be a source of competitive advantage.

Following a brief review of the ROT and HR flexibility literatures, we model staging HR deployment via the option to promote staff employees to middle-level management, itself embedding the option to rise to top management (see Figure 1), provide guidelines on how this methodology can be applied to companies like Google (see also Appendix A) and offer validation and evidence from a multi-case study of 10 leading U.S. firms across industrial sectors.

INSERT FIGURE 1 ABOUT HERE

Review of real options and HR flexibility

Real options

An option gives the right, but not the obligation, to take a specific future action (e.g., invest) at a specified cost. The outcome of exercising the decision right is asymmetric as the decision maker can take the future action only if it is beneficial, but not otherwise. Certain rights might be established

2. By Career Development Option Value (CDOV) we mean the option value obtained for an organization's career development/promotion process viewed as a multi-stage compound option adjusted with stage probabilities of (promotion) success. Although an equation involving multi-stage compound options with probability adjustment is beyond the scope of this article, the more mathematically inclined reader may find a related article by Cassimon et al. (2011) in the context of pharmaceutical R&D offering a set of formulas of interest; the general reader may find the simpler Excel based valuation shown in Appendix A to be simpler, more intuitive and of more practical use.
3. See also Bhattacharya & Wright (2005).

through contracts (e.g., options on stock, patents, JVs) or through specific knowledge acquired by the firm (e.g., through R&D or M&A). The basic decision asymmetry of option payoffs gives rise to an asymmetry in firm outcomes. In the case of a call option to invest, the firm can take advantage of upside opportunities (through exercising the call e.g., to invest or expand) while limiting downside losses (by not exercising it in adverse conditions). Due to this inherent asymmetry, higher uncertainty of the underlying asset (investment project or firm) or a broader range of possible outcomes benefits the holder of an option.

"Real options" extend the theory of financial options from the financial markets to the realm of strategic decision-making by capitalizing on "opportunities to purchase real assets on possibly favorable terms" (Myers, 1977: p. 163). But whereas for financial options an investor has the right to pay a set price (the exercise price) within a given horizon (option maturity) to acquire a financial security (e.g., a company's stock), in real options the underlying asset is a "real" asset whose current value (the analogue to the stock's current price) is estimated as the present discounted value of incremental cash flows resulting from the construction or expansion of a factory, the development of a new product via an R&D program or the commercialization of a patent, and so forth, by incurring a discretionary investment cost. Real options has thus extended options thinking from the financial markets, where options are based on traded contracts with specified terms, to real assets, tangible or intangible, with potentially more fuzzy terms. Tangible assets underlying real options include real estate, natural resources, R&D and patents, physical plants and strategic acquisitions; intangibles include brand and reputation, unique business processes, flexible human capital, and knowledge developed in joint ventures or other cooperative agreements. As a result, there are many different types of real options, described in Panel A of Table 1 (Trigeorgis, 1996). Most firms manage a portfolio of options within and across the different categories. Real-life decisions firms make regarding the acquisition, upkeep and exercise of these real options can affect the value of other options in the firm's portfolio, and negative interactions due to functional redundancy need to be accounted for when making these decisions and accessing the value of the firm's options portfolio.

INSERT TABLE I ABOUT HERE

Further, unlike financial options, many real options may not be liquid or traded in organized exchanges (occasionally may not even yet exist, as in R&D); they may be asset or firm specific (and hence partly irreversible), which gives rise to challenges such as information asymmetries or path dependence; and their terms (e.g., maturity) may not always be clearly defined. Inasmuch as earlier activities and complementary investments shape future investment opportunities, a temporal linkage among the firm's previous and future investment activities is evidently dependent on the firm's prior resource endowments and adaptive capabilities. Firms that lack necessary pre-investments or are unable to envision how particular follow-on opportunities stem from prior systematic activities, may not have access to the same investment opportunity set on the same terms. In this sense real options can lead to a competitive advantage by providing preferential and heterogeneous access to future investment opportunities.

Real options may also be influenced by firm actions and external parties, such as rivals (e.g., options can expire with rival entry). Benefits from real options are often remote and difficult to predict or secure, as in R&D. Unlike financial options whose exercise does not typically affect the holders of other such options, exercise of real options in an oligopolistic setting can affect (e.g., hurt or preempt) other option holders (e.g., rivals). Another challenge for the modeling of real options is that multiple sources of (exogenous or endogenous) uncertainty can affect their value (e.g., see Dixit & Pindyck, 1994; Trigeorgis, 1996; Folta, 1998). The (non)proprietary nature of real options also needs to be addressed. Sometimes the rights might be exclusive to one firm (e.g., outputs of internal R&D), but this may often not be the case (Trigeorgis, 1996). Proprietary options are usually firm-specific and the option value simply expires if the firm does not exercise it (Myers, 1977). In the case of shared options held by many firms (e.g., to enter a new market), the exercise of an option by one firm can impact the value of the option to invest by rival firms. Considerations such as competitive threat, (non)exclusivity of the option, the degree of uncertainty, irreversibility, and follow-on options jointly influence the decision whether a firm should commit by entering early or in large scale vs. staying flexible by deferring or staging the investment. The above highlights some of the unique challenges of real options as well as their special connection to the management field (e.g., Cuypers & Martin, 2007; Li, 2007; Li et al., 2007; Miller & Folta, 2002; Reuer & Tong, 2007). Panel B of Table 1 highlights some dimensions involving extensions, which present challenges to real options modeling.

HR flexibility

An important new application of ROT is in the domain of strategic human resource management (SHRM). In this literature, HR flexibility represents the ability of a firm's management and employees to respond to a changing environment (Trigeorgis & Mason, 1987; Sanchez, 1995; Trigeorgis, 1996). The flexibility to adapt human resources has been key in this field (Lengick-Hall & Lengick-Hall, 1988). In SHRM flexibility is viewed as a valuable firm adaptive capability (Milliman, Von Glinow, & Nathan, 1991; Wright & Snell, 1998; Gibson & Birkinshaw, 2004). Flexibility has been shown to improve firm value and performance in finance and resource allocation (Trigeorgis, 1996), strategy (McGrath, Ferrier, & Mendelow, 2004), operations and product customization (e.g., Parthasarthy & Sethi, 1993; Rangan, 1998; Thomke, 1998). Yet the role of HR flexibility in firm value creation and performance has not been adequately addressed.

Battacharya, Gibson, & Dotty (2005) provide a broad discussion of flexibility in HR. HR flexibility enables adaptation of employee knowledge, skills and behaviors to environmental changes (Milliman et al., 1991; Lengnick-Hall & Lengnick-Hall, 1988; Wright & Snell, 1998; Wright, Dunford, & Snell, 2001). Linking dynamic capabilities (Teece, Pisano, & Shuen, 1997) with SHRM, HR flexibility emanates from employee skills and behaviors reinforced through HR practices. According to Wright & Snell (1998), HR flexibility has three dimensions: flexibility in employee skills, employee behaviors, and HR practices. Flexibility in employee skills represents the range of alternative uses and how individuals with different skills can be redeployed (Wright & Snell, 1998: 764-5). Flexibility in employee behaviors represents possessing a broad set of behavioral scripts adaptable to varied demands. Flexibility in HR practices allows practices to be applied across various situations, business units or geographic locations.

To achieve employee skill flexibility, firms may retain employees who possess broad-based skills and use them in varied business conditions to meet current or future needs. A firm may develop broad firm-specific employee skills through job rotation, cross-functional teams and project-based work. Broad skills may lead to new business opportunities, as in IBM's transformation from a hardware to a services firm (Lengnick-Hall & Lengnick-Hall, 1988). Firms may also employ diverse "specialist" employees enabling to reconfigure collective skills profiles to changing requirements. When new needs arise, the firm can reorganize its employee groups (e.g., via relocation or through project teams) to achieve the needed skills profile. Organizational HR flexibility can be attained by deploying combinations of some employees with broad generic skills and others with more specialist firm-specific skills.

Employee behavior flexibility motivates employees to adapt to changing conditions and exhibit adptive behavior (Lepine et al., 2000). Employees may be skilled but lack the knowledge or incentives to change. Employees' personality may also differ in the ability to adapt to change (Lepine et al., 2000). Firms can develop or retain employees with greater organizational adaptability, e.g., greater willingness to relocate. Behavioral flexibility presupposes an overall adaptive organizational culture. Adaptable employees help avoid rigidity-related losses (Lepine et al., 2000), while behavior flexibility enables the organization to face new situations.

Flexibility in HR practices enables the firm to adapt its practices to new situations. A variable compensation plan linked to profitability can adjust more readily to profit shocks. Flexible practices also encourage flexible employee behaviors, e.g., when compensation is linked to firm success in new conditions. The firm can also offer similar practices across business units, allowing reallocation of the employee skills pool.

Building on Sanchez (1995), Wright & Snell (1998) highlight resource and coordination flexibilities. Resource or switch use flexibility (Kulatilaka & Trigeorgis, 1994; Sanchez, 1995) refers to a firm's assets or resources being usefully applied to alternative uses or in varying contexts. Coordination flexibility refers to the capacity to acquire, coordinate and (re)deploy needed resources flexibly. As part of such coordinating flexibility, we herein discuss career development staging flexibility from the perspective of the organization (rather than the employee). Each of the resource or coordination flexibilities reside in employee skills, behaviors or HR practices. Coordination flexibility in employee skills reflects how individuals with different skills can be redeployed readily in the value chain. It also encompasses the firm deploying standard employees or "contingent workers" (Wright & Snell, 1998: 765-7). This is exemplified when employees possess a variety of skills or when they are redeployed, promoted or dismissed lacking such skills.

The benefits of flexible employee skills and behaviors were examined at different levels. At the employee level, research focused on skill adaptability (Lepine et al., 2000) or employee behaviors. SHRM has examined HR practices and their impact on overall firm performance (e.g., Delery & Doty, 1996; Huselid, 1995). HR practices affect firm profitability through improved productivity, cost-efficiency and HR management (Huselid, 1995).

A long-standing debate regarding the tradeoff between HR flexibility and specificity or cost efficiency is ongoing (Adler et al., 1999). Some scholars argue that flexibility involves a trade-off with cost efficiency as it invariably increases costs (e.g., Parthasarthy & Sethi, 1993). Others posit that flexibility and cost efficiency can co-exist (e.g., Gibson & Birkinshaw, 2004). A firm with flexible employee skills, behavior and HR practices can better adapt to shocks with its current employee base, avoiding layoffs, turnover and reduced morale. Weighting the value of HR flexibility against the costs involved presupposes the ability to quantify HR flexibility, which is our focus in the career development context in this paper.

As Kryscynski & Ulright (2015) point out, theory and its core assumptions are often at odds with management practice. Managers, for example, rarely rely on Net Present Value (NPV) in making multi-stage development decisions (e.g., R&D, technology advancement). Much work in strategy, finance and economics consequently focused on investment decisions based on ROT, examining whether investment phenomena are more in line with ROT. New insights were subsequently derived in joint ventures, international entry decisions, governance choices and collaborative relationships, foreign direct investment, MNC network operations, as well as R&D investment decisions and venture capital portfolio choices. We here focus on applications most relevant to HR decisions involving sequential investment decisions. RO logic prescribes that when faced with multi-stage decisions it is useful to view the staged development of technologies as options on options, recognizing the value of future growth stages and the option to discontinue following early failures. Management behavior adheres closely to this theoretical ROT prediction.[4] Hence ROT passes "the sniff test in practice" of matching theory to phenomena (Kryscynski & Ulrich, 2015).

The need for overcoming the deficiencies of traditional criteria (e.g., NPV, ROI) and capturing the value of management flexibility in strategic decision-making processes is also at the root of combining RO analysis with knowledge metrics, such as the knowledge value added (KVA) method proposed by Housel & Bell (2001). This has been implemented in real-world business cases via the KVA+RO valuation framework (Housel & Nelson, 2005). KVA allows managers and investors to analyze the value of corporate knowledge, for example as embodied in firm employees, by estimating the value creation potential of a firm's current core processes by reference to a common unit of knowledge (e.g., the time it takes to complete a task) measurable in terms of price and cost. KVA theory postulates that output is a function of a core business process performed by human capital or technology assets on input(s). There exist three approaches to KVA as the amount of knowledge within a business process required to make a change at company level can be measured as learning time, process instructions, or bits.[5] Value can be quantified via several metrics: (1) Return on

4. For RO work in R&D see e.g., Trigeorgis (1996); McGrath & Nerkar (2004).

5 While converting inputs into outputs, a core business process produces a change at the company level generating incremental revenues and ultimately creating value (Housel & Kanevsky, 1995). By capturing the value of knowledge embedded in an organization's core processes, KVA enables identifying the price/revenue and cost of a process, product or service and ranking processes by the degree to which they add value to the organization (Pavlou et al., 2005; Mun & Housel, 2006). KVA consists of allocating revenues and costs to a firm's core processes based on the amount of change each process produces. Any change can be measured by the amount of knowledge and time required to make it. If the first approach is applied, learning and performance times (for an average employee) are the ways to measure the amount of knowledge contained in a given business process and the cost of usage of such knowledge, respectively. Revenue (per

Knowledge (ROK), a ratio of knowledge value added to knowledge utilization cost, which enables comparing productivity and value creation potential among core processes; (2) Return on Investment (ROI) (Mun & Housel, 2006). The outputs from a KVA analysis then become an input into a RO model (Komoroski et al., 2006; Mun et al., 2009).

Approach, sample and real option methodology

To examine the relevance of our compound real option methodology, we bring in both theoretical (RO-model based) as well as empirical evidence, recognizing the importance of focusing on market outcomes (Molloy & Barney, 2015). Specifically, to bring theoretical and empirical validation for our staging valuation approach, we present some case study research that enables quantifying the option value of a career development program and allows assessing how much a mismatch exists in a sample of ten leading public U.S. companies. These firms span U.S. industrial sectors and industry dynamics: from 'defensive' covering consumer goods (e.g., General Mills) and health care (e.g., Stryker), 'normal' such as consumer services (e.g., Nordstrom), to 'sensitive' sectors spanning telecom (Qualcomm), technology (Google and Intel), oil and gas/energy (e.g., Devon Energy), and 'cyclical' encompassing basic materials (EOG Resources). These are summarized later in Table 2, along with 10-year business volatility estimates per industrial sector (lowest for defensive and higher in more cyclical sectors rich in real options content).

The sample firms are from *Fortune's 100 Best Companies to Work For 2014*, with many cross-listed in *Forbes'/Glassdoor 50 Best Places to Work 2014*.[6] This double check enhances validity and acceptance as to which are best-HC companies (cross-referenced from two independent sources),

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unit of output) and cost allocation to core processes is based on estimation of such average learning and performance times.

6. The sample data were based on the *2014 Fortune's 100 Best Companies to Work For*. This represents a stable economic period (following the 2007-2010 global financial crisis). To check if the evolution of the economic context and of the labor market might have affected the results presented hereinafter, we updated the valuation of one representative company from our sample list (Stryker) which is also on the *2019 Fortune 100 Best Companies to Work For* and found that the Career Development Option Value (CDOV) as % of Enterprise Value (EV) has not changed significantly from what it was in 2014 (11% in 2019 compared to 10% in 2014). In any event, the choice of the sample does not diminish the theoretical value and contribution of our proposed approach.

also ensuring that most are known companies from Fortune 500. We restrict our sample to public companies as we rely on market data for our compound-option model (shown in Figure 2) to estimate the career development value in these firms.

INSERT FIGURE 2 ABOUT HERE

Specifically, we estimate the theoretical value of the option to promote a typical employee from base staff to middle management, also accounting for the follow-on option to reach top management, as well as the probability of stage-by-stage successful promotion. We refer to this theoretical value as Career Development Option Value (CDOV) or HC Staging Option value. Figure 2 depicts our RO framing of a base employee's flexible career path as a compound option or option on an option (the option tree in Figure 2 models the dotted boxed part of the staged career development process of Figure 1) (see also Mun, 2016).[7] Options here are represented with a hexagon, commitments with a box. The cash-flow outcome or payoff at the maturity of each option, indicating the resulting net value (value of cash flows received, *V*, net of costs incurred) if the option is exercised, is shown below the hexagon, along with its timing (maturity *t*).[8] For example, at stage 1 the firm (e.g., Google) has an option to promote a base employee (staff) to middle management, with payoff at year 10 as follows:

$$\mathrm{Max}(-(\mathrm{S}_1 * (1+\mathrm{b}) + \mathrm{T}_1) + e_1 * V + \mathrm{p} * C, 0) \qquad (1)$$

Here p is the probability (as of stage 1) of successful promotion to top management. The Max (, 0), representing the right to receive an (positive) outcome if beneficial with no obligation to go ahead and receive 0, is omitted in the graph as it is implied by the hexagon (being an option). It is explicitly shown in the Excel illustration in Figure A1 of Appendix A. *V* is the expected or average cash-flow

7 For related RO-based case study applications, see also Chapter 11 of Mun (2016).

8. In calculating the generated cash flow to the firm by the typical (average) employee (the underlying human "asset"), *V* (at $t = 0$), we assume that the indicative career lifecycle (20 years in the illustrative example) is repeated in perpetuity (as the firm has a non-ending life) since when the typical employee retires or leaves the firm it would be replaced by another similar employee with similar salary and job characteristics.

value per typical base employee (assuming the employee is replaced with a similar employee in perpetuity), representing the underlying human "asset" of the firm's option to promote the employee in stage 1 by paying her incremental salary (S_1) augmented by various incremental benefits (b% of S_1) and training costs (T_1).[9] When a typical employee is promoted from base staff (contributing value V at $t = 0$) to middle management in stage 1 (at year 10), her direct value contribution to the firm increases by a multiplier e_1 to $e_1 * V$. This multiplier is estimated as the ratio of the cash-flow-generation value contributed by a typical middle manager relative to that of a base employee at that firm as represented by the ratio of their base compensations. In addition, the firm also receives, with probability p, the value of the option to promote the employee in the future to top management ($p * C$). This is besides the expected expanded cash flows resulting directly from promotion to middle management, $e_1 * V$. To exercise the option to promote base staff to middle management, the firm incurs an incremental salary differential (i.e., pays a salary increase), S_1, amplified (multiplicatively) by associated benefits, such as health benefits, amounting to b% of salary ($b * S_1$), plus incremental training costs from promotion to middle management of T_1 thousand \$ (k) per employee. A similar analysis on an incremental basis occurs in the last option (hexagon labeled top management) in the last stage (stage 2 at year 20 in Figure 2) involving subsequent promotion from middle to top management (not the CEO position). We assume there are no training costs for top management. The average timing of a typical career move in the illustrative example of Figure 2 is 10 years.[10]

Certain additional clarifications on the modelling aspects may be useful here. Our modeling assumes that promotion would only be considered following successful performance in the prior stage

9. The fixed costs relevant to the decision to promote the employee involve incremental healthcare costs (b% of salary S_1 in equation (1) above) and training costs (T_1). We do not consider the firing or exit/retirement decision and related costs to keep the model simple and tractable (for a broader discussion on seniority wages and dismissing older workers before retirement, see e.g., Frimmel et al., 2018).

10. The timing of a career move in the example is assumed 10 years (from staff to middle management and again 10 years from middle to top management) for illustrative purposes. This is realistic for more stable company environments but less so for volatile environments or environments characterized by disruptive innovation. However, we have to strike a balance between realism and the benefit of simplification for illustrative purposes. If we assumed that career moves occur every 3 or 5 years, for example, we would need to model more than two stages during a typical career lifecycle of 20 or 30 years (i.e., a multi-stage compound option). Although this is not a problem to handle technically, it would complicate the exposition considerably.

(i.e., the value of the underlying human "asset" in the binomial tree would go up only if the employee performs the previously assigned task successfully and if demand and other conditions develop favorably). In this setting, as in Lazear & Gibbs's (2014) recruitment theory, we assume that middle management serves as a probation stage to see if the employee is skilled and fits the particular higher role in the organization. We use option valuation theory focusing on the firm's option to promote the employee to a higher level (or stay in the same position). To keep the modelling focused on the promotion option, we do not explicitly address the option not to invest in human capital (except on an incremental basis via the option not to promote) or to abandon non-performing employees, although these options could be modelled similarly. Hence we do not focus on the full fixed costs in human capital investment, but rather on the incremental fixed costs involved with the promotion decision, such as training and health care costs. The modelling relies on standard risk-neutral option valuation commonly used in the real options literature. Our model is based on the binomial option tree method which starts from the end and proceeds backwards (*à la* dynamic programming); it is not a game-theoretic model per se in that it does not consider the interaction among players but rather considers the optional decision of a firm to promote an employee or not under conditions of uncertainty.

We are not considering a signalling strategy in recruiting (Lazear & Gibbs, 2014). We do not assume that the employee is paid low wages and is willing to take the job because she believes in competencies and likelihood of promotion (we leave this as an opportunity for future extension). An employee may also be willing to accept lower wages in exchange for acquiring flexible general skills that may be used in other companies --but would not be willing to do so for firm-specific skills. A discussion of the tradeoff between more flexible generic skills and specific skills is interesting (e.g., see Wasmer, 2006) but is beyond the scope of our analysis. We abstract away from signalling issues involving accepting lower wages by assuming a competitive labor market: if the firm underpays, the employee can take a more competitive offer elsewhere. What we focus on here, given competitively fair wages paid by the firm to its employees, is the value of the flexibility to promote the employee given uncertainties in employee skills and performance, future demand for the firm's products and services etc.

We account for two types of uncertainty that together influence the value of optionality embedded in a firm's employees associated with their career development. One type of uncertainty is exogenous and concerns demand uncertainty (σ) related to the product and employee skills --this uncertainty affects the current value of the underlying human "asset" (V at t = 0) via the discount rate (WACC). Another type of uncertainty is 'technical' and affects the chances of not being promoted to the next stage (1– p). This may include the chances of the employer finding another more qualified person from the external market to perform the higher rank role.[11]

To implement the above ideas, we obtain firm-specific data on ten U.S. firms. These data are shown in the case of Google in Figure A1 of Appendix A. Valuation results for other companies are summarized later in Table 2. These data correspond to standard (compound) option model inputs and are applied individually for each firm. These inputs (described in more detail for the case of Google in the next section) include: the average cash-flow value generated by a typical base employee, assumed to be replaced in perpetuity with an identical employee (underlying asset, V); basic salaries for staff, middle, and top management to estimate salary differentials from promotions (S_1 and S_2); incremental benefits (including health) as % of salary increments ($b*S_1$ and $b*S_2$); incremental training costs for promotion from base employee to middle manager (T_1); firm-specific probabilities of successful promotion to middle and top positions by stage; promotion /expanded value contribution multiples from promotion to middle (e_1) and to top (e_2) positions; average time of a typical career move (e.g., 10 or 20 years), etc. These firm-specific data, supplemented with industry sector 10-year volatility estimates (shown in Table 2 third column) along with relevant economic data, such as interest rates, are applied to each firm to estimate its theoretical RO value from the staging/promotion

11. From the employee's perspective, career prospects might also include the chances of having higher salaries elsewhere if the human capital gained in the firm is of general nature. Accumulating general knowledge may be one factor increasing the chances of being promoted. In this article, we focus on the perspective of the employer (the organization).

option. Volatility plays a key role in the valuation of career development as a compound option,[12] as well as in whether career development and flexible human capital management can lead to competitive advantage via value creation and capture.[13]

Illustrating career development option valuation at Google

This section describes the input estimates used and illustrates the RO valuation of Google. We first discuss the estimation of inputs and then show a binomial tree valuation. This involves three binomial trees: for the underlying human "asset", V, the second-stage option of promotion to top management, and the first-stage or compound option of promotion to middle management (accounting for the follow-on option to promote to top management).

The inputs used for the compound option valuation for the career development/promotion of base staff employees (CDOV) (in the model of Figure 2) for Google are as follows. The average cash-flow value per base employee (underlying asset) is V = $4,382 thousand (k).[14] The basic annual

12. Volatility refers to variability from the mean in either direction, measured by standard deviation (σ). Volatility (shown in the third column of later Table 2 for each firm) is a key input in our option modelling of career development and an important driver of the valuation outcomes (CDOV % in Table 2).

13. Standard NPV analysis and real options analysis have different implications in competitive markets precisely because of the role of volatility. In competitive factor markets NPV = V – I would be zero, hence the investment cost or price paid, I, would merely reflect (and equal) the value of expected cash flows from the asset. In other words, the value of generated cash flows from the employee and the additional costs to training and paying the promoted employee would wash out as, on average, employees would be paid their marginal value. However, under uncertainty, from a real options perspective the firm would promote the employee only if RO = C – I > 0, where the career development option value $C > V$ (hence C > I). Volatility is a key driver that makes $C > V$ and hence requires that the option value of employees (C) should actually exceed their marginal value for the promotion decision to be justified.

14. The cash-flow value contributed to the firm by a typical base employee (underlying asset, V) is obtained as follows. The value of the firm is estimated as the perpetual annual free cash flow (FCF) discounted at the WACC (FCF/WACC; *source*: Bloomberg), where WACC is the firm's weighted average cost of capital, computed using the standard formula:

$$WACC = k_E \frac{E}{D+E} + k_D(1-\tau_c)\frac{D}{D+E}$$

This is the value when all the firm's promotion options are exercised and the firm is committed to its employees at various levels, given by $V * N_S + (e_1 * V) * N_M + (e_2 * V) * N_T$ (where N_S is the number of Staff employees, N_M the number of Middle management employees, and N_T the number of Top management employees). As a result, for the value of the firm at the aggregate level (for all firm employees): $V * N' = FCF/WACC$ where $N' = N_S + e_1 * N_M + e_2 * N_T$ is the value-adjusted number of employees. Put simply, if the options are committed the firm is worth V*N' which equals FCF/WACC (perpetuity of no further growth). This yields V = [FCF/WACC]/N'. For Google, we estimated the above parameters as salaries for staff, middle and top management (not CEO) are \$119 k, \$185.4 k and \$3,817 k, resulting in annual salary increments of 66.4 k (\$185.4 – 119 k) and 3631.2 k, respectively.[15] S_1 is the PV (as of stage 1 or year 10) of future annual salary increments thereafter; discounted at a 9% WACC for Google it amounts to \$737.8 k (= 66.4 k/0.09) (or alternatively \$3,018 k at the 2.2% riskless rate if the firm is obliged to make them). S_2 is similarly estimated at \$40,346.7 k (or \$165,073 k at 2.2%).[16] Benefits (including health) are estimated at b = 25% of salary. Incremental training costs from promotion to middle level are \$2 k per employee. The probabilities of promotion to middle and top management positions are 13% and 3%.[17] Promotion/expansion value multiples from promotion to middle and to top management positions (estimated as the ratio of the cash-flow-generation value contributed by a middle or typical top manager relative to that of a base employee as represented by the ratio of their base compensation) are $e_1 = 1.6$ (obtained as the ratio of \$185.4 k / \$119 k) and $e_2 = 32.1$ (= 3,817/119). We assume that the average timing of a typical career move is 10 years.[18] These firm-specific data, supplemented with a 10-year industry sector volatility estimate ($\sigma = 0.23$ or 23% for Google's internet sector),[19] are used below in a standard real options valuation to estimate the RO-based value of the HC staging option (or CDOV).

Figure A1 of Appendix A shows an Excel valuation using standard binomial trees[20] of Google's option to promote a base staff employee to middle and then to top management as a two-stage compound option. Since the firm's decision in stage 1 (at $t = 5$ or in 10 years) whether to

follows: FCF = \$21.25 billion and WACC = 9%, giving FCF/WACC = 21.25/0.09 or \$228 billion. This divided by N' (with $N_S = 41{,}525$, $N_M = 6{,}205$, $N_T = 26$; $e_1 = 1.6$ and $e_2 = 32.1$) gives V = \$4,328 thousand as the average cash-flow value contributed by a typical staff employee at Google.

15. Data on base salaries for junior (staff) and middle management or intermediate software engineers at Google are sourced from *Forbes'/Glassdoor 50 Best Places to Work 2014*, while base compensation to Google's top executives is obtained from www.salary.com (which relies on SEC filings).

16. In the example below we use the conservative assumption of salary payments guaranteed by the firm and hence being discounted at the risk-free rate (resulting in career development option value for the firm being 4.8% of its enterprise value) and in Table 2 we show firm values if the riskiness of future salaries is better reflected by the company WACC (with option value ranging to 10% of EV).

17. Promotion probabilities are obtained from Acosta (2005) and Frederiksen and Kato (2011).

18. We also estimated a 7% annual growth in value for Google and a 0.7% competitive erosion ("dividend yield") rate (δ). These affect the valuation of option values via the risk-adjusted probabilities q.

19. We use 10Y volatility measured as the standard deviation of returns in the Dow Jones index for the specific sector the firm belongs to (e.g. technology in case of Google) as a proxy of the uncertainty it its business environment.

20. See for example, Cox, Ross and Rubinstein (1979); or Trigeorgis (1996).

promote a staff employee to middle management involves a comparison of the incremental costs of promotion (- S_1*(1+b) - T_1) with the total incremental benefits comprising of the extra (expanded) value of cash flows (e_1*V) plus the expected option value of future promotion from middle to top management (C), to be obtained at year 10 with probability of promotion p = 0.03, the latter option value C needs to be estimated first. Formally, for the option to promote a staff employee to middle management to be optimally exercised, it must hold that:

$$-\mathrm{S}_1 * (1 + \mathrm{b}) - \mathrm{T}_1 < \mathrm{e}_1 * V + \mathrm{p} * C$$

Hence valuation starts from the end, at the maturity of the last option (in year 20), considering all possible future scenarios and making an optimal decision when the latter option (of promotion to top management) is exercised or not, and then working back to the previous stage and all the way to the beginning.

The first binomial tree in Figure A1 of Appendix A starts (at t = 0) from the current estimate of the value of the underlying human "asset" (here the current value of expected cash flows brought in to the firm by the typical base staff employee when replaced in perpetuity), V = \$4,382 k, and shows the evolution of that value along different possible scenarios (or paths) into the future (until t = 20) for the given level of business volatility (σ = 0.23 or 23%). Based on standard binomial tree valuation modeling, the stochastic evolution of the value of the underlying human "asset" evolves going up at each time step based on a multiplicative up factor (u)

$$\mathrm{u} = \mathrm{e}^{(\sigma * \mathrm{dt}^{\wedge 0.5})} \qquad (2)$$

and going down based on a reciprocal multiplicative down factor d = 1/u, where σ is business volatility (standard deviation in asset returns) and dt is the length of a subperiod (given by option maturity T divided by the number of time periods N). That is, after one time period (here each time period dt is 2 years), employee human asset value can go up by multiplicative factor u (= 1.3844) to

6,067 (with up move shown horizontally) or down by a reciprocal down factor d (= 0.7223) to 3,165, all the way to the eleven values in the last column after 10 time steps.[21]

Given the possible future "asset" values in the different scenarios shown in the last column of the first tree, Google management would make an optimal decision in the second stage (at year 20) whether to promote the typical middle manager to top management, with the value outcomes shown in the last column of the second tree (the last option tree of promotion to top management). For example, in the topmost node representing the most optimistic future scenario, where the value of a base employee *V* would be 113,323, the expanded benefits from promotion (e_2*V = 32.1*113,323) exceed the incremental costs (-S_2*(1+b) = -165,073*1.25) by a positive margin and hence the employee would be promoted. By contrast, in adverse future scenarios (last 6 nodes in the last column in the second tree of Figure A1 of Appendix A) the value benefits to the firm are not sufficient to cover the incremental promotion costs and the option to promote to top management will not be exercised, resulting in a truncated value of 0.

The basic option valuation formula used in averaging option values across a pair of next-period up and down states (nodes) emanating from a current state and discounting the expected value back one period to obtain the current expectation of option values[22] is:

$$C = \frac{[\mathrm{q} * C^{+} + (1 - \mathrm{q}) * C^{-}]}{1 + r} \tag{3}$$

where C^{+} and C^{-} are the option values in the up and down states next period, *r* is the risk-free interest rate, and q is the risk-adjusted (or risk-neutral) probability of an up move given by:

$$\mathrm{q} = \frac{(1 + r - \delta) - \mathrm{d}}{\mathrm{u} - \mathrm{d}} \tag{4}$$

21. u = exp(σ*dt^0.5) = exp(0.23*2^0.5) = 1.384, d = 1/u = 0.722.
22. See references in note 19.

Here q is equal to 0.4654. Hence, the value of the option in the immediately previous time step (at t = 9) is obtained from the average (expectation) of the follow-on option values in the up (horizontal) and down subsequent states, discounted back at the risk-free interest rate (r = 0.022 or 2.2%), and so on, all the way back to time 0 (with the time-0 value of the option to promote to top management at t = 10 or in 20 years estimated at 13,829). What is of interest is the value of the option to promote to top management back in stage 1 (at t = 5 or in 10 years) when the decision to promote the employee from staff to middle management is to be made. That decision is captured (in the last column at t = 5) in the third tree (the option to promote to middle management). The value of the option to promote to top management in each state (scenario) in the last column of the third tree at t = 5 is obtained (as previously estimated) from the corresponding state (scenario or node) at that time from the second tree. However, that value from promotion to top management is only obtained with p = 0.03 or 3% probability of success in this stage. Hence the follow-on option value must be weighted by 3%. The criterion for exercising the option to promote the employee from staff to middle management is to promote if

$$-(\mathrm{S}_1 * (1 + \mathrm{b}) + \mathrm{T}_1) + (\mathrm{e}_1 * V + \mathrm{p} * C) > 0$$

with probability p = 0.03. For example, in the uppermost node in the third tree at t = 5, with V = 22,285 (for first "asset" tree) and C = 329,967 from second, top management promotion tree, the combined benefits of promotion, $e_1 * V + p * C$ = 1.6*22,285 + 0.03*329,967, exceed the total promotion costs, $S_1*(1+b) + T_1$ = 3,018*1.25+2 = 3,775, and hence the option to promote is exercised. However, this is not the case in the last 2 states resulting in non-exercise of the option to promote to middle management (with values truncated to 0). The standard option valuation process is repeated step by step going back until t = 0, with a time-0 value of the option to promote from staff to middle management of 2,639. Given an estimated 13% probability of promotion to middle management at t = 0 (to obtain this option value), the expected option value (CDOV) per typical Google employee is

$343 k. The above figure would be $690,760 if the appropriate riskiness and discount rate for future salary increments is the WACC (9% for Google).

Discussion of comparative valuation results

Table 2 summarizes the results for Google and other firms in our sample when future annual salary increments from promotion are discounted at each company's WACC. Column (6) in Table 2 lists total enterprise value (EV) in billion dollars and column (7) shows number of staff employees per firm. Column (8) lists career development option value (CDOV or HC Staging Option) per employee. For Google (shaded area), at 9% WACC, this is $690,760 per employee. Multiplied by number of staff employees (from column 7) it gives the career development option value (CDOV) for the whole company ($28.68 bln) in Column (9), representing 10% of EV (column 10).[23] Firms in medical equipment (Stryker with a 10% CDOV estimate), technology (Google with 10%), oil and gas exploration (Devon Energy 11%) and basic natural resources (EOG 12%) have high CDOV, whereas firms in consumer goods (General Mills with 3% CDOV) and fashion retailing (Nordstrom with 6%) have lower values. The average (mean) CDOV across industrial sectors is 7%.

Anecdotal evidence supports the reasonableness of these estimates. According to *Fortune*,[24] at Google (with 10% of value from CDOV), employees can move at a fast pace, with most successful being those who take risks towards innovation. At shoe retailer Nordstrom (with 6% of value from CDOV), employees value internal mobility opportunities to move around the company in terms of positions and geography. "*If you are willing to re-locate for some roles, your professional growth is limitless*," noted one employee. Moreover, there is high variability in salary scales across ranks

23. The career development option value estimates for the other companies, expressed as % of their EV, are derived similarly. These are summarized in column (10) of Table 2 and graphed in Figure 3 across US firms (panel A) and across industrial sectors (panel B).
24. See *Fortune* (January 16, 2014), *100 Best Companies to Work For*, based on an extensive employee survey involving 257 firms from corporate America (in partnership with the *Great Place to Work* Institute).

through a commission pay structure, which raises the value of CDOV. At Devon Energy (with 11% of value from CDOV), seven out of 10 workers believe managers award promotions to those who deserve them.[25] At EOG Resources (with 12% of value from career development), employees praise the company's salaries and benefits. Nine out of 10 employees feel they make a difference at the organization. "*The opportunities are tremendous. Advancement opportunities will be available. It is exciting to be in the growth and able to have a shot at moving up*," noted another employee. In the technology sector, although Intel is comparable to Google, its HC staging option value is somewhat lower (8%) partly because of a policy of flatter salary scales across ranks. Similar career incentives are used in other firms in *Fortune 100 Best Companies to Work For 2014*.[26]

The CDOV estimates for these ten companies, expressed as % of their EV, are graphed in Figure 3 across US firms (panel A) and industrial sectors (panel B) showing a pattern that increases with volatility. The above patterns are reasonable. Firms in less dynamic industries (e.g., defensive) rely more on committed employee modes and on internal development with flatter salary scales, while firms in volatile industries rely more on flexible human resource management, including more staging flexibility.

INSERT TABLE 2 AND FIGURE 3 ABOUT HERE

Relevance and implications for scholars and management

The above RO perspective to the organization's staged career development process is useful for valuing and understanding key aspects of human resource management. This has important implications for both HR and strategy scholars, while being relevant to practicing managers.

25. The employee comments and numbers are obtained from *Fortune's 100 Best Companies to Work For (2014)* and *Great Place to Work Institute* and profiles therein on each covered company (in this case Devon Energy).

26. For example, at National Instruments a discretionary bonus program gives managers the ability to recognize individuals or teams of employees for completing special projects. At American Express, female employees are provided a large array of resources for personal and professional development.

HR scholars and managers

ROT can provide useful guidance and tools for HR scholars and managers. By keeping tabs on HR-based flexibility value and focusing on the key input variables driving HR flexibility, HR scholars and managers can determine the flexibility value unleashed from staging the deployment of HC resources in the face of unanticipated demand and skills shifts. In this regard, Supplementary Appendix B provides a further illustration of how our approach can be used to quantify the CDOV for base staff employees at a small-sized firm operating in the medical equipment sector. This supplementary exemplification shows the usefulness of our methodology for HR managers at smaller companies interested to assess the value of staged career development programs and, ultimately, of human capital's contribution to corporate value creation.

Strategy scholars and top management

Strategic use of human capital at the organizational level opens up exciting opportunities for strategy scholars and top management who would be further interested to better understand how developing a HR adaptive organizational capability can be a source of sustainable competitive advantage for firms in dynamic industries. Strategy scholars and top managers can enhance their understanding and ability to create and capture value in dynamic environments by prudently managing staged human capital and related opportunities, discontinuing failing ones early on while extending and promoting the few successful ones to higher roles and tasks. Strategy scholars might appreciate how to exploit within an HR context prominent features of successful entrepreneurial management experience in line with RO logic. A key feature analyzed here is staging of individual opportunities (i.e., creating compound options) that provide follow-on, expansion or extension options in case of stage success and discontinuation options containing risk and downside losses in case of failure. Extensions of this work may consider the firing decision and related costs as well as the option to recruit new staff to assimilate knowledge acquired in other companies. Another possible extension concerns the active portfolio management of a diverse set of such opportunities, with portfolio diversity and heterogeneity providing more scope for value creation and capture as well as risk containment due to discontinuation options from staging as much as from diversification. Finally, another extension of the basic setup (where if the employee performs well in middle-level management he/she has a probability to be recruited as a top manager) might focus on a signalling strategy in recruitment as in Lazear & Gibbs (2014). From this signaling perspective, there is an incentive to potentially accept lower wages as a good performance in middle level management at stage two leads to a probability to be promoted later to top management, creating a screening opportunity for the employing organization. By paying sufficiently low wages for middle management positions, only the skilled employees would accept the job; the low skilled ones would not accept the job as the wage level is relatively low and they are unlikely to be promoted to top management. However, for this signaling strategy extension to be credible it must be assumed and justified that if the focal firm underpays a middle management employee as a screening device for skill, the employee cannot take a more competitive offer elsewhere.

Conclusions

In this paper, we have shown how to value theoretically a multi-stage decision process in an organizational context involving HC career development programs and provided an innovative application of real options methodology to SHRM. Assessing the value contribution of human resources is important for corporate value creation, objective corporate performance evaluation and the enhancement of competitive advantage, an objective that has eluded the management profession for decades. The proper valuation and optimal management of human and other organizational resources eventually also contributes to enhancing social welfare. This article uses recent data on career path on Fortune 500 firms that allow to quantify the value of human capital's contribution to corporate value creation along the whole career path and provide objective evaluation in the context of organizational career development programs.

Our proposed approach to HC career development programs based on ROT has the potential to be both impactful to HR scholarship and relevant for managerial practice, thus addressing a call by Kryscynski & Ulrich (2015) to make human capital theory both rigorous and relevant. In this regard, we have shown how ROT might help quantify the organization's value of the staged career development process and provided broader guidelines that could be insightful to scholars and relevant for managers. Our approach represents a novel attempt to estimate the option value of staged career development in a multi-case study context of 10 select firms across U.S. sectors. The overall staging quantification idea is important as it offers guidance as to how to value human resources as a sequential investment process under uncertain demand or skill conditions. The above analysis is limited to the extent that staged career development might interact with other types of human capital (e.g., growth, switch and learning) options and HR practices (e.g., training). Human resources may also interact with other organizational intangibles, such as brand equity. Our analysis also does not account for psychological or other subjective considerations from the employees' perspective, such organizational commitment facilitating trust to enable reciprocal commitments (Dalziel 2009), which remains a fruitful subject for future extensions. Finally, the notion of flexibility used in our modeling of the HR career development process abstracts from managerial, organizational and environmental complexities to enable for simpler modeling. In reality, flexibility may depend on managerial characteristics and the organizational environment and hence it can be influenced by psychological, sociological, anthropological and organizational conditions. Flexibility may also depend on the characteristics of the labor market including the legal system, litigation costs and contractual practices. The above managerial, organizational and environmental factors present opportunities for future research development.

The staged RO framework can potentially be integrated with alternative HC-based knowledge metrics such as KVA and applied in other managerial contexts, e.g., extending Milliman et al.'s (1991) staged modeling of organizational life cycles (OLCs) across various stages (early stage, growth/expansion, maturity, revival/integration). Although we only touched on the idea of staging human resource deployment, with possible extensions into portfolio diversity providing more opportunity for value creation and risk containment from discontinuation options via staging decisions, there is scope for more specific and in-depth hypothesis development of numerous testable implications, and for more quantification research and empirical testing of more managerial situations involving staged decisions.

Our article can help enrich the way scholars think about staging human capital resources, making human capital staging more relevant in practice and tie it more closely to observed phenomena. Concerning the HC career development program, besides the ability to quantify its value and show that it increases with volatility, our RO approach rationalizes the common practice among many organizations to be more flexible in the initial career development stages and be more cherry picking as one moves higher-up the organizational hierarchy later on.

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Table 1. Investment choices as real options

Panel A. Basic real options

Type of option	*Investment choice/ Illustration*
Defer or stage	Delay or stage market entry when facing demand uncertainty
Grow	Enter new or foreign market (with option to buy partner)
Alter scale (expand/contract)	Expand or contract plant or scale of outsourcing contract
Switch	Switch suppliers or production across foreign subsidiaries
Abandon/exit	Exit market (or sell technology for salvage) if conditions deteriorate

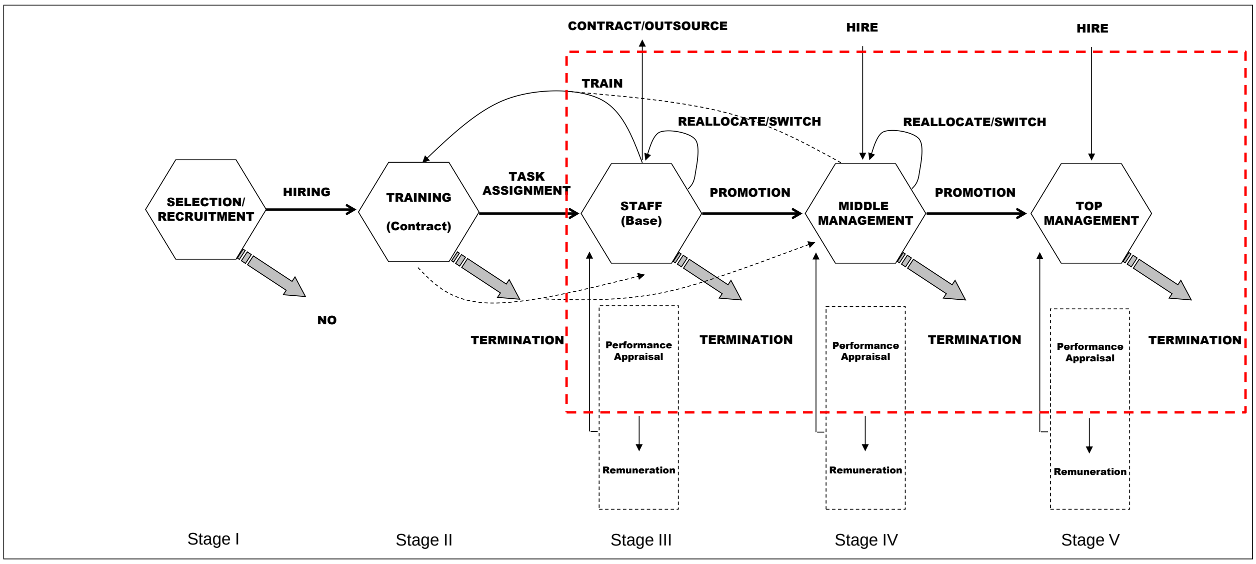
Panel B. Extensions and complications for real options

Option extensions	*Complications*
Portfolios of options and interactions	Option substitutability or complementarity
Multiple sources of uncertainty	Different uncertainties favor different investments and might change market timing and entry modes
Competition and preemption vs. cooperation	Competitive moves by others erodes the value of a firm’s option to defer entry; collaboration (e.g., via joint R&D venture) can instead preserve option to wait
Learning	Value of investing hinges upon reducing endogenous uncertainty

(Source: adapted from Trigeorgis, 1996)

Figure 1. Internal career development of staff employees and associated HC options

Panel A. Staged career development as multi-stage option



Panel B. Uncertainty type, HC options and HR practices along career development cycle

	Stage I	Stage II	Stage III	Stage IV	Stage V
UNCERTAINTY	demand for future skills		turnover & productivity	skill obsolescence; reallocation & employee resistance	HC loss; HC cost
HC OPTION	selectivity for flexible, entrepreneurial & learning skills	growth & learning options	switch options	growth & learning options; switch options	
HC PRACTICE	recruitment selectivity for flexible specialized or broad-based skills	training & fostering learning; Contractual/contingent employment	motivation & commitment preservation; relocation, job rotation	training; project-based work & job rotation; switch within alliance; skill-based pay	firm-level variable pay (limit guaranteed pay/bonus & misuse of benefits)

Figure 2. Modeling the promotion/staging (compound) option of staff employees for Google

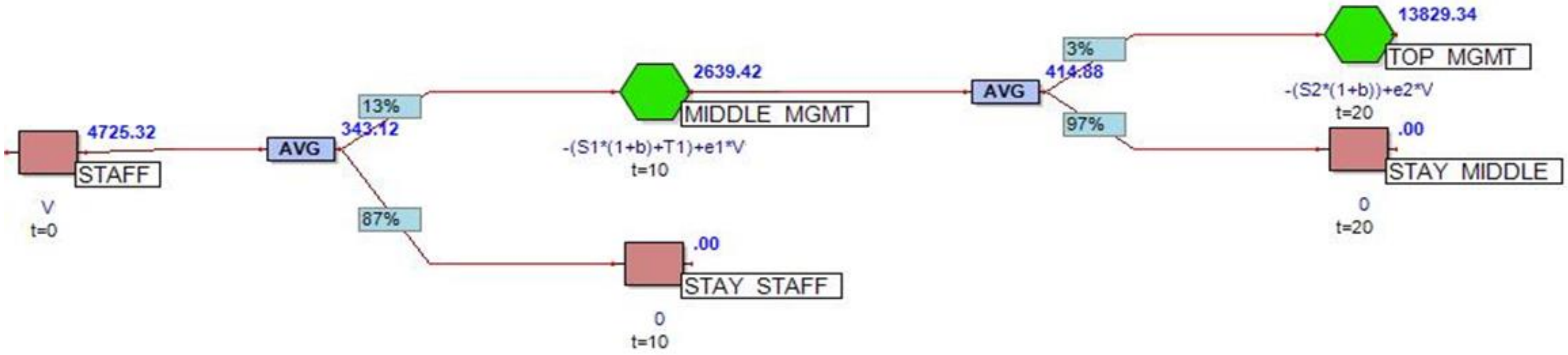
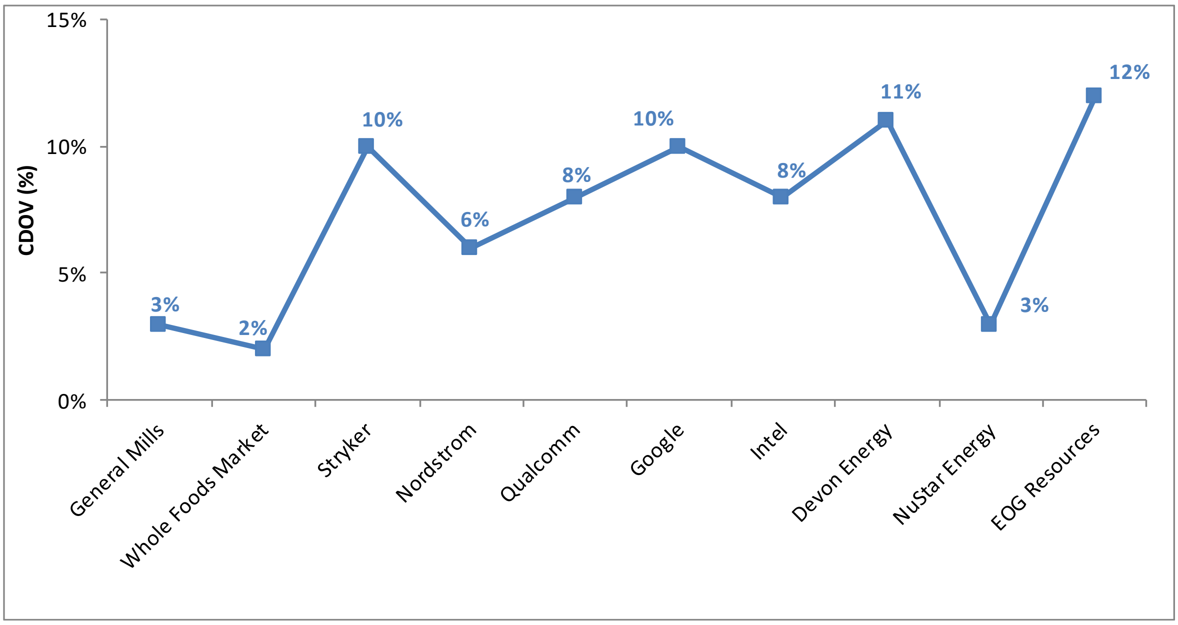


Table 2. Career development option value (HC staging) for a sample of leading U.S. "Best Companies to Work For" in 2014 across U.S. industrial sectors (Fortune)

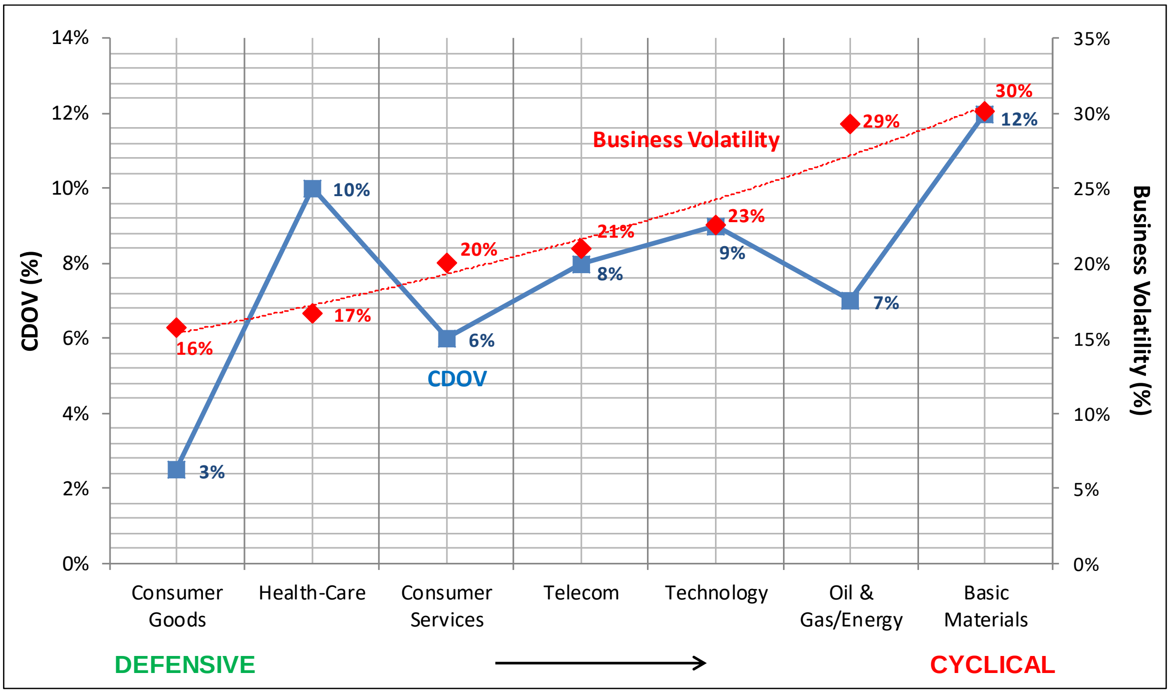
(1) Dynamics	(2) DJ Index	(3) Volatility	(4) Company	(5) Business Description	(6) Enterprise Value (EV)	(7) N° of Staff Employees	(8) Career Development Option Value (per employee)	(9) Career Development Option Value (Company)	(10) Career Development Option Value (% of EV)
					($billion)		($)	($billion)	(%)
Defensive	Consumer Goods	16%	General Mills	Food processing	$38.24	30,420	$41,730	$1.27	3%
			Whole Foods Market	Natural and organic food distribution	$12.70	50,692	$4,900	$0.25	2%
	Health Care	17%	Stryker	Medical equipment	$27.19	19,117	$142,980	$2.73	10%
Normal	Consumer Services	20%	Nordstrom	Upscale fashion retail	$15.63	54,346	$15,110	$0.82	6%
Sensitive	Telecom	21%	Qualcomm	Mobile technology	$103.25	26,960	$319,310	$8.61	8%
	Technology	23%	Google	Internet	$297.42	41,525	$690,760	$28.68	10%
			Intel	Semiconductors	$150.81	47,745	$266,800	$12.74	8%
	Oil & Gas/Energy	29%	Devon Energy	Oil and gas exploration	$34.45	5,109	$742,940	$3.79	11%
			NuStar Energy	Storage and pipeline operations	$6.53	1,642	$136,690	$0.22	3%
Cyclical	Basic Materials	30%	EOG Resources	Natural resources development	$55.47	2,268	$2,899,310	$6.58	12%
									Mean = 7%

Figure 3. Estimates of Career Development Option Value (CDOV) across U.S. firms and sectors

Panel A. *CDOV across U.S. firms*



Panel B. *CDOV across industrial sectors*



Appendix A

Appendix A illustrates the Excel-based valuation of Google's option to promote a typical employee from staff to middle and then to top management as a two-stage (compound) option using binomial trees (Figure A1). The implementation of such valuation is discussed in the article's section "Illustrating career development option valuation at Google".

Figure A1. Excel valuation of CDOV for a typical staff employee at Google

Stage 1 | Stage 2

Underlying ("Human") Asset Value (V) Evolution

Period	0	1	2	3	4	5	6	7	8	9	10
Year	0	2	4	6	8	10	12	14	16	18	20
0	**4,382**	6,067	8,399	11,627	16,097	22,285	30,851	42,710	59,128	81,857	113,323
1		3,165	4,382	6,067	8,399	11,627	16,097	22,285	30,851	42,710	59,128
2			2,286	3,165	4,382	6,067	8,399	11,627	16,097	22,284	30,851
3				1,652	2,286	3,165	4,382	6,067	8,399	11,627	16,097
4					1,193	1,652	2,286	3,165	4,382	6,067	8,399
5						862	1,193	1,652	2,286	3,165	4,382
6							622	862	1,193	1,652	2,286
7								450	622	862	1,193
8									325	450	622
9										235	325
10											169

Option to Promote to Top Management (t = 10 or Year 20)

Period	0	1	2	3	4	5	6	7	8	9	10
Year	0	2	4	6	8	10	12	14	16	18	20
0	**13,829**	27,715	54,072	102,341	187,225	329,967	559,158	912,320	1,443,064	2,239,087	3,431,327
1		6,576	14,051	29,286	59,275	115,889	217,530	389,540	662,573	1,073,845	1,691,666
2			2,608	6,012	13,579	29,907	63,843	130,987	255,341	465,863	783,973
3				773	1,950	4,857	11,900	28,550	66,536	148,639	310,370
4					130	364	1,022	2,867	8,041	22,554	63,621
5						0	0	0	0	0	0
6							0	0	0	0	0
7								0	0	0	0
8									0	0	0
9										0	0
10											0

Max(-S_2*(1+b) + e_2*V, 0)

(Compound) Option to Promote to Middle Management (t = 5 or Year 10)

Period	0	1	2	3	4	5
Year	0	2	4	6	8	10
0	**2,639**	4,988	9,029	15,610	25,887	41,780
1		1,434	2,947	5,768	10,627	18,306
2			638	1,483	3,297	6,829
3				182	512	1,436
4					0	0
5						0

Max(-(S_1*(1+b)+T_1)+e_1*V+p_{top}*C, 0)

Staff (t = 0)

Period	0
Year	0
	343

p_{mid}*C_0

Supplementary Appendix B

Supplementary Appendix B illustrates the application of our proposed RO approach to the career development program of a small-sized firm operating in the medical equipment sector to estimate the Career Development Option Value (CDOV) of its base staff employees. A two-stage (compound) option model is used to value the firm's option to promote a typical employee from staff to middle and then to top management. Figure B1 shows our RO framing of a base employee's flexible career path as a compound option. The inputs used for the estimation of CDOV for a small-sized firm are as follows.

The number of all firm employees (N) is 360. The number of Staff employees (Staff or R&D engineers, Sales Associates) (N_S) is 310, the number of Middle management employees (Senior R&D engineers) (N_M) is 47 and the number of Top management employees (N_T) is 4. If the options are committed the firm is worth $V * N'$ = FCF/WACC, where $N' = N_S + e_1 * N_M + e_2 * N_T$ (N' is the value-adjusted number of employees). This yields V = [FCF/WACC]/N'. For this small-sized firm, the above parameters are: FCF = \$20 million, WACC = 7,07% (with $\beta = 1$), N' = 401. Hence, V = \$706.3 k as the average cash-flow value contributed by a typical staff employee.

The basic annual salaries for staff, middle and top management (not CEO) are \$80 k, \$117 k and \$500 k, resulting in annual salary increments of S_1 = \$37 k and S_2 = \$383 k (discounted at WACC) and promotion value multiples of e_1 = 1.5 (promotion to middle management position) and e_2 = 6.3 (promotion to top management position) (source for data on salaries is *Great Place to Work*, *World's Best Workplaces 2019*). Benefits (including health) are estimated at b = 25% of salary. Incremental training costs from promotion to middle level are \$2 k per employee. The probabilities of promotion to middle and top management positions are 13% and 3% (Acosta, 2005; Frederiksen and Kato, 2011). The average timing of a typical career move is 10 years. A 10-year volatility of 14%, measured as the standard deviation of returns in the Dow Jones U.S. Health Care Index, is used as a proxy of the uncertainty of the firm's business environment. Option valuation via the risk-adjusted probabilities q is also affected by a 12,5% annual value growth (g) assumption (growth estimate for health sector is obtained from Factset, October 2019).

The CDOV per base employee at t= 0 is \$ 219,040 and is shown left to the first hexagon (option to promote a base employee to middle management) below the probability of occurrence of such promotion (13%) in the option tree of Figure B1. CDOV for the whole company is \$67.8 million, obtained by multiplying the CDOV per base employee by the number of staff employees (310). Based on an enterprise value (EV) of \$350 million, CDOV (company) is 19% of EV.

Figure B1. Estimation of the Career Development Option Value (CDOV) for a base staff employee at a small-sized firm