

Penrose's *The Theory of the Growth of the Firm*: An Exemplar of Engaged Scholarship

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Edith Penrose's (1959) classic book, *The Theory of the Growth of the Firm*, made a substantial impact on strategic management research, especially in the context of the resource-based view of the firm, and the ripple effects of her impact continue to unfold today in various disciplines. The book serves as a remarkably rich source of inspiration for scholarly research and a generative source of ideas, which are poised to be further developed. In this study, we examine Penrose's (1959) classic and provide: (1) the process by which this book came about; (2) a summary of its key ideas; (3) some implications for operations management research; (4) the subsequent impact of the book, in which we focus on mathematical models; and (5) a discussion of some of the research lessons learned from this exemplar of engaged scholarship. We invite management science and operations scholars to discover the rich scientific world of Edith Penrose and experience the product and process of her research creativity.

Key words: growth of the firm; engaged scholarship; dynamic adjustment costs; resource-based approach; entrepreneurship
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1. Introduction

We examine Edith Elura Tilton Penrose's classic *The Theory of the Growth of the Firm*, which develops a "resources approach" and considers "the resource-base of the firm" (1959, p. 217). In particular, we provide: (1) the process by which this classic book came about; (2) a summary of the key ideas from Penrose (1959); (3) some implications for operations management research; (4) the subsequent impact of the book, in which we focus on mathematical models; and (5) a discussion of some of the lessons learned.¹

2. Process

There is a growing recognition that the gap between theory and practice in modern business schools is not merely a knowledge transfer problem, but is also a knowledge production problem (Huff 2000, Van de

Ven 2007). Specific aspects of the current knowledge production problem are: (1) a problem is posed with little evidence of the prevalence of the problem; (2) a single theoretical model is proposed without consideration of alternative models; (3) a single method is used in the research design; and (4) statistical significance of results are provided without discussion of their practical significance (Van de Ven and Johnson 2006).

One solution for reducing the theory–practice gap is the method of *engaged scholarship* (Van de Ven 2007), which is a participative form of research that obtains the advice and perspective of key stakeholders (e.g., researchers in various fields; and users of the knowledge, such as managers and other practitioners). Such an approach to research joins "inquiry from the outside" (e.g., models of researchers), and "inquiry from the inside" (e.g., organizational actors immersed in the problems at hand) (Evered and Louis 1981,

Mahoney and Sanchez 2004). It is a knowledge production process in which: (1) problem symptoms or elements are clearly defined and informed by practitioners, and thereby are grounded in reality (Nickerson et al. 2012, Van de Ven 2007); (2) theoretical pluralism is embraced (Mahoney 1993, Mahoney and Kor 2015); (3) methodological pluralism or “triangulation” is utilized (i.e., the use of multiple sources of data, and multiple methods in analyzing the data) (Denzin 1978, Jick 1979); and (4) both practical and statistical significance of results are provided in seeking both rigor and relevance, which Stokes (1997) refers to as “Pasteur’s quadrant.”

The success of Penrose (1959)² is largely because this research follows all four elements of engaged scholarship to achieve both rigor and relevance. Further, we submit that Penrose (1959) did not achieve “Pasteur’s quadrant” randomly. An engaged scholarship process increases the likelihood of impactful research, and Penrose (1959) is an exemplar of a type of engaged scholarship of informed basic social science research with stakeholder advice (Van de Ven 2007).³ In particular, Penrose’s (1959) developed theory was informed by:

1. Discussions during the 1950s with managers pragmatically rooted in real-world problems — reported by Penrose (1959, p. 3) and in Richardson (1964);
2. Research on economic theories of growth (e.g., Domar 1957, Harrod 1952);
3. Research on business literature (e.g., Barnard 1938, Drucker 1946, Simon 1945);
4. Studies of business history and business biographies to inform: (a) firm growth and competitiveness (Florence 1953, Knauth 1956, Lilienthal 1952); (b) growth of large corporations (e.g., Gordon 1945, Maurer 1955, Newcomer 1955, Schroeder 1953); (c) growth in small firms (e.g., Christensen 1953, Hutner 1951, Steindl 1945); (d) vertical integration and diversification strategy (McLean and Haigh 1954, Passer 1953, Williamson 1952); mergers and acquisitions (Weston 1953), and firm growth and public policy (Kaplan 1954);⁴
5. Field studies (e.g., Heller’s (1951) field study of firm growth);
6. Studies of annual reports and the financial press (e.g., the insights gained from General Motors’ annual reports and the *Wall Street Journal* are provided in Penrose 1959); and
7. Observations within the firm (e.g., within the Hercules Powder Company in the summer of 1954; see Penrose 1960).

3. Summary of the Key Ideas of Penrose (1959)

Edith E.T. Penrose’s (1959) classic⁵ made a substantial impact on strategic management research, especially in the context of the resource-based view of the firm in the 1980s and 1990s (Collis and Montgomery 1997, Kor and Mahoney 2000, Wernerfelt 1984), and the ripple effects of this impact continues to unfold today. Penrose’s classic 1959 book was translated into Japanese, French, Spanish, and Italian (Penrose 1971); it serves as a remarkably rich source of inspiration for scholarly research and a generative source of ideas (Pitelis 2002), some of which are waiting to be further developed. Given space limitations, we focus here on five key sets of contributions from this classic: (1) the concept of the firm and its purpose; (2) the firm as a bundle of resources and the central role of managers; (3) unused and underutilized resources as drivers of firm growth, diversification, and innovation; (4) firm-specific and team-specific managerial experience as a key bottleneck on the rate of firm growth, and (5) the Penrose effect on international growth and inter-firm collaborations such as acquisitions. As part of these contributions, we first provide some of the key ideas from Penrose (1959) and then explain these ideas in an integrated discussion.

3.1. The Concept of Firm and Its Purpose:

Idea #1 : Firms are institutions that are created by people to serve the purposes of people.

Idea #2 : Firms operate in a disequilibrium model of firm growth, and seek to maintain administrative coordination within a multi-stakeholder environment.

Penrose (1959) emphasizes that “firms are institutions that are created by people to serve the purposes of people. . . Managers are motivated by the struggle for firm survival and by the need for achievement and recognition to generate both creative innovations and adaptive responses via new resource combinations” (Kor and Mahoney 2000, p. 114). Entrepreneurs and managers are driven to create something novel and worthwhile and to work diligently to grow the firm into the next geographic territory or product market. Given this imprinting, the drive for growth and survival is in most firms’ DNA. In this sense, Penrose (1955, 1959) captures the essence of the firm and of human volition by focusing on the dynamic processes of firm growth – with the key actors of managers interacting with the unique resources of the firm – and the “adventures” that occur on the stage of firm evolution. In this portrayal, Penrose departs from neoclassical economics that describes the firm as a production function, and instead views the firm as an

“administrative organization” (1959, p. 15), in which organizational structures and procedures evolve such that managerial decisions at all administrative levels achieve “a high degree of consistency” (1959, p. 17). Penrose emphasizes “human motivation and conscious human decision” (1959, p. 2), and instead of following the dominant approach of equilibrium models in neoclassical economics, she provides a “disequilibrium theory” (1959, p. 5) to examine the growth of firms. This approach allows for an ever-presence of unused and underutilized firm resources driving firm growth, and managerial resources acting as both the accelerators and the brakes of this growth (Starbuck 1965). Penrose’s (1959) rich disequilibrium theory gets to the heart of the dynamics of how firms operate, grow, and evolve. Penrose’s theory suggests a “jig-saw puzzle” (1959, p. 70) where some pieces – in this case, unused and underutilized firm resources – are always sticking out and calling for further growth, and yet this administrative framework also involves efforts to maintain a range of internal equilibria that are necessary for effective strategy implementation. A firm’s “ability to maintain sufficient administrative co-ordination” (Penrose 1959, p. 20) sets the limit to the rate of firm growth. This administrative ability is disrupted when the firm undertakes new growth or innovation, but a period of digestion and restoring administrative coordination prepares the firm for the next expansionary or explorative move.

Penrose’s (1959) theory of firm growth also elaborates on the link between growth and profitability, and explains the antecedents of profitable growth. Penrose views profits as a necessary condition of expansion or growth and maintains that “in general the financial and investment decisions of firms are controlled by a desire to increase total long-run profits” (1959, p. 29). Managers in firms are posited to have purposive behavior in the pursuit of *profitable growth* (1959, p. 29–30), which allows for firm outcomes to be driven by multiple stakeholder interests and motivations. With a balanced focus on growth (as a natural drive of firms) and profitability (as a necessity for firm survival and continued growth), Penrose (1959) offers a more holistic understanding of the *process* of firm growth and renewal that is both theoretically sound and practically grounded (Van de Ven 2007), and provides key insights into how firms can create (sustainable) competitive advantage (Kor and Mahoney 2004).⁶

3.2. The Firm as a Bundle of Resources and the Central Role of Managers

Idea #3 : The firm is a collection of productive resources and the services made available

from these resources are the drivers of a firm’s uniqueness.

Idea #4 : Managers play the central role—a catalyst role—in the resource-service conversion process.

Idea #5 : A firm’s managers provide both entrepreneurial and managerial services. Versatility of managers’ entrepreneurial services matters as they shape their creative imagination and vision for the firm.

Idea #6 : Managers with firm-specific experience are vital in identifying the subjective growth opportunity and executing growth projects for the firm.

Idea #7 : Managers’ experiential knowledge of the firm’s resources and their entrepreneurial imagination jointly shape how the firm “sees” the demand and which opportunities it will pursue.

Penrose elaborates that “a firm is more than an administrative unit; it is also a collection of productive resources the disposal of which between different uses and over time is determined by administrative decision” (1959, p. 24). In terms of the definition of resources, Penrose states that: “for convenience alone resources are grouped under a few heads – for example, land, labor, and capital – but ... the sub-division of resources may proceed as far as is useful ... for the problem at hand” (1959, pp. 74–75). While resources are crucial to the production process, they are only the “raw materials” in that what gives each firm its uniqueness is its ability to make efficient and innovative use of these resources. Penrose states that: “Strictly speaking, it is never *resources* themselves that are the “inputs” in the production process, but only the *services* that the resources can render. . . [Here] we find the source of the uniqueness of each individual firm” (1959, p. 25). Thus, it is the services of resources that are the key drivers of firm heterogeneity. The services a firm’s resources render are the productive utilities attained as a result of allocating, combining, and deploying resources for specific purposes. These productive services of resources are “a function of the way in which [resources] are used” (1959, p. 25), and thus, they are upstream from the end product and reside in capabilities that might find a variety of final product applications (Kor and Mahoney 2000). This crucial distinction between resources and the services made available from resources highlights the central proposition that firms achieve important outcomes (e.g., new products and services) not merely by possessing resources, but because of effective management of resources. Resource management involves numerous decisions and activities about deployment, development, allocation, utilization, and combining

of various kinds of resources (e.g., physical, human, and intangible resources), and this dynamic managerial orchestration of resources and their interactions constitutes a firm's dynamic capability (Kor and Mesko 2013, Teece et al. 1997).

Managers enact the services of resources (Mahoney 1995). The management of a firm includes individuals supplying entrepreneurial services as well as those supplying managerial services, and the same individuals may provide both types of services (Penrose 1959). *Entrepreneurial services* include services "required for the creation or acceptance of proposals for innovation and for initiating and making decisions on proposals for expansion" (Penrose 1959, p. 183), and *managerial services* are related to "the execution of entrepreneurial ideas" and to the "supervision of existing operations" (Penrose 1959, p. 32).

The services provided by the management of the firm have overwhelming importance to the firms. Entering into new markets requires a "versatile" type of entrepreneurial services such as "the imaginative effort, the sense of timing, the instinctive recognition," and those services are not likely to be equally available to all firms (Penrose 1959, p. 37). The quality of entrepreneurial services is critically dependent on entrepreneurial ambition and "interest in experimenting with new and alien lines of activity, or in moving into new geographical areas" (1959, p. 35). Entrepreneurial versatility involves *imagination and vision* (Jones and Pitelis 2015) and differs from administrative and technical managerial competence, which alone is insufficient for expansion that involves significant change in the firm's range of products and for growing the business of a firm facing unfavorable demand conditions for the existing products. Penrose notes that "there are many examples of firms with vigorous and creative management which have substantially altered their range of products, sometimes completely abandoning their original products... but there are also many examples of other firms which have not been able to make the required adjustments. In such cases, failure to grow is often incorrectly attributed to demand conditions rather than to the limited nature of entrepreneurial resources" in the firm (Penrose 1959, pp. 36–37). Versatility of entrepreneurial services also reflects on the qualities of having "good sense," being "self-confident" (1959, p. 41), and an "ability to create confidence" in investors (1959, p. 38). Therefore, the size of the capital requirements need not be a barrier by itself for growth as long as a robust business idea is coupled with competent and enterprising management. Such managers possess astute entrepreneurial judgment, which is more than their versatility, ingenuity, or ambition, but also includes their ability to develop and utilize "the organization of information-gathering and consulting

facilities within a firm" that enables the firm to carefully assess and manage "risk and uncertainty" in different directions and paths of growth (1959, p. 41).

Penrose's (1959) resources approach is concerned with managers who are "product-minded," "workmanship-minded," and "good-will builders." These managers are interested in promoting the profitable growth of their firms by improving the quality of existing products, reducing costs, developing better technology, and introducing new products where it is likely to have a competitive advantage. Penrose recognizes the presence of other types of entrepreneurs such as empire-builders; however, these purely financially oriented managers are viewed as financial speculators whose firms show little resemblance to an industrial firm with strategic coherence and interlinks among divisions (1959, pp. 39–40).

Besides the versatility of managerial services, firm-specific knowledge of managers matters considerably to firm growth and exploration. Because a firm is characterized as a unique collection of resources, which accumulate in a path-dependent pattern, managerial knowledge of the firm's resources and capabilities is essential for proper identification of the growth opportunities of the firm. Matching of a specific firm's competencies with the specific environmental opportunities must be a well-informed decision, and such intimate knowledge of the firm is gained only through firm-specific experience. For example, in a technology firm, founders and experienced managers possess a tacit understanding of the firm's technological knowledge bases, which enables them to more effectively assess the potential of alternative research and development paths and deploy scarcely available funds to projects that have a higher likelihood of success (Kor 2003).

Managers with firm-specific experiences are vital not only in identifying growth opportunities but also in executing growth projects. Penrose highlights that the process of decision-making and coordination within a firm requires managers with firm-specific experience, because such a process is too complex to be codified as a management "blueprint" that newly hired managers could implement (1959, p. 46). These newly recruited personnel need to learn "the best way of doing things in the particular set of circumstances in which they are working" (1959, p. 52). Executing growth projects also requires the knowledge of team members at various management levels (top executives, middle-management, and front-line managers), who are the champions and/or implementers of growth initiatives. Managers with such knowledge can better match employee skills to projects and employees to each other in team settings (Prescott and Visscher 1980). Team-specific experiences also enable a group of managers to function as a team

(cooperating horizontally or vertically) and make collective decisions and coordinated actions under risk and environmental uncertainty.

Overall, firm-specific managerial knowledge involves the knowledge of firms' stakeholders, including its employees, customers/clients, suppliers, distributors, business partners, and the communities it affects—all of which matter in strategic decision making concerning new growth directions and innovation (Mahoney and Kor 2015). This experiential knowledge goes beyond the knowledge of stakeholders (e.g., who the stakeholders and their needs are). It often contains relational capital and trust that can only develop over time through interactions and exchanges, and are often essential for effective implementation of new growth and innovation initiatives. Thus, managers with firm-specific experience are an essential part of sustained stakeholder engagement.

Ultimately, managers' firm-specific knowledge of the firm's idiosyncratic resources and entrepreneurial imagination *jointly* shape how the firm "sees" the demand and which opportunities it will pursue. A firm's unique resources and capabilities shape managerial imagination and expectations of the future (Boulding 1956) and act as cognitive drivers of a firm's growth strategy. Yet, given some level of plurality in managerial knowledge, expectations, and preferences (Foss et al. 2008), there is subjectivity and heterogeneity in perceiving and imagining what can be accomplished with the firm's specific set of resources. As managers subjectively perceive multiple uses of specific resources and multiple combinations of resources, "there exist a large number of possibilities for entrepreneurial choices and activities, which in turn produces different firm level economic performance outcomes" (Kor et al. 2007, p. 1192). Therefore, Penrose's (1959) theory allows influences on firm growth and exploration of both firm's idiosyncratic resources and competencies that evolve in a path-dependent nature, and subjective (and heterogeneous) imagination and interpretation of managers, which can be less predictable. Thus, Penrose (1959) describes a growth process that is partly path-dependent, and partly subjective and stochastic.

Further, Penrose submits that the growth of the external demand for a firm's existing products is a "powerful influence" on the growth of the firm (1959, p. 82), but maintains that external conditions such as product or factor markets are never a serious barrier to growth, because "there are opportunities for profitable investment open somewhere in the economy" (1959, p. 43), and a "really enterprising entrepreneur has not often . . . taken demand as "given" but rather as something he ought to be able to do something about" (1959, p. 80). Therefore, a firm's (subjective) productive opportunity actually "comprises all of the

productive possibilities that entrepreneurs see and can take advantage of" (1959, p. 31). Departing from the neoclassical economics view in which the environment is "common knowledge," "the environment is treated as an "image" [Boulding 1956], in the entrepreneur's mind of the possibilities and restrictions to which he is confronted . . ." (1959, p. 5). This leads to the *subjective* productive opportunity of the firm (1959, p. 42), which is a decidedly Austrian economics view (see e.g., Foss et al. 2008, Kor et al. 2007).⁷

Here an enterprising management is a "necessary (though not sufficient) condition for continued growth" (1959, p. 8) in that the subjective productive opportunity will be "restricted to the extent to which a firm does not see opportunities for expansion, is unwilling to act upon them, or is unable to respond to them" (1959, p. 32). Thus, human resources and physical resources co-evolve to create "the special productive opportunity of a particular firm" (1959, p. 79).

3.3. Unused/Underutilized Resources as Drivers of Growth, Diversification, and Innovation

Idea #8 : Unused and underutilized productive services of resources are a key source of firm expansion, learning, innovation, and profitable growth.

Idea #9 : The specialized resources and the specialized use of resources lead to a firm's diversification of products and services, which provide a basis for firms to achieve long-run survival and profitable growth in a changing and competitive environment.

Penrose notes that "unused productive services [of resources] . . . shape the scope and direction of the search for knowledge" (1959, p. 77), and thus the direction of expansion (1959, p. 87). In particular, Penrose observed that the expansion of many large firms have been based primarily on "a high degree of competence and technical knowledge in specialized areas of manufacture" (1959, p. 119) and suggests that whether a firm can succeed in a new business is influenced by the fact that "the firm has developed productive services in its existing productive activities which are especially valuable in the new activity" (1959, p. 130). Research building on Penrose (1959) indeed shows that unused and underutilized services of resources (e.g., in intangible resources such as R&D and advertising intensity) help explain and predict related diversification moves (MacDonald 1985, Montgomery and Hariharan 1991). Penrose emphasizes indivisibilities in machines, managers, R&D, and engineering (1959, p. 68), where expansion efforts from previous initiatives lead to excess capacities of resources. This concept of indivisibilities builds on

Babbage's "direct multiples" (1832, p. 68–69), Robinson's "balance of processes" (1932, pp. 31–35), and Florence's "principle of multiples" (1933, pp. 18–20). Excess (unused and underutilized) resources can also be of intangible nature, such as managerial knowledge and organizational reputation, which can be a source of organizational adaptiveness (Pitelis 2007). For example, excess managerial resources become available in the process of learning, as "managerial services absorbed in the planning processes will be gradually released and become available for further planning" (Penrose 1959, p. 49). An expansion program will require the firm to put together a "jig-saw puzzle of resources," and the firm is almost always likely to "find that a number of awkward corners persist sticking out" (1959, p. 69). This jig-saw puzzle becomes more complex due to imperfections of the market (e.g., where excess resources cannot be sold in the market due to indivisibilities, asymmetric information, asset specificity, and/or opportunism). Thus, a firm may need to utilize its excess capacity through vertical integration and diversification initiatives (Tan and Mahoney 2005). It is also noteworthy that we are unlikely to observe among firms an attainment of an "equilibrium position" of firm growth or a "state of rest" where there is no further internal incentive to expand, because (1) a firm's resources are hardly fully utilized due to indivisibility, (2) the same sources can be used differently under different circumstances, and (3) "new productive services are continually being created in ordinary operations" (Penrose 1959, p. 69). Thus, the problem of fully using all resources is never likely to be solved, and this underscores the disequilibrium state in which firms naturally operate. In this disequilibrium state, underutilized services of resources and subjective managerial interpretations (of the internal capacity of the firm and of the external conditions) jointly propel ongoing firm growth.

Penrose (1959) also notes that a firm not only seeks to fully employ its resources, but in particular tries to make full use of the most valuable specialized services of its resources. Indeed, it is the *specialized* use of the resources that leads to emergence of excess productive services, which can create a "virtuous circle" in which "specialization leads to higher common multiples, higher common multiples to greater specialization" (Penrose 1959, p. 73). Ultimately, it is the specialized resources and the specialized uses of resources that lead to the diversification of firm's products and services, because a firm can achieve better economies when these specialized resources are inputs in multiple types of operations or value chain functions (e.g., for different products). However, aiming to fully utilize specialized resources is not only a matter of achieving economies of scope and cost reduction (Teece 1982). The specialized uses of

resources are closely linked to the specialized knowledge bases and capabilities that set a firm apart from others. It is the orchestration of the heterogeneous services available from a firm's specialized *material resources* and *human resources* that gives each firm its uniqueness. When a firm makes long-term investments on the capabilities, which are built on these resources (and the interactions among material, human, and intangible resources), and expands and diversifies in directions to make effective use of such capabilities, they are likely to prosper.⁸

Specifically, Penrose submits that "[i]n the long run the profitability, survival, and growth of a firm does not depend so much on the efficiency with which it is able to organize the production of even a widely diversified range of products as it does on the ability of the firm to establish one or more wide and relatively impregnable "bases" from which it can adapt and extend its operations in an uncertain, changing, and competitive world" (1959, p. 137). Penrose emphasizes that a high degree of competence in specialized areas of manufacture "together with the market position it ensures is the strongest and most enduring position that a firm can develop" (1959, p. 119). Penrose further notes that sustainable competitive advantage can be derived from both a competency-driven strategy of diversification and from "management's experiments with different types of organization structure" (1959, p. 119).⁹

3.4. Managerial Experience as a Key Bottleneck for the Rate of Firm Growth

Idea #10 : Penrose dares to be different. By going beyond the economic research literature on firm growth, she asks a new research question. Instead of the conventional question: "What is the optimal size of the firm?" She asks: What is the optimal growth rate of the firm? (1959, p. 2).

Idea #11 : Managerial capability is the binding constraint that limits the growth of the firm – the so-called Penrose effect or Penrose theorem.

Idea #12 : If a firm deliberately or inadvertently grows faster than the rate at which managers and employees in the expanding organization can obtain the experience with each other and with the firm that is necessary for the effective operation of the group, the efficiency of the firm will suffer.

At the time Penrose was examining firm growth, the economics literature on the subject was preoccupied with the question: "what is the optimal size of the firm?" That question was more concerned with

the diseconomies involved in large firm size, and the general wisdom was that firms lose their efficiencies once they reach a certain size. Penrose was dissatisfied with the existing theories of firm growth as none of them were able to explain the novel insights she encountered during her conversations with various corporate executives as part of the Oxford Economic Research Group, or the observations she made during an in-depth field case study of Hercules Powder Company (Penrose 1960). During these engagements, Penrose saw that the pressing issue on firm growth was not how firms get big and still be efficient. What companies and their executives were deeply struggling with had to do with the limitations on the *rate* of firm growth, and how firms coped with the transition period that placed a lot of stress on some of the key resources, particularly the managerial resources. As a result of her inductive learning during these interactions, Penrose asked a new research question: “What is the optimal growth rate of the firm?” (1959, p. 2), and assuming some firms can grow, “what principles will then govern their growth, and how fast and how long can they grow?” (1959, p. 7). These questions enabled Penrose (1959) to focus on the *process of growth* and incorporate the essential elements of an administrative firm (e.g., resources, productive services of these resources, and managerial and entrepreneurial services), whereas the existing research literature was stuck in examining economies/diseconomies of firm size. Penrose viewed that “growth is a process; size is a state” (1959, p. 88), and found the growth process far more interesting and relevant to investigate.¹⁰

In answering the research questions she posed, Penrose builds on the insight that firm growth can be viewed as a dynamic process of management interacting with resources. Penrose states that: “the experience of management will affect the productive services that all of its other resources are capable of rendering. As management tries to make the best use of resources available, a truly “dynamic” interacting process occurs, which *encourages continuous growth, but limits the rate of growth*” (1959, p. 5). Thus, managerial capability is the binding constraint that limits the rate of the growth of the firm – also referred as the *Penrose effect* (Hay and Morris 1991) or Penrose theorem (Marris 1964, p. 114). According to the Penrose theorem, the availability of managers with firm-specific experience serves as a key bottleneck on the rate at which a firm can grow at a certain point in time. The underpinning premise of this theorem is that, in the short run, the internal supply (availability) of firm-specific managerial talent is inelastic. The primary reason for this inelasticity is that individuals hired from outside the firm do not possess the requisite *firm- and team-specific experience*, which takes time

to develop, and thus, is subject to what Dierickx and Cool (1989) refer as time compression diseconomies—that one cannot cram into a short timeframe the development of tacit (experiential) knowledge. In this case, tacit knowledge is about the firm’s idiosyncratic resources and capabilities, managers and employees including specific team members, and stakeholders (e.g., clients, suppliers, channel members, and communities). The formation of a *gestalt* about the firm’s system of resources, capabilities, routines, people, culture, and vulnerabilities requires a period of close interactions with the firm’s resources and people.

In particular, the knowledge of the people employed in the firm at various levels is a key component of the firm-specific experience, as understanding and appreciating a firm’s idiosyncratic set of resources, competencies, and rituals require translations and interpretations by the seasoned employees of the firm. Social links and relationships are likely to be integral for the “educational process” through which newcomers accumulate firm-specific knowledge. Thus, relationships with people (internal social capital) serve as the conduits of explicit and tacit knowledge about the firm. Also, part of this education and socialization involves learning about the strengths, weaknesses, and idiosyncratic habits of the people one works with, and such knowledge matters for effective teamwork and collaboration (Barnard 1938, Kor and Mahoney 2000). The knowledge of peers’ and managers’ ability, integrity, and personality affects the quality and outcome of exchanges with them (Mahoney and Kor 2015).

Penrose (1959) highlights that new managers and employees can suffer from suboptimal performance due to their lack of firm-specific experience. When people move to a new firm, there is a (temporary) loss of productivity because they lack complementary and co-specialized knowledge of the unique competencies, processes, and people in the firm (Klein et al. 1978, Peteraf 1993). The extent of the loss and duration of recovery of the productivity of human capital depends on the uniqueness of the new firm (Mahoney and Kor 2015).

Even though growth of the firm often requires expansion of managerial services, the amount of new managerial resources that can be efficiently acquired and absorbed in a firm depends on the existing availability of “inherited managerial resources” (1959, p. 48) such that “the amount of activity that can be planned at a given time limits the amount of new personnel that can profitably be absorbed in the “next period” “(1959, p. 49); therefore, “services from “inherited” managerial resources ... create a fundamental and inescapable limit to the amount of expansion a firm can undertake at any time” (Penrose 1959, pp. 47–48). This limitation stems from the fact that for

effective transition and socialization of new managers require time and attention of the current managers with firm-specific experience, and this training of newcomers re-allocates part of managers' time from current operations and obligations to the human capital development for new growth. Thus, the new employee and its managers incur adjustment costs to make the externally acquired human capital productively deployable with the firm's idiosyncratic assets (Mahoney and Kor 2015, Prescott and Visscher 1980, Slater 1980).

It is important to note that growth often involves exploration initiatives (March 1991), including new product innovation projects, and new market entry via product/service or geographical diversification. The degree to which existing managers are stretched in their time and attention can be very high in these exploration scenarios of growth where managers can be both learning the new areas of growth (i.e., developing new expertise) and at the same time mentoring and socializing the newly hired managers (Kor and Leblebici 2005). Reliance on externally hired managers increases when firms venture into new product or geographical markets. These managers bring with them the expert knowledge of the new domains; however, they still lack firm-specific knowledge, and thus, the existing managers must spend time, attention, and effort to collaborate with them because such investments are essential to the success of new managers. Firms can also choose to promote from within as they are implementing the growth initiatives; however, there are also limits to the number of such promising employees that can rise up to management ranks and run such initiatives. Consequently, "the services from "inherited" managerial resources control the amount of new managerial services that can be absorbed, they create a fundamental and inescapable limit to the amount of expansion a firm can undertake at any time... and the larger and more complex the plans the more [managerial] services will be required to digest and approve them on behalf of the firm" (Penrose 1959, pp. 48–49). Some level of slack resources (in management) serves as a cushion that allows organizations to adapt to internal and external challenges, including growth, competition, and innovation challenges (Bourgeois 1981, Cyert and March 1963).

The Penrose effect predicts negative inter-temporal correlations in the growth rates of firms (Hay and Morris 1991); that is, a fast-growing firm will encounter managerial problems and thus slow down its growth in the subsequent time period. Shen (1970) presents the first large-sample empirical evidence for this effect, with the finding of negative correlation coefficients between the growth rates of 4000 Massachusetts manufacturing plants

for two sequential periods. Gander (1991) examines whether there are decreasing returns to managerial resources by using aggregate two-digit SIC US industry data, and finds support for the 1977–1980 period but not for the 1983–1986 period. Thompson (1994) and Shane (1996) suggest that organizational forms may influence the need for the services of internally-experienced managers and thus can relieve firms from the Penrose effect, as their empirical results that US firms following a franchise strategy grew faster than those firms that expanded by establishing hierarchical outlets.

What happens when firms ignore the managerial and employee human capital limits on the rate of firm growth, diversification, and exploration? What happens when firms try to cram managerial learning of new expertise domains and learning of firm-specific knowledge about firm's unique resources, people, and stakeholders? In a sample of large US law firms that pursued legal service diversification and geographical diversification during 1995–1999, Kor and Leblebici (2005) find that availability of partner resources are key to profitable diversification into new expert domains and new locations. Even though the diversification strategy is profitable for firms on average, the ultimate profitability is determined by how the strategy is implemented. Those firms that put their partner resources under double-pressure, first by adopting a high human capital leverage ratio and second by pursuing a high level of diversification, suffer from significantly lower profitability per partner. A high leverage ratio involves increased stretching of partner resources (who have highest level of firm-specific experience) due to a higher number of junior associates (lawyers) who need supervision, mentoring, and socialization. When a high level of partner leveraging is combined with high level of diversification into new legal expertise areas or new locations, these partners are stretched again in overseeing the coordination of legal cases that involve multiple areas of expertise (including new expert domains), or orchestrating the services provided by multiple law offices (e.g., in serving a large corporate client). This overspreading of partner resources washes out some of the value created by the growth strategy. Thus, even though firms can choose to ignore the key limitation on the rate of firm growth as the availability of managerial and engineering talent, they are unlikely to avoid the consequences of it. These consequences can involve compromised quality of operations, products, and services, compromised relations with value chain partners and stakeholders, and reduced financial success (and loss of competitive advantage and jeopardized survival at the extreme).¹¹ In some cases, effects can be temporary; in others, they can be long-lasting or irreversible.

3.5. Penrose Effect on Acquisitions and International Expansion as the Mechanisms for Firm Growth

Idea #13 : There is a limit to the rate of firm growth via the expansion mode of acquisitions.

Idea #14 : Availability of management capability also serves as a bottleneck for the rate of international growth. However, in some cases, acquisitions of subsidiaries in foreign countries can help to reduce the need for direct administrative co-ordination, and thus, the firm can grow at a higher rate than what is possible through organic international growth (greenfield entry form).

Observing that many diversification activities are made through acquisitions, Penrose maintains that “acquisitions can be used as a means of obtaining the productive services and knowledge that are necessary for a firm to establish itself in a new field” (1959, p. 128). Penrose emphasizes that acquiring a firm also means “acquiring an experienced management “team” and an experienced technical and labour force,” which is a far more important reason to choose acquisitions than the reasons of elimination of competition or reduction in cost of entry (1959, pp. 127–128).

However, Penrose cautions that “a firm attempting to diversify and grow through acquisition does not entirely escape the limitations either on the rate or on the direction of expansion imposed on it by its existing resources” (1959, p. 128); there is a limit to the rate of expansion of a firm using acquisitions, “for the problem of regulating the relation between the parent firm and its new acquisition cannot be avoided” (1959, p. 128). Empirical evidence provides supports to this sharp observation. For example, Tan (2009) examined Japanese acquired and greenfield ventures in the United States and found that the growth of acquired ventures was indeed *slower* when achieving synergies requires that the parent firms closely integrate and coordinate with their subsidiaries. Acquisition of foreign ventures enables the parent firm to acquire a group of managers that have team-specific experience within the venture, which would yet be accumulated over time if the parent firm establishes a new venture. However, the parent firm may implement managerial policies and practices that are incompatible with the existing routines in the acquired venture, and thus may trigger resistance from the subsidiary employees. Thus, integration and coordination between the parent firm and the acquired venture are likely to entail adjustment costs that consume managerial attention and services from the parent firm. The parent firm does not incur such

adjustment costs with greenfield ventures because it can “infuse them with suitable managerial policies at the outset” (Tan 2009, p. 1049).

Penrose also highlights that, internal (organic) growth and growth via acquisition, as two alternative modes of expansion, require different kinds of productive services. For internal expansion, “existing plant, equipment, types of raw materials, skills, knowledge, and original ideas will be much more important forces”; while for acquisition, “the entrepreneurial ability to discover an appropriate firm and to negotiate the acquisition, and . . . the managerial resources required to effect the necessary integration” (1959, p. 143) are much more critical. Consequently, the ultimate limit to the rate of growth in acquisition mode of expansion is the entrepreneurial and managerial capacity to explore, negotiate, organize, and implement an acquisition. There is a difference in the shape of the growth curves for two modes of growth, where we are likely to observe a relatively smooth curve for internal growth and a curve proceeding in large steps and “plateaus” for acquisitive growth (Penrose 1959, p. 194).

Observing the huge success of General Motors–Holden’s Ltd., the Australian wholly-owned subsidiary of General Motors Corporation in 1954, Penrose notes that “if foreign firms have any advantage in management, technology, capital or other resources, foreign firms may be expected to grow somewhat faster than domestic firms, even in the absence of any exorbitant degree of monopoly power” (1956, p. 226). Penrose notes that the establishment of foreign subsidiaries is “not essentially different from the establishment of subsidiaries in its own country and the new expansion is still part of the process of growth of the parent company” (1956, p. 225) but recognizes that “international borders make enough difference to justify separate treatment of international firms” (1996, p. 1720). Further, Penrose makes a distinction between foreign and domestic subsidiaries and suggests that “foreign subsidiaries have . . . a greater degree of independence of the parent than have domestic subsidiaries” (1956, p. 226). This is because foreign subsidiaries “operate in a radically different political, economic and social environment,” where the headquarter managers are likely to rely more on local executives for decision making, and, more importantly, “the area over which a close co-ordination of policy is considered necessary is often smaller” for foreign subsidiaries (1956, p. 226). Therefore, expansion in foreign countries may sometimes escape the need for administrative co-ordination (1959, p. 193) and the reduced need for coordinating foreign subsidiaries may relieve some managerial diseconomies that one would expect from domestic firm expansion. Empirical studies in general provide

supports to the suggestion. For example, Tan (2003), based on empirical analysis of Japanese investments in the United States, finds that a fast-growing Japanese firm in a US industry did not slow down in the subsequent time period. Tan and Mahoney (2007) further find evidence that multinational firms bring in their home resources to facilitate growth in foreign markets. In particular, they find that Japanese firms that sent more expatriates to their US ventures at the time of establishment were able to accelerate the development of new managerial resources within the foreign ventures and thus achieved growth in consecutive time periods. Tan and Mahoney (2007) also find that Japanese firms that had greater home experiences were also able to escape the Penrose effect and to achieve growth in successive time periods. Such firms are likely to have developed a “more complete and reliable set of routines, which can serve as a “template” for the to-be-established new routine of the foreign operation” which not only facilitates knowledge transfer and coordination, but also “economiz[es] the time and efforts of headquarters’ managers in developing local personnel’s abilities” (Tan and Mahoney 2007, p. 265). Overall, this evidence supports Penrose’s (1956) suggestion that foreign expansion may be less subject to managerial constraints due to reduced need for close coordination with foreign ventures and the resource advantages of multinational firms.

However, Tan and Mahoney (2005) find that Japanese investors in the United States were more vulnerable to the Penrose effect in industries where close coordination within multinational firms is required. Even though a multinational firm can rely on the local subsidiary personnel and management to manage the foreign operations, effectiveness of this delegation depends on the quality of foreign subsidiary operations and management (Penrose 1959) and also the nature of industries, which may necessitate closer coordination within the multinational firm as foreign subsidiaries cannot be effectively managed as autonomous, independent subunits (Tan and Mahoney 2005). Achieving operational and strategic synergies in such industries requires the services from managers who have experiences in multinational headquarters, as these managers need to ensure the individual actions and decisions from the subsidiaries adhere to corporate policies and culture, and collectively contribute to the best interests of the multinational firm as a whole. Headquarters managers may even have to “sometimes directly involve (as expatriates) in daily operations of the foreign affiliates” (Tan and Mahoney 2005, p. 117). It is also noteworthy that the level of unionization in the industries can further accentuate the Penrose effect that the multinationals experience when they grow, because strict union rules

about job descriptions make it harder to make adjustments to the availability and flexible use of managerial (and other employee) services, and thus, a period of growth may demand a much longer period of digestion during which proper adjustments can be made to human capital stocks and procedures. These empirical studies reveal important nuances and boundaries of the Penrose effect on firm growth, and signal that there is strong merit in further empirical examination of how the Penrose effect applies to cases of international growth, especially when they involve acquisitions of and/or alliances with foreign partners.

Penrose (1959) recognizes that there will be differences among firms in the degree to which they are subject to the managerial limit to the rate of the growth. Penrose states that the “managerial requirements per dollar of expansion depend on (a) the character of the expansion itself, (b) the relation between the type of expansion, the existing activities of the firm, and the complex of external circumstances that I shall simply call “market conditions”, and (c) the method of expansion” (1959, p. 207). Clearly, there is likely to be critical internal and external moderators on the Penrose effect as firms grow, diversify, experiment, and innovate, and pursue collaborative initiatives. We welcome research that uncovers these moderators and interactive effects as such research can reveal the degree to which the binding managerial limit on the rate of firm growth, diversification, and innovation is diminished or elevated. New insights into this domain can further contribute to a process theory of firm growth by demonstrating the contingent nature of the dynamic interactions among the firm’s employees, managers, resources, and environments. Relatedly, making sense of how the growth process of today’s corporations is shifting and evolving, and understanding whether the boundary conditions on the rate of firm growth are also adjusting, require fresh thinking and new scholarly research.

4. Some Implications for Operations Management Research

We elaborate on a couple of research avenues where Penrose’s (1959) theory of the growth of the firm is particularly relevant. Firm growth and diversification are likely to introduce many challenges for operations management. Penrose maintains that a firm that expands faster than it can increase its internal managerial capacities is likely to incur managerial problems. One such managerial problem occurs when adding new recruits and/or reorganizing the production process disrupts the current culture within the firm/plant. Thus, it would be useful to consider how a firm can sustain a culture of quality in its production

(or service operations) while growing rapidly. What is the optimal rate of firm- and plant-level growth to sustain such a culture? Corporate-level strategy and decisions that bring rapid growth have implications for sustaining plant-level culture that ensures excellence in quality. To maintain this culture, selection of employees and managers with the appropriate skills and mindset matters. Penrose (1959) emphasizes the importance of internally experienced managers in planning firm expansion as these managers “know the ropes” of doing things in the firm and understand the corporate culture that the firm has established over time. Yet new recruits from outside the firm can bring in fresh perspectives that may stimulate change and innovation. Hence, when a firm is expanding an existing plant or setting up a new plant (or service operations), the recruitment strategy involves important tradeoffs. Should the firm try to mostly hire from within the company (from other plants or operations of the firm), bring in young employees to train in-house, or recruit seasoned workers from outside the firm? If the firm’s plant culture is unique and firm-specific, what is the appropriate recruitment and socialization strategy? If the firm pursues a combination of these strategies (hiring from within, from the same industry, or outside the industry), what is the optimal mix to sustain a culture of quality (or a unique plant-level culture)? Stating more generally, what are the optimal ratios of employee categories (in specialized skill set, experience, and cultural-strategy orientation) in conjunction with operations- and strategy-based contingencies, and how much can firms deviate from these ratios without experiencing significant compromises in operational and financial outcomes?

In expanding production capacity, firms also must consider the availability (or insufficiency) of skilled labor in the community/region. How do these labor supply conditions affect the optimal mix of employees to recruit and train? How does this mix affect the design of operations? What modifications will be needed? If the firm must provide substantial on-the-job training, what plant and production designs are required? If the firm must rely on externally hired employees that come with undesirable “old habits” or incompatible national cultural backgrounds, what modifications will be needed in job and work flow design, and in the involvement of supervisors and managers? Likewise, in designing and managing expanded operations, firms need to consider the level of unionization and the nature of the firm-worker relationships, both at the focal firm/plant and at firms/plants from which hiring may take place. Existing operations management procedures may need substantial adjustments as the gap between the firm’s current operations and new operations widens. In

summary, if the firm is expanding rapidly or growing into locations with different labor supply conditions and national cultures, as it happens today in emerging markets/locations and industries, new challenges arise quickly for operations management. Discovering the system of operations management decisions and practices that deliver positive outcomes at different rates and conditions of growth will be important to overall firm success. Considering the tradeoffs posed by growth, appropriate design, and recalibration of the operational systems will drive the firm’s ability to sustain the plant’s (or operation’s) unique system and culture. Knowledge of the key operational boundaries and bottlenecks on successful firm growth also informs corporate strategy, including decisions on the rate, direction, and mode of growth. In this sense, operations management has important feedback effects on strategic management.

We also highlight that Penrose’s (1959) growth theory may have important implications for the scaling up of operations of start-up companies. New ventures often go through a period of very rapid scaling up of firm’s operations. New venture growth involves a dual process of business model development/calibration along with expansion of the operations, where planning, replanning, and implementation happen about the same time (in overlapping intervals). This growth process may differ from the growth of large firms which often rely on existing or familiar models, blueprints, and systems to implement growth. As a startup firm frequently makes improvements to its product/service design, its operations keep getting disrupted. These disruptions delay the conversion of experiences into standard operating procedures or best practices. This challenge is combined with limited resource availability and slack in startup firms, which restricts the number of trials they can run.

These conditions pose significant operations management challenges. How can firms develop/design a process of growth that both enables development of systems, procedures, and routines, and at the same time allows rapid replacement of these systems with superior versions? What are best ways to capture learning curve effects in product design and production while trying to develop operational systems that deliver efficiency, reliability, speed, and quality? How can firms maintain effective coordination at the plant/firm level when they continuously add new people and new components to the production system in the process of scaling up operations? These pressures suggest the potential for synergies in co-developing, co-locating, and/or co-running the firm’s product design and production functions, which are separated today in many established firms. When do such synergies exist, and what does it take to capture them? Addressing these startup firm

challenges may also have important ramifications for large firms that operate in fast-cycle industries (where the rate of new product introduction is high) or for firms that try to differentiate and economize through customization capability and a rapid changeover capability in production. Identifying some of the key bottlenecks in designing and running systems of flexible growth will be an important contribution to both operations and strategic management research. Penrose's (1959) theory of the growth of the firm can be inspirational in such endeavors.

5. Subsequent Impact of Penrose (1959)

Itami and Numagami (1992) maintain that influential research can impact four key areas: (a) *Mathematical models*; (b) *Statistical data analysis*; (c) *Logical compound synthesis*¹²; and (d) *In-depth case studies*. Kor and Mahoney (2000) follow this four-part structure and document almost all of the major research influenced by Penrose (1959) up until 2000.¹³ Because formal modeling in this area of the research literature has been underdeveloped, we focus on Penrose's (1959) impact on mathematical modeling. Although Penrose (1959) did not provide a formal mathematical model, the logic of the book inspired several subsequent models as documented in Kor and Mahoney (2000). Here, we focus on the topic of (dynamic) adjustment cost models (Ingham 1992, Lucas 1967, Mortensen 1973, Treadway 1970, Uzawa 1969). As noted above, Penrose (1959) considered the specific case of the adjustments costs in having the current managers of the firm training new managers as they entered the organization and the *Penrose effect*, which suggests an optimal growth rate of the firm (Dorfman 1951, Rubin 1973, Slater 1980), and that fast-growing firms in one time period tend to experience slower growth in the next period.¹⁴

Penrose's original work contains no formalization of her theory; she presents arguments without weaving them into a mathematical model. However, several economists have since incorporated some of her ideas into more formal models. One application resides within the theory of corporate investment. This theory is concerned with how a firm should invest into its own asset stock over its lifetime. This asset stock generally has a "natural decay," and requires replenishment. Optimal control policies in this literature usually take a step-increase form, where the firm would initially invest a huge amount to bring their asset stock up to an optimum, and then simply replenish the stock to compensate for natural decay. Such a normative policy did not match with empirical observations. Uzawa (1969) provided a different view by drawing on Penrose's (1959) argument that a firm needs managerial resources to expand,

and that an increase in these managerial resources itself can only happen under some constraints and with a time-lag. This has often been termed as an "adjustment cost" to the capital stock. As a result, managerial resources cannot increase as fast as capital investments. Optimal control policies across firms in an industry thus take the form of common growth at a constant rate – resulting in a constant ratio of investment flow to assets in an industry.

Another stream of literature in which Penrose's work has been formalized relates to the discussion of profit vs. growth objectives. Penrose (1959) is clear that managers pursue profitable growth – i.e., not growth for the sake of increasing the size of their firm, but growth for the sake of increasing profits. Williamson (1966) analyzes this question more formally, and concludes that pricing/output policies of growth vs. profit maximizing firms are similar. Slater (1980) later reexamines this question, and demonstrates that this result from Williamson (1966) was driven by the assumption that the marginal cost of production is unaffected by the growth rate. Slater (1980) proposes instead that firms must devote their management resources either into sustaining production or into training new managers to sustain the production resulting from future growth – an argument in line with Penrose (1959). The resulting control policies show that output decisions made by profit-maximizing firms can be quite different from those of growth-maximizing firms.

It is clear from this brief discussion that while Penrose's (1959) work has influenced the development of some normative models in the area of economics, no attempt has been made to fully capture Penrose's thoughts in a formal model of growth. As Thomas (2004, p. 17) points out in his discussion of Uzawa's work, "Penrose herself may not have agreed with a model of this sort, or even recognized her own work in it." We will thus provide in this study a simple attempt to formalize Penrose's key ideas. The purpose of our model is not to be comprehensive or realistic; our objective is simply to illustrate Penrose's ideas in more formal terms.

Consider a profit-maximizing firm that develops a growth plan for time period t . The firm earns a profit margin α for each unit of output Q_t . The firm employs a group of managers, which together can provide managerial services up to the volume of M_t . In each period, the firm needs to decide how to allocate their scarce managerial services across three different activities: Production (P_t), Training (T_t), and Innovation (I_t). Managerial activity devoted to production enables efficient operations and thus serves the purpose of ensuring that the production of output Q_t occurs without inefficiencies. We assume that there is an adequate amount of resources devoted to sustaining existing operations

given by Q_t/a , where the parameter a measures the productivity of managerial resources in this effort. We thus measure the cost of providing insufficient managerial resources for production by a quadratic adjustment cost (AC):

$$AC_t = \beta((Q_t - aP_t)^+)^2. \quad (1)$$

The plus sign in the internal bracket in Equation (1) indicates that allocating excessive resources to production will not lead to increased adjustment cost. Of course, an optimal allocation will naturally make this precautionary specification detail unnecessary, since extra managerial resources would rather be allocated differently or remain unused. The quadratic cost form is used to simplify the analysis, and to ensure that an interior solution for the resource allocation problem can exist. The cost parameter β measures the extent of the adjustment cost of one-unit shortage of managerial services devoted to sustaining existing operations.

Managerial activity devoted to training increases the availability of future managerial services available, such that we can write $M_{t+1} = M_t + bT_t$. The productivity parameter b here measures the effectiveness of management to train new managers. As Penrose (1959) stresses, integrating new managers into the firm not only requires time (which we indicate by the time-lag), but also requires an active effort by the existing management team. Thus, the managerial resources necessary to support production in the future require an investment of resources in the present. Managerial activity devoted to innovation creates growth; this activity is what Penrose (1959) emphasizes as the entrepreneurial aspect of management. We will formalize this component of our model by defining $Q_{t+1} = Q_t + cI_t$. The parameter c here measures the productivity of management in creating growth. Note that for simplicity, we assume the same time-lag between managerial training and innovation activities becoming effective. We further include the managerial effort required to integrate novel growth opportunities into existing operations in this innovation activity. Growth itself here is unconstrained, since there is no upper limit to I_t . Growth is only endogenously constrained through the inequality

$$P_t + T_t + I_t \leq M_t, \quad (2)$$

i.e., every unit of managerial resource dedicated to growth means that this unit is not available to support operations in the current period (resulting in higher adjustment costs presently), or for training new managers to support growth in the future (resulting in higher adjustment costs in the future).

We can thus write the profit function for period t as follows:

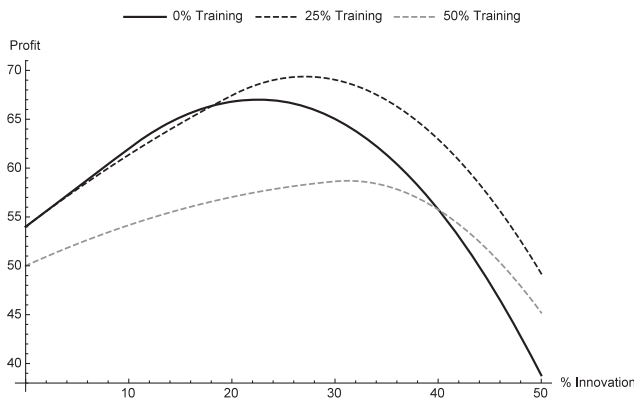
$$\Pi_t(Q_t, M_t) = \alpha Q_t - AC_t. \quad (3)$$

Note that we see the production volume Q_t as well as the volume of managerial services M_t as state variables which allow linking different time periods together. We begin our analysis by assuming a terminal period T . This assumption is mostly made to simplify the analysis; it is maybe best interpreted as an assumption that firms construct their growth plans in a somewhat myopic way, that is, not adjusting their current growth plans to the potential growth that could exist beyond a certain time frame. The decisions in this terminal period are trivial to analyze. Since no successive period exists beyond T , the firm would not train additional managers ($T_T = 0$), and no innovation would occur ($I_T = 0$). All managerial effort will be dedicated to supporting current production if necessary, i.e., $P_T = M_T$ if $aM_T \leq Q_T$, and $P_T = Q_T/a$ otherwise, resulting in profits Π_T^* . The more interesting problem becomes analyzing decisions in the preceding time period, i.e.,

$$\begin{aligned} \max_{P_{T-1}, T_{T-1}, I_{T-1}} \quad & \Pi_{T-1}(Q_{T-1}, M_{T-1}) \\ & + \delta \Pi_T^*(Q_{T-1} + cI_{T-1}, M_{T-1} + bT_{T-1}) \quad (4) \\ \text{s.t.} \quad & P_{T-1} + T_{T-1} + I_{T-1} \leq M_{T-1} \\ & P_{T-1}, T_{T-1}, I_{T-1} \geq 0. \end{aligned}$$

The parameter δ here describes a discount factor that allows for a comparison of cash flows occurring in different time periods. Before we briefly discuss the optimal solution to this problem, it is useful to consider an example to illustrate the underlying decision and examine different growth strategies. To construct such an example, we examine how Π_{T-1} changes for different values of T_{T-1} and I_{T-1} , assuming that P_{T-1} is set optimally. An overview of this example is given in Figure 1, which shows how changes in innovation activity (expressed as a percentage of total managerial services available, i.e., I_{T-1}/M_{T-1}) influences profits for different values of training activity (expressed as a similar percentage, i.e., T_{T-1}/M_{T-1}).¹⁵

The nonlinear relationship between innovation activity and profitability is clearly visible in Figure 1. Allocating too little managerial services toward innovation fails to realize growth potential, reducing profitability. Too much innovation activity not only crowds out resources to support production, but is also unsupported by adequate production resources in the next time period. An optimal growth strategy thus needs to factor in the constrained managerial resources. As the dotted lines

Figure 1 The Profit Implication of Different Growth Strategies

show, investing in new resources by increasing the amount of managerial resources allocated to training can reduce this constraint; with some training, the optimal growth increases. However, if too much of the resources are allocated into training, again not enough resources are available for production in the current period, leading to a decrease in profitability.

It is easy to show that an optimal growth strategy exists for problem equation (4). As long as growth is sufficiently profitable – i.e., the productivity of growth c is sufficiently high – the firm will invest jointly into innovation as well as training in period $T - 1$. A more detailed analysis of this model, as well as a dynamic programming approach that would look at longer-term strategies, is beyond the scope of this article. The only interesting remaining aspect of our analysis to be discussed here are some comparative statics on the optimal solution, specifically:

$$\frac{\partial I_{T-1}^*}{\partial Q_{T-1}} = -\frac{1+b}{ab+c}, \quad \frac{\partial I_{T-1}^*}{\partial M_{T-1}} = \frac{a(1+b)}{ab+c}. \quad (5)$$

Equations (5) demonstrate that growth in period $T - 1$ decreases in the production volume of period $T - 1$, which is in turn the result of past growth. This is the Penrose effect – fast growth in one period creates slower growth in the next period, since growth *per se* reduces the resources that are available in the next period to sustain growth. However, equations (5) also show that this effect can be mitigated by adequate increases in management through training; the decrease in innovation activity in period $T - 1$ through a higher production quantity can be more than offset by a similar increase in management resources if $a \geq 1$. In other words, adequately planned growth may allow mitigating the Penrose effect, though this planned growth itself poses another constraint on the total growth possible within a period.

6. Lessons Learned

Penrose's growth theory of the firm serves as an exemplar of engaged scholarship (Van de Ven 2007). In her classic book, she aspires to be both rigorous and relevant by providing "a way of looking at the growth of firms that will be useful for both theoretical and "practical" purposes" (Penrose 1959, p. 2). What makes the product of her research so profound and impactful is her research process. Penrose's research plan and process captured the idea of triangulation (Denzin 1978, Itami and Roehl 1987, Jick 1979) where she gathered data and insights from multiple sources: business histories and biographies of individual businessmen, annual reports of corporations, journal and newspaper reports, interviews with businessmen (1959, p. 3), and a 6-week case study of Hercules Power Company – a firm that redefined itself through successive episodes of growth, diversification, and innovation (Kay 2002). In this inductively collected rich data, Penrose (1960) observed regularities such as managerial talent serving as a key bottleneck for firm growth. While Penrose's learning process is largely influenced by her inductive research, her writing of the theory of firm growth is iteratively inductive, abductive, and deductive.¹⁶ Deductive reasoning is appealing, because it is the language of science where key concepts and assumptions are carefully defined; relationships between constructs are established and explained; and falsifiable predictions are put forward. Abductive and deductive reasoning enable us to develop models, frameworks, and theories that we use to understand and interpret the world in a parsimonious and simplified fashion. This parsimony allows us to deliberate about the phenomenon despite its complexity and our limited cognitive abilities.

Deductive reasoning by itself does not assure that scientists are working on the important problems and their findings have any practical relevance or significance. This is where Penrose delivers exceptionally. In her writing, Penrose combines inductive, abductive, and deductive insights concerning the *theory-in-use* and *logic-in-use* (Argyris and Schon 1978, Kaplan 1964) of managers, and the *rational reconstruction* of the economics and management disciplines (Foss 1999, Langlois 1986). Rich, inductive observations and abductive insights are complemented by disciplined ordering, organizing, and rational reconstruction. A fertile imagination must be balanced by analytical rigor (Beveridge 1957), and creativity and scientific discipline must be joined in order for scientific innovation to become accessible to researchers and further developed (Weick 1989).

Penrose's (1959) theory of firm growth demonstrates the power of joining inductive, abductive, and deductive reasoning. If Penrose relied only on

deductive reasoning, “she was unlikely to have come up with a *new* theory of the firm, since all the existing theories were based on managerial diseconomies as the limit to firm size (Florence 1953)... On the other hand, if Penrose had only used inductive reasoning—if she had not specifically identified her assumptions, variables and interrelationships between variables—she might have ended up by just describing the phenomenon” (Kor and Mahoney 2000, pp. 124–125). Thus, there is some magic in the iterative cycle of inductive, abductive, and deductive reasoning for developing new questions¹⁷ and new theory (Arieti 1976, Mantere and Ketokivi 2013, Van de Ven 2007). Penrose’s research process also highlights that diversity of knowledge, experiences, and interests facilitate the initiation and development of innovative research (Huff 1981, Ladd 1987). Scientific inventions involve creating a new bisociation (Koestler 1964)—i.e., connecting things that are not formerly seen to be connected. Scientific observations, insights, knowledge, and premises can come from different theoretical perspectives (or disciplines) or discovered via different methodologies. This suggests a model of scholarly engagement where one builds an area of expertise (and specialized research skills) but also has some breath of knowledge from other domains. Venturing into other domains and learning/gathering new insights and methods can be fruitful in generating research that is path-breaking.

Finally, for organization and management science researchers, a genuine connection to managerial problems can be an empowering component of scientific discovery. Managers can help us identify the important issues and new research puzzles, and they can also help us see some of the observed regularities. We all have blind spots. Managers are often too busy with daily tasks to systematically reflect on their decisions, actions, and consequences. As researchers, we can also be too immersed and entrenched in our paradigms and theoretical perspectives to take notice of some of the shifts in the world, and reflect on whether our research has anything to contribute to these issues in a relevant way. Focused conversations with managers can keep us be more honest, aware, and attentive, and they can help managers to pause, reflect, and learn. Thus, business schools around the world should give managers (as stakeholders) a seat at their “research tables” to either enable informed basic research (i.e., engaged scholarship; Van de Ven 2007) or even to provide the co-production of knowledge by those inside and outside of academe (see e.g., Bartunek and Louis 1996), who together can provide remarkable (abductive) insights. Likewise, managers should take better advantage of the research efforts at universities as systematic dialogs and exchanges with

researchers can help to address some of their most critical and complex problems.

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Notes

¹We thank Kalyan Singhal for suggesting this agenda for our paper.

²As of April, 30, 2016, Penrose’s (1959) classic has been cited over 24,350 times, according to *Google Scholar*.

³Numerous classics followed an engaged scholarship process including: Ansoff (1965); Chandler (1962); Cyert and March (1963); Nelson and Winter (1982); Penrose (1959), Simon (1945); and Williamson (1975), among others.

⁴Penrose notes that: “Charles H. Wilson’s [1954] *History of Unilever* is a model of what good firm histories can be. I have leaned heavily on this type of work (and there are some others), as well as direct discussions with businessmen, for insight into the processes of firm growth” (1959, p. 3).

⁵Edith Penrose (1914–1996), an American-born British economist and management theorist, received her PhD at Johns Hopkins University in 1951. Penrose held positions at Johns Hopkins University, the Australian National University, Bagdad University, University of London and INSEAD. She published more than one hundred articles and essays that covered an extraordinary range of topics including: (1) international patenting, (2) the theory of the firm, (3) limits on the rate of firm growth, (4) multinational enterprise, (5) the growth of the firm, (6) economic history, (7) the international oil industry, (8) economic development of the Middle East, and (9) developments in Iraq (for further details, see Kor and Mahoney (2000, p. 110) and Christos Pitelis’ (2002) book concerning the legacy of Penrose’s scholarship).

⁶Penrose notes that “a preoccupation with growth does not necessarily conflict with an equal preoccupation with profits. We have assumed that firms are concerned with increasing their total profits over the long period from their own operations. They therefore will invest as much as they profitably can in these operations, for all profitable investment in the firm will increase total profits” (1959, p. 144, footnote 1).

⁷Penrose’s epistemological approach was influenced by her dissertation advisor at Johns Hopkins University, the Austrian economist, Fritz Machlup (Matheson-Connell 2007) -- see e.g., a collection of his essays in Machlup (1967) -- as well as by the Austrian economics of Hayek (1948) and Schumpeter (1934).

⁸Penrose notes that “if resources were completely non-specific, a firm could in principle produce anything. In reality no firm does produce just anything that happens to be in strong demand at any time in the economy” (1959, p. 82). In explaining the extent and nature of diversification and firm growth, “demand is no more important, and

is perhaps less important, than the existing resources of the firm" (1959, p. 84). In fact, "demand from the point of view of the firm is highly subjective—the opinion of the firm's entrepreneurs" (1959, p. 85).

⁹Penrose's (1959) research on diversification strategy and organizational structure was being worked out independently by Chandler (1962) in his classic book, *Strategy and Structure*.

¹⁰Penrose also maintained that: "Under competition, and in the presence of economies of large-scale production and operation, there may be a *minimum* size of firm, but we have rejected the proposition that there is for every firm some *optimum* size beyond which it will run into diseconomies. Only for firms incapable of adapting their managerial structure to the requirements of larger operations can one postulate an optimum size" (1959, p. 98).

¹¹Firms utilize a range of external services and contracting to put an ease on the need for administrative coordination (among others). However, Penrose suggests that "[r]egardless of the extent to which a firm may use managerial and industrial engineering consultants and similar advisory services to improve its organization, to test markets, and to suggest possible avenues of expansion, all advice and proposed plans have to be considered and approved somewhere within the firm's own managerial hierarchy before action is taken" (1959, p. 49). Thus, while some of these external services may help to expedite the preparation for growth or its implementation, it is unlikely to mitigate the burden completely. How much of alleviation these services may provide requires empirical examinations.

¹²Itami and Numagami describe logical compound synthesis in the following way: "Just like chemists synthesize various materials into some chemical compounds that are used in the world, researchers of this approach pick up various theoretical concepts and empirical findings and synthesize them into a plausible logical story. This approach derives its plausibility from the robust coherence among its component stories and reveals logical connections among conceptual constructs" (1992, p. 133).

¹³Of all the resource-based theory articles published in the early 1990s the one that most explicitly built on Penrose (1959) was arguably Mahoney and Pandian (1992), which was highly influenced by Teece (1982).

¹⁴Empirical studies examining the Penrose effect include: Gander (1991); Shane (1996); Shen (1970); Tan (2003); Tan and Mahoney (2005, 2007); and Thompson (1994).

¹⁵Other numerical values chosen for this example are $M_{T-1} = 4$, $Q_{T-1} = 6$, $a = 2$, $b = 1$, $c = 5$, $\alpha = 5$, $\beta = 1$, $\delta = 0.8$.

¹⁶*Induction* is the process by which we move from particulars to generals. In this process, we seek to derive knowledge from empirical experience based on a system of processing sense data. *Deduction* is the process by which we move from generals to particulars. In this process, conclusions are derived based on premises through a system of logic. The pragmatist philosopher, Charles Sanders Peirce (1940) argued that induction and deduction are each incomplete, and pioneered the concept of *abduction* or hypothetical inference. Abduction is a form of inference comprising the generation and selection of a (tentative) hypothesis as to the cause of something observed by

creative insight in the interpretation of data and a coherent resolution of an anomaly. The concept of abduction is further developed in Hanson's (1958) *patterns of discovery*. Van de Ven notes that: "... Hanson [1958] held that a major defect of logical positivism was that it confines attention only to the finished product of scientific theorizing and gives no attention to the process of reasoning whereby laws, hypotheses, and theories receive their tentative first proposal. ... [Hanson 1958] emphasized that theories are not discovered by inductively generalizing from data, but rather are *retroductively* [abductively] inferred hypotheses from conceptually organized data" (2007, p. 46).

¹⁷While the economics profession at the time had considered rationales for the existence and size of the firm—that is, the "nature of the firm" (Coase 1937), Penrose (1959) was concerned more with its (organic) growth—i.e., the "nurture of the firm and its growth process."

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