Article:
Bodrozic, Z orcid.org/0000-0003-1408-1924 and Adler, PS (2018) The Evolution of Management Models: A Neo-Schumpeterian Theory. Administrative Science Quarterly, 63 (1). pp. 85-129. ISSN 0001-8392

https://doi.org/10.1177/0001839217704811

The Evolution of Management Models: A Neo-Schumpeterian Theory

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Manuscript version of article forthcoming in
Administrative Science Quarterly

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2017 version

Abstract

Over the last century and half, US industry has seen the emergence of several different management models, but we still understand little about the factors that drove their evolution. We propose a theory of this evolution based on three nested and interacting processes. First, we identify several successive waves of technological revolution, each of which prompted a corresponding wave of change in the dominant organizational paradigm. Second, nested within these waves, each of these organizational paradigms emerged through two successive cycles—a primary cycle which generated a new management model that obsoleted the prior organizational paradigm, and a secondary cycle which generated another model that mitigated the dysfunctions of the primary cycle's model. Third, nested within each of these cycles, we identify a problem-solving process in which the development of each model passed through four main phases during which various related management concepts competed for dominance.

Keywords: management model, organizational paradigm, technological revolution, neo-Schumpeterian

Acknowledgements:
Eric Abrahamson, Galit Ailon, Steve Barley, Tom Cummings, Yrjö Engeström, Peer Fiss, John-Paul MacDuffie, Reijo Miettinen, Chris Nyland, Carlota Perez, Dan Raff, Jaakko Virkkunen, Sid Winter, as well as Associate Editor Mauro Guillén and three reviewers

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Even in the more advanced industrial economies, it was less than two centuries ago that the internal organization of business enterprises, until then essentially "primordial" and traditionalistic, became the object of deliberate organization design efforts (Pollard, 1965; Coleman, 1993). These design efforts have often been informed by management models—a term we use to refer to the distinct bodies of ideas that offer organizational managers precepts for how best to fulfill their technical and social tasks. The present paper proposes an explanation of the evolution of such models.

The main models are well known. In broad outline, the sequence of their emergence has been: Industrial Betterment, Scientific Management, Human Relations, Strategy-and-Structure, and Quality Management. We extend the history backward in time one further step, to include the Line-and-Staff model developed in the early railway industry, and we extend it to two more recent models—to what we call the "Business Process" model and the Knowledge Management model.

While there are growing bodies of research on the rise and fall of specific models and on the generic dynamics of innovation, fads, and fashions in management models, efforts to explain the longer-term evolution of these models in the history of American management are far sparser. The main contributions—Barley and Kunda (1992), Abrahamson (1997), Kunda and Ailon-Souday (2005)—have been impressive in their scope and creativity; but they leave us with a frustratingly thin account of this historical development.

The limitations of this prior research can be stated succinctly. Barley and Kunda in their various works (Barley and Kunda, 1992; Kunda and Ailon-Souday, 2005) argued that this sequence can be understand as a pendulum swinging between cultural antinomies of "rational" and "normative" approaches reflecting long Kondratiev waves of economic growth. While we find much with which to agree in their account, we will argue that it gives us no way to explain how or why one rational model differs from other rational models, nor how or why the various normative models differ from each other. Abrahamson (1997) enriched Barley and Kunda's account by showing the effects of labor movement activity and labor turnover rates on the post-emergence persistence of these models; he also discussed different factors that have an impact on the timing of the pendulum swings; but he offered no further insight into the models' contents.

We argue that to understand the changing contents of these models beyond their classification as rational versus normative, we need to bring into the foreground the role of technological innovation, rather than leaving this factor in the background as this prior scholarship had done. To do this, we build on recent work in the neo-Schumpeterian tradition of technology studies (as developed by the authors discussed below) and on Bodrožić's (2008) synthesis, and advance a new theory of the evolution of management models. Our theory differentiates three nested processes and show how these processes interact to generate the observed evolution of the models and their contents.

First, we identify four main ***waves*** of change in models, and we suggest that these are driven by corresponding waves of Schumpeterian technological revolution. We argue that the emergence of a technological revolution in leading industries generates radically new organizational and management problems. The solution to these problems takes the form of a new organizational paradigm—a new understanding of the nature of enterprise organization, calling out the distinctive characteristics of the organizational context within which managers perform their duties.

Second, nested within these waves, we distinguish two main ***cycles*** of management innovation, which create in succession two new management models: together these two model form the new organizational paradigm. Initially, a primary cycle, sparked by a technological revolution, yields a management model that represents a revolutionary break with the prevailing organizational paradigm. The unanticipated dysfunctions of that initial, paradigm-revolutionizing model provoke a secondary cycle, which yields a model that aims to overcome the dysfunctions of the paradigm-revolutionizing model and thus stabilize the new paradigm.

And third, within each of these cycles, the development of each model passes through four ***phases*** akin to the phases characterizing the development of a new technology and akin too to the phases of development of a new cultural or social movement. These are: (a) the identification of a widespread organizational and management problem, (b) the creation of innovative managerial concepts that offer various solutions to this problem, (c) the emergence and theorization[1] of a new model from among these concepts, and (d) the dissemination and diffusion of this model. These phases are nonlinear and overlapping.

This theory allows us to overcome the key problem of prior scholarship on the evolution of models and lays a foundation for future research in this area. By linking the emergence of new models to specific underlying technological revolutions more rigorously than did prior scholarship, we can explain major changes in the models' contents. Moreover, by integrating a dialectical account of the cyclical process with a stronger account of the longer-term waves of paradigm change, we can see how apparently competing models—such as Scientific Management versus Human Relations, or Strategy-and-Structure versus Quality Management—are better understood as complementary pairs within a common organizational paradigm. And by unpacking the phases of development of each model, we can identify the different roles played by different actors and management concepts in driving change in the models' contents, and we can discern the agency behind these structural changes.

With a more robust theory of this longer-term evolutionary development, we are better able to understand the causal dynamics of specific historical episodes, and we enhance our capacity to interpret the organizational changes that are currently underway. The present paper therefore aims to contribute, if only in a modest way, to a fuller answer to one of the big questions of our field—"Where do new organizational forms come from?"—a question that to date remains "largely unresolved" (Suddaby and Greenwood,

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1 Strang and Meyer (1993: 492): "By theorization, we mean the self-conscious development and specification of abstract categories and the formulation of patterned relationships such as chains of cause and effect." This might also be called "codification" in the sense of Winter and Szulanski (2001).

2005: 35).

We focus on the USA, because this country was increasingly central in the world economy over the past two centuries and because it served as the main locus of innovation in management models for most of the period. We hope that future research will address the experience in other countries, synthesizing some of the ideas we present here with the internationally oriented research of Guillén (1994) and others.

In the following sections, we first summarize briefly the prior research on management models. We then explain the neo-Schumpeterian foundation of our theory. Building on that foundation, we sketch in narrative form the evolution of management models over the past century and a half. We then re-read this history more theoretically to explicate the three key processes driving this evolution. A discussion section explores the how our account can be applied to make sense of both some recent management concepts and the longer-term trend in management models. The conclusion summarizes and suggests some directions for future research.

PRIOR RESEARCH ON MANAGEMENT MODELS

Distinguishing models, paradigms, concepts

The concept of a ***management model*** has not received much scholarly attention. Prior terminological choices seem to be loose. Management models were referred to as both "rhetorics" and "ideologies" by Barley and Kunda (1992) and Abrahamson (1997). Guillén (1994) called them equivalently "models" and "paradigms." We define a management model as a distinct body of ideas that offers organizational managers precepts for how best to fulfill their technical and social tasks. We have in mind what Kramer (1975: 47) described as "systematically organized knowledge applicable in a relatively wide variety of circumstances" and "a system of assumptions, accepted principles and rules of procedure."

We propose that these models can be considered as the organizational analogues of what the neo-Schumperians scholars of technology call "generic all-pervasive technologies" (Perez, 1994), or "general purpose technologies" (Bresnahan and Trajtenberg, 1995). If, following Griffith (1999: 474), we define technology as the "tools, machines, and/or techniques for instrumental action," then general-purpose technologies can be defined as higher-order families of technologies (such as those pertaining to water power, steam power, electricity, computers) from which lower-order, more specific technological applications derive.

We can thus distinguish the idea of management model from the lower-order construct ***management concept.*** Within a given management model, there are often multiple management concepts, sometimes competing for preeminence, sometimes complementary, but sharing common themes (see Davenport, Prusak, and Wilson, 2003 for a partial list of such concepts). We propose two criteria for differentiating management models from these lower-order management concepts: (a) generality—management models, like general purpose technologies, open up entire new fields of application, relative to the lower-order, more specific implementation concepts; and (b) pervasiveness—management models are applicable in a wider range of industries. Abrahamson and Eisenman (2008) for example, have shown that concepts such as Job Enrichment, Quality

Circles, and Total Quality Management all share some common themes, and that these themes are quite different from those associated with Management by Objective (a concept more common in the prior period) and those related to Business Process Reengineering (which emerged later).

We also propose to differentiate management model and management concept from a higher-order construct—the ***organizational paradigm***. This term has been used in passing by several articles (Djelic and Ainamo, 1999; Höllerer et al., 2014), and receives more in-depth treatment in Simsek and Louis (1994). Adapting Kuhn's (1970) concept of scientific paradigm, we define an organizational paradigm as a set of ideas that characterize the essential features of the enterprise as an organization. While management models specify managers' key tasks, organizational paradigms aim at a more abstract level, articulating an understanding of the organizational context within which managers work.

From specific models to their historical evolution

There is broad agreement on the identity of the main management models, and there is a considerable literature focused on individual models as they emerged in the USA. We list here just a few of the key sources. These and other studies are also convincing in showing that the models under discussion were not only discursive constructs in the management literature, but had wide-ranging impact on management practice.

Railroads and their Line-and-Staff management model were discussed by Chandler (1965, 1977), and Industrial Betterment by Brandes (1976), Jacoby (1985) and Nelson (1975a). Taylor's (1911) Scientific Management, the dominant model during the first half of the 20th century, has been the object of many studies (e.g., Aitken, 1960; Nelson, 1980; Kreis, 1992; Nelson, 1992; Kanigel, 2005; Wren, 2005; Nyland, Bruce, and Burns, 2014). Several studies (e.g., Gillespie, 1991; Wren, 2005; Bruce and Nyland, 2011; Hassard, 2012) analyzed the relationship between the Human Relations model (Roethlisberger and Dickson, 1939) and Scientific Management. General Motors and its multidivisional form inspired the preeminent model of US companies in the second half of the 20th century—Strategy-and-Structure: it has been analyzed by several famous texts (Drucker, 1946; Chandler, 1962; Sloan, 1964). Guillén (1994: Ch. 2) traced the evolution from Scientific Management, to Human Relations, and Strategy-and-Structure. Several studies have analyzed the relationship between this last model and the subsequent emergence of quality and culture concepts in US industry (e.g., Dertouzos, Lester, and Solow, 1989; Womack, Jones, and Roos, 1990; Cole 1999). Several authors have argued that we now live in an age in which internal and external networks are interconnected by IT-supported work and information flows (e.g., Nohria and Eccles, 1992; Castells, 1996): Business Process Reengineering inaugurated what we call the Business Process model that captured some of the potential of these new technologies (Hammer, 1990; Hammer and Champy, 1993). More recently, the focus has shifted to Knowledge Management as a possible alternative model (Nonaka, 1994; Nonaka and Takeuchi, 1995; Prusak, 1997; Davenport and Prusak, 1998; Scarbrough and Swan, 2001; Davenport, Prusak, and Wilson, 2003).

Prior scholarship has not only explored specific models but also made important progress in understanding the evolution of these models. As noted above, for Barley and Kunda (1992), the main factor explaining the content of successive models is the pendulum swing between rational and normative cultural antinomies. Rational models are associated with and supported by surges of rational rhetorics—surges whose subsequent life-cycle resemble the evolution of social movements (e.g., Blumer, 1969; Macionis, 2012)—before being challenged by a normative rhetoric and a surge of normative rhetoric.

Barley and Kunda (1992) argue that the alternation of rational and normative models is driven by long, Kondratiev waves of economic growth, which, at least according to some accounts, are in turn driven by waves of technological revolution (Schumpeter, 1939). Abrahamson (1997: 501-502) elaborates: "In order to innovate and cause long wave upswings, organizations depend on engineers and scientists, and consequently, such individuals ascend to positions of authority in these organizations (Fligstein, 1990). Engineers and scientists need management techniques to fit employees to new technological innovations, and they are receptive to the machine and system metaphors used in rational rhetorics to describe and justify the use of techniques that could serve this purpose." Surges of normative rhetoric, by contrast, occur because "when returns on capital begin to decline, managers should show greater interest in rhetorics that focus on the utilization of labor, industry's second factor of production" (Barley and Kunda, 1992: 391).

This account, rich as it is, leaves us without any explanation for the differences between the ideas expressed in one rational rhetoric and another, or between one normative rhetoric and another. Each model is classified as either rational or normative; but we are left with no way to differentiate any further these models' contents. This is the gap that prompts the question at the heart of the present paper.

Labor process theory grounds a second strand of scholarship on the history of management models; but it offers only a little more texture in its account of these models' contents. The underlying assumption in this scholarship is that, insofar as the employment contract is an incomplete one, the interests of workers and executives are starkly opposed in determining the actual delivery of labor services; and the conflict over work intensity is therefore the main determinant of work organization (Braverman, 1976). Under competitive and profitability pressure, managers develop and adopt new technologies; they respond to workers' struggles over work intensity by developing ever-more refined systems of labor control; and these systems diffuse where workers lack the capacity to resist.

Where Braverman posited a simple contrast between the direct entrepreneurial control that predominated in the 19th century and the family of Scientific Management techniques that proliferated in the 20th century, later work in this stream of scholarship suggested greater complexity. Edwards (1979) saw a shift from direct control to a variable combination of technical control via the assembly line and bureaucratic control based on internal labor markets (the latter emerging in conjunction with the Human Relations model). Barker (1993) interpreted the Quality Management model as a new control system he calls concertive. Burawoy (1985) saw the main sequence going from market despotism (Edwards' direct control), to hegemonic control (Edwards' bureaucratic control), and most recently to a neo-liberal system of "hegemonic despotism."

As noted by Barley and Kunda (1992), for the main part this labor process tradition sees the evolution of management models as following a sequence that can be described in terms of Etzioni's (1961) typology of control, going from coercive to utilitarian to normative forms of control. Others have sought to nuance this rather linear view. Littler (1982) highlighted the importance in the 19th century of internal contracting as an alternative to direct control. Friedman (1977) argued that a strategy of "responsible autonomy" was an enduring alternative to direct managerial control and Scientific Management. Jacoby (1985) made a similar argument with respect to the "welfarist" tradition of non-union employment relations. From this literature, we take on board the idea that struggle over work intensity influences forms of work organization and models of management; but these studies on labor control offer little further insight into the evolution over time in the content of the successive models.

A NEO-SCHUMPETERIAN FOUNDATION

We argue that technology is a powerful factor shaping the evolution of these management models' contents. Our argument builds on and extends Chandler's historical research (Chandler 1962, 1965, 1977, 1990). Chandler showed how radical technological innovation (most notably, the steam-powered railways) provided the impetus for organizational and management innovation (e.g., Daniel McCollum's contribution to the Line-and-Staff model), and described how this organizational and management innovation, in turn, stimulated the growth of the innovators' firms (e.g., the Erie Railroad). These exemplary firms, in turn, contributed to the growth and shaping of new leading industries, and such industries contributed to transforming the entire economy and society of the US (Chandler, 1977). Chandler, however, did not develop an explicit theory of these causal connections (as noted inter alia by Nelson and Teece, 2010): such a theory is our goal here.

In pursuing this goal, we propose to bring forward to center-stage Schumpeter's (1934) analysis of technological revolutions. Schumpeter's analysis has been invoked sometimes by the scholarship we reviewed in the previous section, but always only as a background factor. In bringing his analysis forward, we shift the focus from long Kondratiev cycles of economic growth to one of these cycles' main antecedents. In this move, we are following the path traced by a more recent neo-Schumpeterian generation, most notably Freeman (Freeman, 1994; Freeman and Soete, 1997; Freeman and Louçã, 2001; Freeman, 2008) and Perez (2002, 2007, 2010) (see also Murmann (2003, 2013), Nelson and Winter (1982) and Winter and Szulanski (2001)).[2]

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2 It is worth quoting Perez (2010: 190) at greater length on this shift in focus: "It should be noted that this concept of great surges represents a break with both Kondratiev's and Schumpeter's notion of long waves (Kondratiev, 1935; Schumpeter, 1939). For them, the focus is on the upswings and downswings in economic growth. Although Schumpeter clearly ascribes such waves to technological revolutions while Kondratiev does not commit himself to any particular causal factor, they are both trying to explain long-term variations in gross domestic product (GDP) and other economic aggregates. What this author proposed (Perez, 2002: 60-67, 2007: 783–786) was to focus instead on explaining the process of diffusion of each technological revolution and on its transformative effects on all aspects of the economy and society, including among them the impact on rhythms of economic growth. This re-orientation has resulted in a different dating of the surges (as opposed to those of the traditional long waves) and in identifying a different set of regularities in the patterns of diffusion, which are the object of the discussion that follows." For an overview of evolutionary economics that situates Perez alongside Schumpeter as well as other long-wave theorists, work on systems of innovation,

We make this conceptual move aware that it involves several tradeoffs: they are all aspects of the choice we have made in favor of generality over simplicity and even more so over accuracy (using the classic trilemma articulated by Thorngate, 1976; see also Weick, 1999). First, when we shift the focus from macro-economic conditions to their technological antecedents, we substitute for a relatively simple, quantitative construct (such as GDP growth rate) one that is far more complex, multidimensional, and difficult to measure. Second, while this move promises greater insight into some aspects of the evolution of management models, it will inevitably downplay the role of the contingencies of history such as wars or legislation. Third, we do not attempt to take the next step further back in the causal chain, where the interplay of science, technology, politics, and culture would explain the content and timing of technological revolutions themselves. We should also note that we will focus on the emergence of new management models, and as a result, we pay less attention to their persistence or the subsequent emergence of related management concepts in the later phases of a model's life.

Technological revolutions are based on general purpose technologies. The appearance of such technologies portend massive changes in the entire industrial landscape. According to the neo-Schumpeterians, technological revolutions generate a "cluster" (reprising the term used by Schumpeter (1939: 167)) of inter-related revolutionary products, production processes, and infrastructure (e.g., highways for automobiles, telecommunication and internet for microprocessors), giving rise first to new core industries and then diffusing to older industries. Table 1 summarizes Perez's chronology of these revolutions. We should note that the US took the lead in the last three, whereas in the first two, the UK was the locus of the original technological breakthroughs.

--- Table 1: Timeline of technological revolutions ---

The effective utilization of the revolutionary new technologies in the new core industries and their diffusion to older industries require change at both the broader institutional level and the firm level. Given this paper's motivating question, we focus on the latter. At the firm level, the uptake of the new technologies is accelerated by the emergence and adoption of a new techno-economic paradigm, that is, "a best practice model for the most effective use of the new technologies within and beyond the new industries" (Perez, 2010: 185). Prior work by Perez (2002) and Freeman (2008) sketched some of the key technological and economic elements of these paradigms, but had little to say about the properly organizational and managerial elements. Our premise in the present paper is that this neo-Schumpeterian framework provides an effective scaffolding within which to build a robust account of the evolution of management models.

Neo-Schumpeterians divide the life-cycle of these technological revolutions into distinct periods (Perez, 2002). Let us review these periods briefly.

First, before the developmental potential of new technological breakthroughs is

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Nelson and Winter (1982), and other strands, see Fagerberg (2003). For a parallel periodization of long waves along with critical commentary on Perez's theory, see Tylecote (1992). See Silverberg (2007) for a skeptical review of efforts to interpret these waves as cycles with any necessary periodicity. Perez's (2002, 2010) account has the merit of not requiring any strong theory about the linkage between techno-economic paradigms and macro-economic waves, nor any strong theory about the timing of revolutions themselves.

broadly recognized as such, each technological revolution goes through a ***gestation*** period, during which the future core technologies emerge and evolve. This period is highly variable in duration.[3]

At some point, the ***installation*** period begins, during which new industries and a new facilitating infrastructure begin to take shape around the most successful of the new technologies. (The beginning and duration of this period is affected by technological, economic, and social circumstances.) Radical innovations are embodied in successful exemplary products, which spark the imagination of entrepreneurs and draws attention from investors—for example, Ford's model T in the 1910s, and Intel's microprocessor in the 1970s. Corresponding new process and infrastructure technologies emerge and cohere around new core industries. A new techno-economic paradigm begins to emerge.

The full exploitation of the technological revolution's developmental potential across the rest of the economy is, however, limited, because the context—both the broader political-economic institutional structures of society, and the dominant economic, organizational, and management practices of firms—was formed in the prior wave under the impact of the previous technological revolution, and this context is ill-suited to the new technologies.[4] This tension eventually provokes institutional and organizational change, which opens the way for the ***deployment*** period. Here, guided by the new techno-economic paradigm, the revolution diffuses beyond the lead industries into the older, previously established industries. This diffusion is, of course, uneven: some industries and firms adopt the new paradigm and are thoroughly revolutionized in both their technologies and their organizational forms—these industries experience "de-maturity" (Abernathy, Clark, and Kantrow, 1983)—while others may find a niche for themselves in the new order, proceeding unchanged or adapting and implementing only elements of the new paradigm.

Finally, the revolution enters a period of ***exhaustion****.* The paradigm can no longer drive productivity or stimulate innovation and growth because the developmental potential of the new technologies is largely fulfilled and innovations show an increasingly incremental character (for the distinction between radical and incremental innovation see Abernathy and Utterback, 1978; Dosi, 1982). Where, for example, the automobile revolution gave us the combustion-engine-powered vehicle in the late nineteenth and early

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3 This makes it difficult to select a clear start-date for each revolution. As a result, several neo-Schumpeterian studies (e.g., Freeman and Perez, 1988; Tylecote, 1992) refer to a starting period rather than a specific year.

4 Perez (2002, 2007, 2010) argued that during the installation period, while the rest of the economy still cannot absorb the new techno-economic paradigm, enthusiasm prevails within the new core industries. As a result, she argues, on the one hand, investors crowd into the leading industries to fund the exciting new opportunities, and any existing regulatory constraints are deliberately weakened to encourage more investments. The result is typically a financial bubble—whence the "canal mania" of 1790s, the "railroad mania" of the 1840s and early 1850s, the "roaring 1920s," and the "Internet bubble" of the 1990s and 2000s. The installation period thus typically culminates in a major financial and socio-economic crisis, which also represents an inflexion point in the wave of paradigm change. After the crisis is resolved, we see a return to economic stability and macro-economic growth, the re-regulation and re-stabilization of the financial markets, and the paradigm moves into the deployment phase, reaching across the broader industrial landscape.

twentieth century, later in the twentieth century it offered incremental refinements such as air conditioning or automatic transmission. It is this exhaustion of a revolution that, according to the neo-Schumpeterians (for example Perez 2007, 2010), energizes technological innovation efforts in new directions.

A PRELIMINARY HISTORICAL SKETCH

Taking this account of technological revolutions as our starting point, this section traces the corresponding shifts in organizational paradigms, management models, and management concepts. The following paragraphs offer a compressed, historically-informed narrative for each major wave of technological revolution, and situate the major management models within them: Table 2 summarizes. This narrative provides the empirical foundation for the theorization we propose in the subsequent section.

--- Table 2: Revolutions, paradigms, models, concepts ---

The water power and iron revolution

We begin with the technological revolution based on water power and iron, which was incubated during the 1750s, took off in the 1770s, and had exhausted itself by the 1840s. This was the initial revolution that launched the entire period known as the "industrial revolution," and it predated the historical emergence of deliberate organization change efforts.

The British engineer John Smeaton was a key player in this revolution, improving the design and efficiency of water wheels by using iron instead of wood. He also acted as a consulting engineer for large iron producers who used water as a power source (Freeman and Louçã, 2001). Smeaton focused exclusively on the technological challenges of this new paradigm. In contrast, his contemporary, British engineer and pottery entrepreneur Josiah Wedgwood, was an innovator not only in technology but also in management, being one of the first industrialists to give sustained attention to the organizational form of enterprises (Pollard, 1965; Langton, 1984).

Wedgwood established some of the first principles of factory organization, most notably in moving from a craft form of organization to extensive task specialization so as to ensure efficiency and quality for large batch production (Langton, 1984; Freeman and Soete, 1997; Freeman and Louçã, 2001). He was guided by a machine metaphor—"to make such machines of the Men as cannot err" (quoted in Freeman and Louçã (2001: 169)). Wedgwood's ideas, however, diffused very little across industry. One impediment to diffusion was the locational dependence of water-power-based production on streams and local topography (Rosenberg and Trajtenberg, 2004; Seidel, 1976). This dependence kept owner-inventors' development and optimization efforts focused on technical, environmental and local political challenges rather than organization principles. The great majority of owner-inventors relied on their own intuitions in organizing their business and on traditionalistic models of craft. As a result, no widely-shared professional management model was established in the UK during this revolution (Pollard, 1965; see also Landes (2003: 337) on the "amateurism and complacency" of British entrepreneurs in this period). In the US, the situation was similar: while some more self-reflective approaches to management and organization could be found in the plantations, water-powered textile industry, and armories, such examples had little impact on other industries (Chandler, 1972, 1977).

The steam power and railways revolution

The steam-power and railways revolution spanned the 1790s through 1890s. In its first decades, the British inventor James Watt was a key actor. Watt created an effective and widely applicable power source by developing a fuel-efficient and profitable model of steam engine (Seidel, 1976; Nuvolari, 2004). Together with the entrepreneur Matthew Boulton, Watt started a small technical consulting business, which marketed his patent-protected engine and sold it to Cornish copper and tin mine entrepreneurs (Seidel, 1976). After the expiration of Watt's patent, Cornish mine entrepreneurs established a network among themselves, and used a monthly journal to exchange knowledge. This triggered a stream of innovations improving the efficiency of steam engines in their mines (Nuvolari, 2004). Watt and the people around him, like Smeaton before them, focused mainly on technology, and this period, like the preceding one, yielded no widely-shared management model.

American entrepreneurs were initially much slower in deploying steam engine technology than their British counterparts. From the late 1820s onwards, however, the availability of inexpensive anthracite coal and iron permitted the far more rapid adoption of steam engine technology in the US (Chandler, 1972). Nowhere was the US catch-up and overtaking more visible than in the vast expansion of the US railway industry in the mid-19th century, creating and utilizing the infrastructure for moving goods and people between the West and East of the USA (Chandler, 1977, 1990).

The use of steam power in railway locomotives brought organizational and managerial issues into the limelight. The steam locomotive provided fast, regular, and dependable transportation and lowered radically the unit cost of moving goods, especially where locomotives could run on geographically expansive railroad networks. The railroads received a powerful assist from the telegraph, which provided fast and dependable long-distance transmission of information. However, full utilization of the new technologies was limited by the absence of a management model that would enable firms to cope with the size and complexity of single-track networks. Lacking such a model, railways experienced diseconomies of scale and major train accidents (Chandler, 1965, 1977).

The main actors involved in solving this organizational and managerial problem were civil engineers such as Benjamin Latrobe (at the Baltimore and Ohio Railroad), Daniel McCollum (at the Erie Railroad) and J. Edgar Thomson (at the Pennsylvania Railroad) (Ward, 1975; Chandler 1977). These civil engineers became examples of a "new type of businessman" (Chandler 1977: 95)—the salaried manager who advanced to the highest leadership positions without the benefits of ownership or family ties to the owner. To deal with the scale and complexity of the railways, and a resulting need for coordination, these professional managers developed new organizational and operational principles, specifically a structure in which divisional "superintendents" operated with considerable autonomy from headquarters staff, as well as an organizational chart to illustrate more clearly the relations of authority and communication between these managers (Chandler, 1965, 1977). These innovations were integrated in what we call the "Line-and-Staff" model.

As Chandler notes (1977: 105), earlier texts on the management of large-scale enterprises focused entirely on the control of workers; with the railways, we see the first model of the control of line managers by a corporate staff down through several layers of management. This model encompassed and synthesized several more specific management concepts regarding financial, capital, and cost accounting, functional differentiation, and clear principles of delegation and reporting (Chandler, 1977). The new management model gave initial expression to a new paradigm of organization, one that differed qualitatively from the prevailing traditionalistic paradigm which was based on a combination of owner-entrepreneur, family enterprise, and craftsman-apprentice. We call this new organizational paradigm the "Professionally-managed firm."

The new management model and the organizational paradigm that it inaugurated emerged in large companies such as the Erie Railroad for which the need for professional managers was particularly pronounced, and then diffused across the railroad industry. Driven by the challenge of coordinating rail operations among the distinct companies spanning the USA, middle managers from these companies cooperated in developing new technical and operating standards, and the model diffused via numerous meetings, industry magazines, and books, becoming standard practice by the 1870s. A key part of the new model was codified and diffused in the form of an organizational chart for the management of railway companies that was developed by Daniel McCollum (Chandler, 1977; Yates, 1989). The business editor Henry Poor published and popularized McCallum's organizational innovation in his *American Railroad Journal*, selling copies of the organizational chart (Chandler, 1956, 1965, 1977). Railroad Managers often moved to other industries and brought the model with them. Andrew Carnegie, for example, was a former manager at the Pennsylvania Railroad, with Thomson as a mentor, before he applied the Line-and-Staff model to the steel industry and became one of its leading figures (Wren and Greenwood, 1998).

The professionalization of management was one of the factors that enabled the US railway companies to become the largest business enterprises in the world (Chandler, 1977), and led to high profits and vast power for its stockholders and managers (Ward, 1975), but also to a "growing gap between the management and the worker" (Nelson, 1995: 121). Management paid scant attention to employees' working and living conditions (Tolman, 1909; Kaufman, 2008). When railroad mania years were followed by years of crisis when workers' salaries were reduced even while stockholders' dividends remained high (Ward, 1975), violent strikes erupted. Two of the most prominent were the one at the Erie Railroad in 1857 (Wren and Greenwood, 1998) and the Great Railroad Strike of 1877 (Kaufman, 2008).

Shaken by theses disruptions, some railway shareholders and railroad executives such as the railway magnate Cornelius Vanderbuilt sought ways to avoid future outbreaks. They initiated efforts in what was later called "industrial betterment" or "welfare work" (Rudin, 1972; Brandes, 1976). In the last three decades of the 19th century, these efforts gave rise to the creation of numerous Young Men's Christian Association (YMCA) centers at major railroad stations across the country, offering railroad workers food, shelter, baths, libraries, athletic facilities, classes on railroad work, bible classes and religious meetings. "The underlying theory was that well-housed, well-fed, clean, properly educated Christians do not strike" (Brandes, 1976: 15). By 1890, Industrial Betterment programs had been adopted in several other industries (Brandes, 1976).

If the Line-and-Staff model inaugurated a revolution in the dominant organizational paradigm, these Industrial Betterment programs represented an effort to stabilize the new paradigm—aiming not to undo the Line-and-Staff model, but rather to mitigate its lack of attention for employees' working and living conditions (Tolman, 1909). The main actors involved in developing this paradigm-balancing model were the new "welfare secretaries" (Brandes, 1976; Kaufman, 2008). The creation of the function of welfare secretary can be seen as a social counterpart to the technical- and business-oriented function of the professional manager. As staff members, welfare secretaries were incorporated into the Line-and-Staff model. In some firms, their focus was entirely on the workers' lives outside work—a form of social work; in other firms, they played roles that prefigured those of the later generation of personnel managers (Tolman, 1909; Kaufman, 2008).

Three organizations were particularly significant in delineating the function of welfare secretary and the practice of welfare work and in diffusing them across different industries: the YMCA, the National Civic Federation, and Josiah Strong's and William Tolman's New York City based Institute of Social Service (Kaufman, 2008). These organizations educated welfare secretaries, sponsored conferences, published "success stories," and gave consulting advice to clients. The function of welfare secretary would evolve and become one of the starting points of personnel management and Human resource management, thereby having a lasting and pervasive impact on management (Kaufman, 2008).

The steel and electric power revolution

Before about 1860, steel was expensive, its use reserved mainly for tools, luxury cutlery, and swords. The steel and electric power revolution (approx. 1850s–1940s) begins with the replacement of the traditional crucible process of steel-making by the Bessemer and open-heath processes, which allowed for much larger volumes at much lower costs. Demand exploded, since steel is characterized by a significantly higher tensile and compression strength than iron and is therefore the superior material for many applications. Steel became the material of choice for railroads, bridges, city infrastructures, buildings, and military equipment. The effectiveness of machine tools was often considerably improved by incorporating steel materials and tools, which allowed them to operate at much higher speeds even under steam power. Electric power for such machine tools and other production equipment soon allowed equipment to be used far more effectively and factories to be laid out far more efficiently, no longer constrained by the central location of a steam-power generator (Devine, 1983). The arrival of a more efficient factory organization allowed a qualitative jump in productivity (David, 1990; on this revolution, see also Devine, 1983; Freeman and Louçã, 2001; Perez, 2002.)

It was during the installation period of this revolution that the organizational challenges posed by new technologies became the focus of sustained attention. Effective exploitation of the new technologies was initially limited by industry's widespread reliance on craft-like variants of traditionalistic management (Aitken, 1960; Nelson, 1980). Factory operations were typically led by multiple, independent internal-contractors, each of whom hired and managed their own crews (often from their extended family), contracted with the owners to supply a given amount of output for a given price, and relied on their own traditional methods to achieve that output. Thus, the typical factory functioned as "a loosely organized cluster of operations" characterized by "chaotic conditions" (Nelson, 1995: 35; see also Litterer, 1963).The dramatic growth in demand for steel enabled by the new technologies threw into sharp relief the need for more scientific planning of workstation operations, of workflows between workstations, and of machine and tool maintenance (Freeman and Louca, 2001: 232-236; for an instructive example of the interrelation between technological and organizational innovations see Aitken, 1960: 102-3;). The prior Professionally-managed firm paradigm had formalized the functions of management, but that paradigm and its associated Line-and-Staff and Industrial Betterment models did not offer an answer to this new type of problem.

In the last decades of the 19th century, Taylor was one of the key figures among the emerging community of mechanical engineers and engineering consultants who identified and addressed this problem, and who suggested various new management concepts as solutions (Aitken, 1960; Nelson, 1980, 1992; Guillén, 1994; Nadworny, 1957). From the competition and cooperation among these actors, Taylor eventually emerged as preeminent. Taylor attacked the underlying problem both technologically and organizationally. Through an unprecedented program of systematic engineering experimentation, he discovered a new way of tempering steel (for which he received a famous patent, albeit later rescinded), and invented a new high-speed cutting tool that used this steel to increase the machine-tool's speed from 90 to 250 revolutions per minute (Kanigel, 2005). The same spirit of systematic experimentation guided his organizational innovation efforts, resulting in time-and-motion studies, new principles in plant layout, and rationalized incentive payments (Nelson, 1975b).

The new Scientific Management model inaugurated the Factory as a new organizational paradigm based on the exemplars of Midvale Steel and Bethlehem Steel (Nelson, 1980). This new paradigm was characterized by the unitary, centralized organization structure with a workflow designed to optimize and accelerate production across an interdependent set of operations—a radical shift in focus from that of the prior paradigm on the rational design of the management superstructure.[5]

Taylor subsequently disseminated Scientific Management through his books (Taylor, 1911), lectures, and consulting for companies. After the failure of his efforts to mobilize the American Society of Mechanical Engineers (ASME) for the diffusion of this new approach, Taylor brought together a community of like-minded reformers (e.g., Carl Barth, Morris L. Cooke, Henry Gantt, and Frank Gilbreth) in the Society to Promote the Science of Management (renamed the Taylor Society after Taylor's death in 1915), which established itself as an important forum for discussion and publication of more specific management concepts and tools for efficiency-oriented consulting (Aitken, 1960; Kaufman, 2008). Scientific Management was also given a major boost by the World War One efforts at industrial planning (Bruce, 1995).

Taylor worked mainly in companies associated with the core new industries of this technological revolution (e.g., Midvale Steel Company, Bethlehem Iron Company). In these

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[5] We should clarify our use of the term "paradigm." Obviously, many factories that applied Scientific Management ideas were professionally managed. Our differentiation of the Factory and Professionally-managed firm as distinct paradigms does not mean to imply that they are mutually exclusive, any more than Einsteinian physics obviates the value of Newtonian physics. These organizational paradigms simply bring different features of the enterprise into the foreground.

core industries, the dominant organizational and management problem—how to accelerate operations beyond what was possible under the traditionalistic craft form of work organization—emerged earlier than in other industries. It was the historical novelty of the motivating problem that explains the need for time-consuming experiments in Taylor's early organization change efforts at Midvale Steel Company. Taylor's version of the Scientific Management solution preserved something of this spirit of experimentation and exploration: his work as a change-agent typically involved lengthy phases of analysis and experimentation, and he was hostile to those who sought to distill Scientific Management into a set of standardized solutions (as evidenced by his recommendations to the consultants working at the Watertown Arsenal: see Aitken, 1960).

This type of organization change process, however, severely limited the speed and extent of diffusion of Scientific Management. The new model's diffusion was greatly accelerated by larger consultancies such as Charles Bedaux's (Nelson, 1995). Bedaux was born 30 years after Taylor. He became part of the wider Scientific Management network in the early 1910s. By then, the economic crisis of the 1890s had been resolved, socio-economic circumstances had stabilized, and the macro-economic conditions for a broad diffusion of Scientific Management were more favorable. The dominant organizational and management problem was defined more narrowly (as the "efficiency problem") and Scientific Management was accepted as the solution to it (Nelson, 1992). The number of companies that asked for external help in implementing the first new management model of this age was much higher than in the age of the railways (Nelson, 1995), which led to the birth of the consultancy industry, with the Bedaux consultancy as its first leading company (Kreis, 1992; Kipping, 2002). In contrast to Taylor, Bedaux did not undertake a search for a new model of management, but instead applied a very simplified variant of Scientific Management methodology that led to relatively quick results. It focused on time studies to identify bottlenecks and set production standards, and installed an incentive wage system that pressured workers for greater output (Nelson, 1995). Some of the other Scientific Management consultants, such as Harrington Emerson, employed approaches that were more faithful to Taylor's approach; but all of them confronted the need to simplify in order to grow their businesses profitably. Bedaux and his employees used their approach for a large number of clients from a wide circle of industries (and later in different countries) (Guillén, 1994). The difference between Taylor and Bedaux exemplifies the early phase of a deepening division of labor within the overall network of actors involved in the development and diffusion of new management models: between (a) the innovator-theorist (in this case, Taylor), and (b) larger consultancies (such as Bedaux) which focus on dissemination in order to grow their businesses.

The wider application of Scientific Management frequently had dysfunctional side-effects, particularly in the form of high turnover and low morale of workers (e.g., Lewin, 1920; Gillespie, 1991) and vociferous (although not unanimous) union opposition (see Aitkin, 1960; Jacoby, 1983a). Many of Taylor's disciples argued that Scientific Management was not hostile to workers or unions (Nyland, 1998); but it was often implemented in ways workers resented and resisted (Bendix, 1956: 274-287; Aitkin, 1960).

The source of this strife was different from that experienced by the railroads in the previous period. The earlier Line-and-Staff model had focused on the management structure rather than on workers' tasks; the labor troubles that ensued were taken to be due to management's ignorance of the deterioration of workers' living and working conditions; and the Industrial Betterment remedy was primarily to add a social function among the staff responsible for improving the quality of workers' lives. By contrast, the Scientific Management model aimed directly at the wage-effort bargain; and the ensuing strife was fueled by workers' reactions to management's efforts to take control over how and how fast workers would execute those tasks.

From among the various management concepts that developed in response to these problems, Elton Mayo's and Fritz Roethlisberger's version of Human Relations emerged as the dominant model.[6] The main actors involved in Human Relations were social scientists and personnel managers (see Guillén, 1994).[7] In the 1920s and early 1930s, social scientists Mayo and Roethlisberger developed and conceptualized personnel counseling as a remedy to Scientific Management's dysfunctions at the Hawthorne factory of Western Electric (supported and promoted by Western Electric's personnel managers such as William J. Dickson). Here, supervisors attempted to influence individual workers' attitudes so as to (re-)create greater harmony and sense of community within the company (Roethlisberger and Dickson, 1939; Bendix, 1956: 308-319; Gillespie, 1991). With this, Human Relation theorists sought to counter-balance what they saw as the alienating effects of Scientific Management's time-and-motion regimentation and incentive payment systems.

Both the Scientific Management and Human Relations models eventually diffused widely across US industry, aided considerably by the Training Within Industry (TWI) program conducted during World War Two (War Manpower Commission, 1945; Gillespie, 1991; Robinson and Schroeder, 1993; Breen, 2002). TWI was a government-subsidized, non-profit network that trained supervisors from over 16,000 plants all over the USA, having a major impact on the rapid expansion of US industry during World War Two. It brought together several actors and organizations (among others, Scientific Management experts such as Clifton H. Cox, personnel managers, researchers on Human Relations such

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6 In parallel with Mayo's and Roethlisberger's Human Relations approach, the researcher Kurt Lewin created a distinctive set of concepts to deal with the dysfunctional side-effects of Scientific Management. Lewin's approach relied on action research and group dynamic concepts that he and his colleagues developed. His Research Center for Group Dynamics was financed by government and other non-profit sources. Here, the focus was on as-yet unresolved problems (see Lewin, 1944; Marrow, 1969). It was only later that students of Lewin such as Lippitt, Benne, and Bradford developed a more scalable tool, in the form of group dynamics training. Their home base was the National Training Laboratories (NTL), which undertook less research than Lewin's Center and focused instead on training for a larger number of clients (see Cummings and Worley, 2009). Many actors in Lewin's Human Relations network later contributed to the Organization Development movement (see e.g., Cummings and Worley, 2009), which was subsequently connected to work on ''Learning Organizations" (Argyris and Schön, 1978) and ''Organizational Culture" (Schein, 1985). Organization Development constituted a far-flung network of change agents working primarily in paradigm-balancing problem-solving efforts (see Cooke and Cox, 2005).

7 The 1930s saw a surge in the creation of personnel departments, often evolving out of welfare departments (Kaufman, 2008). They deployed personnel counseling alongside a broader set of concepts required to sustain what later came to be called "internal labor markets" (Jacoby, 1983b), such as centralized personal administration, job analysis, and promotion ladders.

as Roethlisberger, union and company representatives), with the aim of rationalizing US industry to assure wartime production. It is particularly telling for our account that TWI did not treat Human Relations as incompatible with Scientific Management. On the contrary, TWI deliberately sought to integrate the two approaches and facilitated their respective tools' adoption with standardized training programs and materials. TWI's "Job Methods" module was based on Scientific Management, and the "Job Relations" module was a simplified and codified version of the Human Relations personnel counseling method. A second strand of explicit synthesis was proposed by the sociotechnical system approach which started as an attempt of integrating "technical" Scientific Management and "social" Human Relations (see Trist and Bamforth, 1951; Emery and Trist, 1969; Cummings, 1978).

Notwithstanding some rhetorical gestures suggesting a more radical goal, and notwithstanding the declared hostility of some Human Relations advocates to Scientific Management, the Human Relations model did not have the effect of displacing Scientific Management, but rather helped to accommodate workers to the new organizational paradigm inaugurated by the Scientific Management model (see Mayo, 1924). Industrialists such as John D. Rockefeller, Jr exerted significant influence in Mayo's Human Relations network and strongly supported this role for Human Relations (O'Conner, 1999; Bruce and Nyland, 2011; Hassard, 2012). In this sense, Human Relations was what we call a paradigm-balancing model rather than a paradigm-revolutionizing one. Where Scientific Management represented an effort to adjust the organization to a radical technological change—reestablishing what organization theorists call environmental, or external fit—Human Relations represented an effort to realign the elements of organization to better fit each other—reestablishing internal fit (using the distinction made by Miller, 1992).

The automobile and oil revolution

The subsequent wave of technological revolution (approx. 1880s–1980s) introduced the automobile powered by internal combustion engine; the development of assembly-line technology in that automobile industry (famously associated with Ford's Model T) and then in others; the use of oil as a core input; the resulting explosion in demand for automobiles by both industry and households; and the creation of networks of highways as part of the new transport infrastructure (Perez, 2002).[8] However, this generalization of mass production and mass consumption was out of sync with the inherited context at both the macro-societal and organizational levels, so it led to

8 Two points of clarification are pertinent here. First, this revolution also saw a generalization of the use of electricity. Electricity is an example of a general-purpose technology that was, in different forms, important in several successive technological revolutions—electricity for powering machine tools and other factory equipment; then for automobiles, cities, and homes; and finally for microelectronics for computers. Second, the final period of the steel and electric power revolution (approx. 1918s–1940s) and the installation period of the automobile and oil revolution (approx. 1908–1929) overlapped, just as later the final period of the automobile and oil revolution overlaps with the installation period of the computer and telecommunications revolution. As a result, Human Relations and Strategy-and-Structure also overlapped. This is another reason we need to go beyond Barley and Kunda's (1992) pendulum model: Strategy-and-Structure emerged at the same time as Human Relations—not in response to it, but in response to a whole different set of problems.

increasing market instability in the 1920s and 1930s (see Fligstein, 1990). The unitary functional organization structure of the paradigm we called the Factory, with its inherited orientation toward single product lines, could not respond effectively to the growing diversity of expanding consumer needs. Firms needed a more flexible and more market-focused organizational form, one that was geared towards changing markets, rapid product development, and manufacturing and marketing on an increasingly global scale.

The main actors involved in developing this new management model were managers, management theorists, and management consultants associated with the automobile industry and other industries in the core of this technological revolution (see Guillén, 1994). Managers such as Alfred Sloan at General Motors recognized the inadequacy of the inherited organizational paradigm, and they searched for solutions within their companies. Sloan's search for a solution was based on the expectation that the diffusion of automobiles was “creating a new transportation system” (Sloan, 1964: 43), one that would involve many more, and more diverse, consumers. His solution, developed in the 1920s, was a radically new management model in which differentiated market segments would be assigned to distinct, more or less self-contained, business divisions—the Strategy-and-structure model. This management model allowed General Motors to pursue a strategy of product differentiation (“a car for every purse and purpose” (Sloan, 1964: 438)) and shared parts, and thereby to overtake Ford as the preeminent firm in the automobile industry (Chandler, 1962). It also inaugurated a new organizational paradigm: the multi-divisional Corporation replaced the unitary Factory as the paradigmatic frame of reference.

The diffusion of this model across the new core industries helped to unleash rapid productivity increases and contributed to the dynamism of the “roaring 1920s;” but the institutional framework was out of sync with these dynamics and (with several other factors contributing too) the Great Depression ensued (Perez, 2002). While Sloan’s organizational innovation occurred before the Great Depression, it was only after the radical institutional reforms of the New Deal and World War II and after the stabilization of the post-war macro-economic context that the Strategy-and-Structure model, with General Motors as a paradigmatic exemplar, could diffuse beyond the core industries.

The management theorist Peter Drucker (1946) was among the first to generalize and elaborate the innovative solution developed at General Motors, articulating and theorizing its core concepts. It is indicative of the gap between innovator and theorist that within GM itself Drucker’s theorization was criticized as a misleading oversimplification (see Sloan, 1964). Drucker helped to disseminate this Strategy-and-Structure model through publications and through his practice as an individual consultant. He also led training sessions for junior consultants of McKinsey in the late 1940s and early 1950s (Edersheim, 2004). Like Taylor, however, Drucker saw organization change as an exploratory process (Drucker, 1954), and this type of practice yielded only slow diffusion.

Management consultancies took up the challenge of further codifying the new model, and firms such as McKinsey eventually came to dominate its diffusion (Kipping, 2002; McKenna, 2006). Treating the underlying organizational and management problem as basically resolved by these solutions, these consultancies shifted from the innovation orientation of Sloan and Drucker to a diffusion orientation, disseminating the results of the prior innovation and theorization efforts in the form of best-practice templates to a large number of corporations that faced similar problems. McKinsey’s main intervention tools were the General Survey Outline and a growing store of best-practice exemplars. The consultancy recruited new employees from prestigious business schools, developed an elaborate internal hierarchy of consultants, and cultivated a network of repeat-business clients. This system enabled the multiplication of interventions with clients in many industries and, increasingly over time, in many countries (Bhide, 1996; Edersheim, 2004).

The development and diffusion of the new management model involved a division of labor between (a) the problem articulator and innovator (Sloan), who contributed to the creation of a solution for the dominant problem, (b) the guru-theorist (Drucker), who contributed to the theorization of this solution and transforming it thereby into a management tool, and (c) larger consultancies (e.g., McKinsey), which further simplified this tool in order to grow their businesses.

For a long period, the Strategy-and-Structure model, enhanced by management concepts such as Operations Research, "marched from victory to victory" (Womack, Jones, and Roos, 1990: 43), and the success of US companies in the world market distracted enthusiastic proponents of the model from its dysfunctional aspects (Dertouzos, Lester, and Solow, 1989; Womack, Jones, and Roos, 1990). Despite the development of management concepts such as matrix management, and despite efforts to match organizational structure to "contingency factors" (Burns and Stalker, 1961; Woodward 1965; Lawrence and Lorsch, 1967), these dysfunctions lead to poor quality and service, low worker involvement, and lack of cooperation and political gamesmanship within the management ranks. When global competition intensified as Japan and Germany rebuilt after World War Two and reasserted their industrial strength in the 1970s and 1980s, it was no longer possible to ignore these problems (see Dertouzos, Lester, and Solow, 1989).

In this new context, different and partially intertwined problem-solving efforts emerged, each addressing one or more of these dysfunctions. Alongside management concepts such as the "Learning Organization" (Argyris and Schön, 1978), and "Organizational Culture" (Schein, 1985), the most popular of these balancing problem-solving efforts was the one associated with the quality movement (see Cole, 1998, 1999). (The dominance of this framing is clearly visible in the data underlying Table 2 above, where references to "quality management" and "total quality management" far outnumber those to "organizational culture" or "organizational learning.")

The new Quality Management model, with Total Quality Management (TQM) as the key concept, borrowed extensively from the rising Japanese competitors. Indeed, when the organizational and management problem of quality improvement came to the fore in the US, it had already been addressed in Japan (Cole, 1998; Winter, 2000). After the Second World War, the Japanese automobile industry was in a deep crisis. A series of organizational innovations would lead to the emergence of what was later called the Toyota Production System. In the course of defining and resolving the challenges faced by Toyota, its chief engineer Taiichi Ohno (1988) criticized management practices that led supervisors and shop-floor personnel to prioritize production over quality. Fearful of negatively impacting productivity, workers and foremen typically passed errors downstream rather than call attention to them. Ohno pointed out that this practice was ultimately wasteful. The mobilization of shop-floor personnel for eliminating waste and improving quality became core elements of the Toyota Production System and its associated management system (Ohno, 1988; Liker, Fruin, and Adler, 1999).

In contrast with these Japanese practices, US firms had long relied on staff experts to track quality and set quality targets. These targets were set to “optimal” levels based on the assumption that quality and productivity were in a trade-off relationship. Japanese competition brought both an awareness that competitive advantage could be derived from shifting this trade-off (to this extent, “Quality is free,” argued Crosby (1980)), and to effect this trade-off shift, primary responsibility for quality should be shifted from staff to line personnel. Quality theorists such as Deming, Juran, and Ishikawa argued this prioritization of quality was the secret of the Japanese manufacturers’ success (Cole, 1999). Acting as bridges between Japan and the US, they developed a set of management tools aimed at quality improvement, later popularized as TQM (Hackman and Wageman, 1995). The efforts of these change-agents were constrained by the arrogance of established (US) industry leaders when faced with upstart (Japanese) challengers (Cole, 1999). Over time, however, the quality movement developed a broad following impressed by its capacity to address the quality-related dysfunctions of the Strategy-and-Structure approach while leaving intact the latter’s basic elements—the divisionalized firm, with financial and strategic but not operational controls over the operating divisions, and with bureaucratized internal labor markets.

The Quality Management model shared some features with Human Relations, notably a concern with employee attitudes; but the differences are also striking. Where Human Relations was focused on individual employees and motivated by concern with their alienation and resistance to task control, Quality Management was motivated by process and product quality and focused on teams and their engagement with this dimension of their work.

One of the main mechanisms for diffusing the new Quality Management model became the Malcolm Baldrige National Quality Award (for others see Cole, 1999). Created in the US in 1987 as a joint venture between the government, scholars and leading companies in industry (Garvin, 1991; Cole, 1998), the Baldrige system synthesized the overlapping principles and techniques of a host of theorists and quality gurus. When a growing number of US industries came under intense and global competitive pressure in the 1980s and 1990s, Baldrige offered them an iterative process of learning, implementation, and practice that promised superior performance (Cole, 1998). It spread from core manufacturing industries to the service sector, including finance, schools, hospitals, and government.

The division of labor here was similar to the one we saw in the Human Relations case. Innovators such as Ohno contributed to a creation of a solution. Theorists (Deming, Ishikawa) conceptualized TQM as a management tool. The Baldrige system established a network that linked actors from government, science and industry in disseminating this tool. Note however that the network of actors involved in developing the Baldrige system was considerably more diverse than in the case of TWI, and the result was a whole family of best-practice exemplars rather than a single standardized set of procedures.

The computers and telecommunication revolution

The 1970s saw the beginnings of a new wave of technological revolution, having incubated during the 1950s and 1960s, and then taking off as the previous revolution moved into its exhaustion period. Successive innovations in microelectronics, computers, the Internet, and eventually mobile telephones provided opportunities for new industries, a new infrastructure of digital and wireless networks, and much wider and cheaper access to information and communication pathways.

Identifying computers and telecommunication as the next technological revolution in the sequence is not particularly controversial; but identifying the corresponding organizational and managerial transformation is riskier. Efforts to put the more recent past in historical perspective always run the risk of premature assessment (Chandler, 1990: 628). With that caveat, let us offer the following sketch as a working hypothesis.

The new technologies enabled the emergence of more complex and dispersed organizing structures and relationships (networks, internal markets, outsourcing relationships, etc.), and the resulting organizational complexity called for some kind of rationalization. A variety of concepts emerged to fill that need, and to simplify and transform the way work was done. Conversely and simultaneously, the new technologies represented “solutions” looking for bigger “problems” to solve. Indeed, the implementation of new computer-based technologies initially yielded frustratingly limited improvement in organizational performance (see e.g., Zuboff, 1988). A host of economic indicators showed a disturbing lag in productivity gains during the 1970s and 1980s relative to massive wave of investment in information technologies—the so-called “productivity paradox” (Solow, 1987; Short and Venkatraman, 1992). Effective exploitation of the new opportunities offered by IT would require expanding IT’s role beyond support functions and expanding its functionality beyond the automation of stand-alone technical or administrative tasks. The key organizational and management problem was therefore how to use ICT to rationalize operations across broader spans and higher levels of decision-making, and to adapt accordingly organizational strategy, structure, systems, and processes (Venkatraman, 1991).

The resolution of this problem led to the emergence of a paradigm-revolutionizing management model that we call the Business Process model. The Business Process model was initially dominated by two competing management concepts: the more prominent Business Process Reengineering (BPR) (Hammer, 1990; Hammer and Champy, 1993) and Business Process Redesign (Davenport and Short, 1990; Davenport, 1993). The common core was their “process orientation” (Davenport, 1995) which encouraged firms to rationalize not only the processes that linked activities but also the location of the organizational boundaries that separated those activities.

The centrality of the Business Process model was buttressed by the emergence of the concept of "supply chain management" (Cooper, Lambert, and Pagh, 1997). IT tools were created to standardize interfaces and linkages and thus to facilitate the flow of information across boundaries both within and between firms (Lambert and Cooper, 2000; Sturgeon, 2002; García-Dastugue and Lambert, 2003). Along with this change in organizational structure, strategy shifted its focus from “corporate strategy” to “core competencies” and “strategic alliances” (e.g., Gulati, 1998; Gulati and Singh, 1998; Ireland, Hitt, and Vaidyanath, 2002; Lavie,2006). (Kunda and Ailon-Souday’s (2005) characterization of “market rationalism” covers much the same conceptual terrain as we associate with the Business Process model, without however linking this new “rational” pendulum swing to the emergence of ICTs.)

The Business Process model thus inaugurated a radically new organizational paradigm, which we call the Network (Langlois and Robertson, 1995; Sturgeon, 2002).[9] This paradigm focused attention on network ties—work and information flows—across units within the enterprise as well as between the focal enterprise and other enterprises up- and down-stream (see Short and Venkatraman, 1992).

The main actors contributing to the establishment of the new Business Process model and Network paradigm were IT specialists in companies, academia, and consultancies. BPR had its origins in a collective research project known as PRISM. In a series of case studies, the PRISM project brought together theorists (often working later as consultants) such as Thomas Davenport and Michael Hammer, practitioners such as Charles Sieloff at Hewlett-Packard (HP), Charles McCaig and Keith Glover at Mutual Benefit Life, and others at American Express and IBM, as well as consultants such as James Champy. During the project, these actors cooperated to define the problem, capture and theorize solutions, and develop dissemination approaches (Davenport and Short, 1990; Davenport, Prusak, and Wilson, 2003). The companies involved were often in the revolution's core industries. Through this effort, Hammer, Champy, Davenport and Short theorized the organization innovations advanced by the IT practitioners and transformed them into a management model, reaching guru status when they published their respective articles and books (Davenport and Short, 1990; Hammer, 1990; Davenport, 1993; Hammer and Champy, 1993). The guru-theorists were further involved in supporting the practical dissemination of the Business Process model: Hammer created his own consultancy; Davenport has directed research centers of Accenture and other IT consultancies.

Large IT consultancies such as Champy's CSC Index and subsequently Andersen Consulting/Accenture played a key role in the diffusion of the Business Process model (Fincham, 1995; Fincham and Evans, 1999). Andersen/Accenture developed an elaborate, standardized consulting process to support this line of work. Their system relied on sophisticated IT support for conducting intervention steps and on modules of ready-made solutions. This standardization allowed them to conduct industrial-scale Business Process projects, profitably leveraging less experienced (and less expensive) consultants (Nanda, 1995; Thompson, 2004; Falk, 2005). Eventually, enterprise-systems vendors such as SAP also came to play key roles in disseminating the Business Process model. They relied even more than large consultancies on generic best-practice exemplars that abstracted from companies' specific needs (Davenport, Prusak, and Wilson, 2003).

We should acknowledge at this point that it is not self-evident that the Business Process model should be classed as a management model comparable in generality and

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9 Of course, networks of organizations existed before and independently of the computers and communication revolution, for example in form of the pre-industrial European putting-out system (e.g., Mendels, 1972; Mokyr, 2001), 19th and early 20th industrial districts in the UK (e.g., Marshall, 1919), or the late 20th century interlinked microfirms in the Italian Emilian-Romagna region (Piore and Sabel, 1984; Lazerson, 1995). However, all these examples depended on strong local ties. Other networks, such as hawala, the Muslim world's money transfer system (El Qorchi, Maimbo, & Wilson, 2003), span larger geographies without advanced technology, but rely on strong ethnic/religious ties. The establishment and worldwide diffusion of global supply chains only became possible on the basis of IT and telecommunication tools and infrastructure (Sturgeon, 2002).

pervasiveness to Scientific Management or Strategy-and-Structure. Its initially dominant concept, Business Process Reengineering, had a faddish quality, pushed aggressively by consultancies and then rapidly abandoned as a consulting product. We argue, however, that this model's process orientation lived on and was widely diffused, assisted by concepts such as Supply Chain Management. Davenport seems to support this interpretation:

> "The most profound lesson of business process reengineering was never reengineering, but business processes. Processes are how we work. Any company that ignores its business processes or fails to improve them risks its future. That said, companies can use many different approaches to process improvement without ever embarking on a high-risk reengineering project" (Davenport, 1995: 74-75).

Indeed, Business Process Reengineering was a contested concept from very early on. Through the 1980s and 1990s, one of the IT specialists involved, Sieloff from HP, argued that "knowledge management" was more critical than the IT infrastructures that were emphasized by the most prominent BPR proponents (Sieloff, 1999: 47). Sieloff's point of view was captured in the aphorism, "If only HP knew what HP knows." Davenport himself (Davenport, Prusak, and Wilson, 2003) criticized Hammer and Champy's version of BPR for ignoring Sieloff's point and overselling and oversimplifying BPR. BPR, the critics argued, had become an excuse for massive layoffs, and the failure rate of big BPR projects was distressingly high (see Champy, 1995, Davenport, 1995). These failures typically occurred when large consultancies designed radically new work processes without consulting the front-line practitioners who knew most about these processes, and without taking the time to redesign work processes that would fit the client organization's specific needs (Davenport, Prusak, and Wilson, 2003). The factor driving this short-sightedness was, according to these critics, exacerbated competition for profit and growth among the consultancies (see Davenport, 1995; Davenport, Prusak, and Wilson, 2003).[10]

The dysfunctional side-effects of the Business Process model were addressed by several different and partially intertwined problem-solving efforts. Perhaps the most prominent of these efforts was the one anticipated by Sieloff and known as Knowledge Management (e.g., Nonaka and Takeuchi, 1995; Davenport and Prusak, 1998; Brown and Duguid, 2000). [11] One of the goals of Knowledge Management was to mitigate the risk that

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[10] We thank one of our reviewers for suggesting another factor: BPR was so focused on cost reduction and more effective "exploitation" of ICT's potential that it was bound to provoke a response aimed at supporting industry's "exploration" efforts (using the exploitation/exploration distinction introduce by (March, 1991).

[11] We understand Knowledge Management here in a broad sense, as the cultivation of knowledge-creating and knowledge–sharing communities of practice. Our argument is that Knowledge Management was ultimately driven by the computers and telecommunications revolution, but was deeply marked by its role as a (secondary-cycle) response to the deficiencies of the Business Process model, which was the prior (primary-cycle) response to that revolution. This interpretation is consistent with the history offered by Koenig and Neveroski (2008); but it is a hypothesis that needs further testing. An alternative hypothesis is that Knowledge Management is better understood as part of a distinct, primary-cycle-type response to that technological revolution.

Business Process-related reengineering, downsizing, and outsourcing programs would destroy the fabric of collective tacit knowledge shared among experienced employees both within and across interdependent firms.

The key to accomplishing this was to re-establish, strengthen, and deploy the collective knowledge-generating and -sharing capacity of geographically- and organizationally-dispersed personnel working in related domains. The focus of Knowledge Management was thus broader than the focus on individuals or teams found in prior secondary model-development cycles. It was now on more diverse and extended collectivities, labeled by Lave and Wenger "communities of practice" (Lave and Wenger, 1991; Wenger and Synyder 2000; see Brown and Duguid, 1991).

As with the prior paradigm-balancing models of Industrial Betterment, Human Relations, and Quality Management, Knowledge Management did not lead to a new organizational paradigm, but instead mitigated the dysfunctional side-effects of the Business Process model and rebalanced the Network paradigm. Compared to the prior cycles, however, the Business Process model's innovation and dissemination phases were more intertwined, and the dissemination of this model provoked much sooner a corresponding paradigm-balancing effort in the form of Knowledge Management.

The main actors in the development and diffusion of Knowledge Management were IT practitioners, IT theorists, IT consultants and HR managers (see Scarbrough and Swan, 2001). One strand of development involved many of the original actors of the Business Process network, leading from innovative Knowledge Management practices developed in US companies such as HP by IT specialists such as Sieloff (1999) to IT scholars such as Davenport and organization experts such as Prusak (Prusak, 1997; Davenport and Prusak, 1998; Davenport, Prusak, and Wilson, 2003) who theorized and elaborated these innovative practices. A second strand led from innovative practices created in Japanese companies such as Honda, Canon and NEC, to the theorization of Nonaka and Takeuchi (Takeuchi and Nonaka, 1986; Nonaka 1991, 1994; Nonaka and Takeuchi 1995) and in particular to Nonaka and Toyama's (2003) concept of "Ba," which seems close to that of community of practice (as suggested by Choo and Alvarenga Neto, 2010). Other management concepts too might be arrayed under the umbrella of Knowledge Management, such the Scrum and agile methods of software development, "coworking spaces" (Johns and Gratton, 2013) and "open innovation" (we discuss the last two further below). Thus, we argue, Knowledge Management is more general and pervasive than it seems, and perhaps warrants status as a management model.

Concepts and methodologies related to Knowledge Management were diffused by larger IT consultancies (Davenport and Prusak, 1998; Scarbrough, 2002), but also by many smaller consulting businesses such as Prusak's (1997), by academic institutions (Davenport, Prusak, and Wilson, 2003), and by intra- and inter-organizational networks of proponents of Knowledge Management (see Scarbrough and Swan, 2001). IT consultancies often focused on the IT infrastructure, while the other actors increasingly focused on establishing and cultivating the social networks and shared values that supported communities of practice (Wenger, McDermott, and Snyder, 2002; Hansen, Nohria, and Tierney, 1999).

Some observers claim that the implementation of Knowledge Management techniques and tools did not live up to the promises made by guru theorists and consultancies (Rigby, 2001; Scarbrough, 2002; Spender, 2005). Indeed, many large consultancies abandoned Knowledge Management as a product line soon after its boom in the second half of the 1990s (Grant, 2011). While major Business Process IT infrastructure projects may have yielded disappointingly few benefits for the clients, projects aimed at implementing communities of practice yielded even less profit for the larger consultancies. Notwithstanding these latter disappointments, proponents have continued advocating Knowledge Management and hold out hope for its future development (see Grant, 2011).

The ICT revolution, however, is not yet exhausted (at least, not as of our writing in 2017). The bursting of the Internet bubble in 2001 and the financial crash of 2008 revealed major institutional misfits that would need to be resolved before ICTs can be deployed effectively across wider swaths of industry. Indeed, notwithstanding the apparent ubiquity of ICT, there remain vast regions of the economy where its deployment has been as yet very limited. ICT has the potential to de-mature, for example, the automobile, transport and logistics industries, sparking new developmental trajectories in the leading industries of the prior wave. The recent emergence of autonomous vehicles and the more general idea of an "internet of things" (e.g., Atzori, Iera, and Morabito, 2010; Hui, 2014) underscore the massive untapped potential for ICT to revolutionize many more parts of industry and everyday life. We have barely begun to see full-scale deployment in healthcare or education.

Notwithstanding this uncertainty, one feature of the current wave of technological change is noteworthy: it has brought challenges, first, to the role of gurus with oversimplified best-practice theorizations (see studies such as Abrahamson, 1996; Kieser, 1997, criticizing the faddish quality of many concepts and tools deployed by consultancies), and second, to the profit-driven diffusion of these models and tools by large consultancies (see critical consultancy studies such as Kipping and Engwall, 2002; Clark and Fincham, 2002; Kipping and Clark, 2012). Such criticisms have already inspired the exploration of alternatives to guru- and consultancy-dominated processes of creating and diffusing management models. Some have argued for a new role for scholars (such as in the engaged scholarship proposed by Van de Ven and Johnson, 2006; Van de Ven, 2007). Others have argued for new forms of action research (such as the Finnish methodology Developmental Work Research developed by Engeström, 2005, which uses interventionist research to stimulate organizations' innovation capacity). And there has been a proliferation of "collaborative" forms of mutual learning among practitioners (Devers, Foster, and Brach, 2013; Kilo, 1998; Øvretveit et al., 2002; Schouten et al., 2008). The criticism of consultancies and the exploration of alternative organizational innovation and change mechanisms seem to have further intensified during the early 21st century crisis (e.g., Hodgkinson and Starkey, 2011; Alvesson, 2013).

FROM DESCRIPTION TO EXPLANATION: THREE NESTED, INTERACTING PROCESSES

We argue that the evolution of management models sketched in the previous section can be theorized as the resultant of the interplay of three nested and interacting processes driven by successive waves of technological revolution. We present these key processes in the following paragraphs, zooming in from the most macro to the most micro.

We understand these processes as relatively autonomous, yet interdependent and interacting. In this characterization, we take inspiration from Freeman and Louçã's (2001) approach to historical analysis and evolutionary theories that allow for both bottom-up and top-down selection (a similar approach is adopted by Geels and Schot (2007)).

Four major waves of paradigm change

Our sketch of almost two centuries of management models has given a key role to long waves of technological revolution. Each of these waves, we suggested, prompted the emergence of new organizational challenges. We are certainly not the first to identify such a long-wave pattern in management history; but there is debate over how to interpret it. By shifting our focus from the Kondratiev waves of GDP growth that were emphasized in prior scholarship to waves of technological revolution, we can see that each of these revolutions posed radically new problems in industry, which in turn prompted the emergence of radically new organizational paradigms in each wave as part of the process of "creative destruction" (Schumpeter, 1942: 83).

In the first period of each of the last four major technological revolutions, new technologies emerged and became the basis for the growth of new core industries (railroads and steam power, steel and electrical power, automobile and oil, computers and telecommunication), and in these industries, organizational and management problems were posed acutely enough to prompt substantial and disruptive organizational innovation. Each of the four technological revolutions generated a qualitatively new paradigm: from Professionally-managed firm, to Factory, to Corporation, to Network. Companies emblematic of progress in one paradigm—such as the Erie railroad, Bethlehem steel, General Motors —appeared in the subsequent waves as "dinosaurs" (Perez, 2010).

Two model-development cycles in each wave

Moving down to the next nested level, we observe two model-development cycles in each major wave of change. The idea of recurrent, paired cycles of management model change is well-established in management history. Barley et al. (Barley and Kunda, 1992; Kunda and Ailon-Souday, 2005) advanced the most prominent version, characterized by an alternation between rational/technical and normative/human cycles, and this alternation was presented as a pendulum movement between incommensurable "antinomies" reflecting a deep "dualism" in our culture.

We agree with Barley and Kunda that the observed succession of these models' emergence presents an alternating focus on technical and human issues; but we are missing too much important detail if we see these models only as variants of two basic patterns in a cultural dualism. They are better understood, we argue, as poles of a dialectical contradiction resulting from primary and secondary model-development cycles: the second pole in the pair certainly opposes the first; but it also presupposes it; and the two do not simply oscillate as a pendulum but are eventually synthesized before a new technological revolution renders that synthesis obsolete.

Let us recapitulate the sequence of models across the four main waves of technological revolutions. The *first* primary model-development cycle (sparked by the steam and railroad revolution) yielded the Line-and-Staff model, and thereby contributed to the establishment of a new organizational paradigm which we call the Professionally-managed firm. But this cycle led also to a degradation of working and living conditions for workers. This degradation provoked conflicts, which in turn led to a secondary cycle that gave rise to the Industrial Betterment model. Industrial Betterment did not undo the Line-and-Staff model, but added a counter-balancing social function in the form of welfare secretaries.

The *second* primary cycle (sparked by the steel and electricity revolution) yielded the Scientific Management model, and thereby contributed to the establishment of a new organizational paradigm that we call the Factory. But it led also to high turnover and low morale of workers due to close control over how and how fast tasks were performed. These problems provoked a secondary cycle that yielded the Human Relations model. This Human Relations model certainly built on some of the ideas of the Industrial Betterment model; but it also introduced a new array of management concepts to deal with the distinctive features of the problems thrown up by Scientific Management. As we showed with our discussion of TWI, Human Relations did not undo Scientific Management but rebalanced the Factory paradigm.

The *third* primary cycle (sparked by the automobile and oil revolution) yielded the Strategy-and-Structure model, and thereby contributed to the establishment of an organizational paradigm that we call the Corporation. But it led to poor quality and service, low worker involvement, lack of cooperation and political games among managers. These problems provoked a secondary cycle aimed at quality, organization culture, and organization learning. The resulting Quality Management model did not undo the Strategy-and-Structure model but remedied its dysfunctions and stabilized the Corporation paradigm. Here too, while Quality Management inherited some ideas from Human Relations and Industrial Betterment models, it introduced in turn an array of novel concepts that were motivated by the distinctive problems arising from the Strategy-and-Structure model and that therefore focused on the team and its responsibility for improving quality.

Our analysis of the most recent wave was more tentative, but we suggested that the *fourth* primary cycle (sparked by the computer and telecommunication revolution) yielded the Business Process model and thus contributed to the establishment of a new organizational paradigm that we call the Network. Here ICT was deployed to outsource all non-core activities and to rationalize the management of both internal and supply-chain processes. But this cycle led to the neglect of human involvement and weakened the innovation-generating capacity of firms. These problems in turn appear to have provoked a secondary cycle that led to the emergence of Knowledge Management. And here again, while there is some continuity of Knowledge Management with prior paradigm-balancing models, we see conceptual innovation around the idea of community of practice.

Generalizing across these four waves, we see that the primary cycles focused on developing a model that facilitated the exploitation of the new possibilities generated by the new technologies—overcoming the limitations in this new technological context of the paradigm inherited from the prior revolution, and leading to the emergence of a new organizational paradigm. By contrast, the secondary cycles responded to the unanticipated problems created by the limitations of this primary-cycle model, and aimed to rebalance the new paradigm. Our historical account offered some evidence for this interpretation: Table 3 offers some further textual evidence for it. Here we see in the words of proponents of each of the second-cycle models explicit reference to this rebalancing goal.

------- Table 3: Secondary cycles and their motivating problems ----

We see these paired models as reflecting a contradiction (where the second simultaneously opposes and presupposes the first) rather than a cultural antinomy. Viewed this way, we can recognize that beneath the appearance of alternation we find that the two models eventually give way to a dialectical synthesis. Industrial Betterment's welfare secretaries evolved into personnel managers—specialized staff managers who were integrated into and enhanced the effectiveness of the Line-and-Staff model in professionally-managed firms. Although Human Relations proponents often portrayed their efforts as opposing Scientific Management, in reality the two models were often used in conjunction, and under TWI they were explicitly synthesized. Similarly, quality, culture and learning approaches were often portrayed as opposed to the mechanistic bureaucracy of Strategy-and-Structure; but in practice these normative and rational approaches were typically combined (see for example Bate, Khan, and Pye, 2000; Beer and Nohria, 2000). More recently, theorists such as Davenport have sought a synthesis of the Business Process model and Knowledge Management (Davenport, 2010).

Four problem-solving phases in each cycle

To avoid an excessively mechanical account of this evolutionary process, we need to zoom in yet one more step, to account for the actors that lead to the birth of new management models and their diffusion. As is visible in the historical sketch offered in the previous section, this process unfolds in four interrelated, overlapping, and non-linear phases: (1) various efforts to articulate a widespread organizational and management problem, (2) competing management concepts offer innovative solutions, (3) a management model emerges from among these concepts as a theorized solution, and (4) the management model is diffused.[12] Each phase is typically dominated by different actors, and the different pressures and opportunities facing these actors influence the diffusion successes and failures of any given management model.

These four phases and their constituent moments are often discussed separately in the management literature. Many studies focus on problem articulation (e.g., Cowan, 1986, 1990; Landry, 1995; von Hippel and Tyre, 1996), or management innovation (e.g., Damanpour, 1991; Van de Ven, 1999), on theorizing management concepts (the literature on management fashions, e.g., Abrahamson, 1996; Kieser, 1997; Suddaby and Greenwood, 2001, 2005) or diffusing management concepts (the literature on consultancies, e.g., Kipping and Engwall, 2002; Clark and Fincham, 2002; Kipping and Clark, 2012); but our understanding is deepened if we see their interconnection. Birkinshaw, Hamel and Mol (2008) show the way, in an account that addresses the first three phases.

The cycle characterized by these four phases parallels, as Barley and Kunda (1992) demonstrated, the evolution of successful social movements (e.g., Blumer, 1969; Macionis, 2012); we argue here that it also parallels the trajectory followed by individual technological innovations (e.g., Utterback and Abernathy, 1975; Dosi, 1982; Nelson and

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[12] While both sequences might be represented as S-shaped logistic curves, the four phases are different from the four periods of a technological revolution: the former are notional, and in reality are interrelated, overlapping, and non-linear; the latter are distinct historical periods in the trajectory of a given cluster of technologies.

Winter, 1982; Freeman and Louçã, 2001; Perez, 2002; Murmann and Frenken, 2006). A technological trajectory starts with a technological discontinuity and the identification of "reverse salients"—the parts of the emergent new system that lag the advancing performance frontier and hamper its progress (Hughes, 1993). Various actors address these reverse salients through experimentation (Abernathy and Utterback, 1978, Perez, 2010). Eventually, as these reverse salients are overcome, there emerges a "dominant design" (Utterback and Abernathy, 1975, Utterback and Suarez, 1993), "technological paradigm" (Dosi, 1982), or "technological guidepost" (Sahal, 1981). A dominant design functions like a technology standard: technological innovation can now focus on improving the processes for implementing that design (Abernathy and Utterback, 1978). This opens the diffusion and adaptation phase, when process innovation efforts comes to the fore (Nelson and Winter, 1977) along with incremental product innovations compatible with the dominant design (Utterback and Abernathy, 1975). The diffusion process is further accelerated by mechanisms such as bandwagon effects and network externalities (Arthur, 1988).

Let us explicate the phases of managerial innovation in light of what this literature has taught us about the phases of technological innovation. In the first phase, innovators articulate a widespread organizational and management problem—an organizational reverse salient. For the primary-cycle, paradigm-revolutionizing models, this reverse salient was the inadequacy of prevailing models of management relative to the potentialities of the new technologies. One indicator of such a reverse salient are "productivity paradoxes" such as the one observed in the 1980s (Solow, 1987; for a discussion of similar paradoxes during prior waves see David, 1990). For the secondary-cycle, paradigm-balancing models, the reverse salient was the disruption caused by the inadequacy of the primary-cycle's model. In the primary cycles, the salient was encountered first by actors in the new core industries: examples include McCollum at the Erie Railroad, Taylor at Midvale Steel, Sloan at General Motors, Sieloff at HP. In the secondary cycles, the salients were felt more diffusely.

The second phase of this cycle—creating innovative solutions to this organizational and managerial problem—typically involved considerable trial and error experimentation, in a cyclical movement of "reflective thought and action" (Dewey, 1910) or of "expansive learning" (Engeström, 1987, 2005). Such processes often took many years, as in the cases of Taylor, Mayo/Roethlisberger or Ohno. Multiple management concepts emerge in this phase, competing with and complementing each other.

In the third phase, a new model emerges from among the promising concepts and offers a theorized solution. This theorization facilitates diffusion to other companies and other industries. The challenge here is to find what Dayvdov (1990) characterize as a "theoretical generalization"—the simplest conceptualization of a phenomenon that captures all its relevant elements and relationships and that provides the methodological means for relating different variants of the phenomenon to each other (thereby enabling the applicability of the conceptualization in different contexts). Winter and Szulanski (2001) characterize this challenge as identifying the "Arrow core" of the innovation—"knowledge of which attributes are replicable and worth replicating, together with knowledge of how these attributes are created" (2001: 731). This process was advanced by theorists (Taylor; Mayo/ Roethlisberger; Drucker; Deming/ Ishikawa/ Juran; Hammer/

Davenport; Nonaka/ Takeushi) who were typically connected to companies in which the innovations were developed, and who were knowledgeable about the respective new technologies or the social problems following the implementation of these technologies.

In the fourth phase of this cycle, the successful theorists' ideas were popularized in articles and books and sold as products by consulting companies. Over the past century, boutique consulting by such theorist-gurus was increasingly overtaken by larger consultancies (Bedaux, McKinsey, CSC/Accenture etc.) and public-sector organizations (TWI, Baldrige). These organizations further codified the theorists' models to maximize their utility for "industrial-scale" implementation of solutions in a large number of client companies.

The case of the Business Process model and its initially dominant concept BPR illustrates how solutions that were used as best-practice exemplars by consultancies deviated from the solutions conceptualized by theorists, and how the latter in turn deviated from the solutions created by the innovators. Not surprisingly, the effectiveness of consultancies in improving their clients' performance has been much debated. We see much the same critical comments and debates concerning Scientific Management consultancies (Kreis, 1992), Strategy-and-Structure consultancies (Ernst and Kieser, 2002) and Business Process consultancies (Davenport, 1995; Fincham, 1995).[13]

A multi-layered evolution

We understand the interaction of these three processes—waves, cycles, phases—to operate along the lines suggested by Giddens (1984) in his characterization of the mutual constitution of structure and action (see also Barley and Tolbert, 1997). When actors are confronted with a technological revolution (which we treat here as largely exogenous) that radically transforms the structure of technological constraints and affordances, they are thereby also confronted with the inadequacy of existing management paradigms, models, and concepts inherited from the prior period. The resulting structural tensions prompt actors to create, theorize, and spread organizational innovations that contribute—via the "upward path" from micro agency to macro structure—to the resolution of these tensions by the formation of new management concepts. Through trial and error, some of these concepts eventually cohere as a robust new management model, and such models first revolutionize and then rebalance a new organizational paradigm that fits the new technological conditions. (In parallel with this process, other actors, working in other spheres of activity, are developing ideas and artifacts that will eventually manifest themselves as a new technological revolution.) Figure 1 suggests a visualization of this process.

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Once a paradigm, model, or concept achieves a dominant position, it functions as a new "structure" (in Giddens' (1984) sense), exercising "downward pressure", which shapes

[13] We note that this contestation has been more intense for primary-cycle paradigm-revolutionizing models than for secondary-cycle paradigm-balancing models. These latter were dominated by other types of actors, such as governmental agencies, research systems, institutes, user networks: these actors are less profit-driven, which may obviate some of the problems experienced in consultancy-driven diffusion.

subsequent action by creating a taken-for-granted frame of reference, associated routines and artifacts, as well as new interests in sustaining the new status-quo. Paradigms, models, and concepts are thus all structures "stretching across time-space" (Giddens, 1984: 377); but they vary in their generality, pervasiveness, and therefore in their durability: paradigms are more durable than models, and models more durable than concepts. As a result, management innovation progresses—via the mutual constitution of agency and structure—from concepts to models to paradigms, challenging and eventually changing those structures.

DISCUSSION

We have argued that the evolution of management models can be understood as the resultant of the interplay of three interacting processes. Here we explore whether this account helps us make sense of the emerging new management concepts, and whether, looking back over the past century and half, it helps us make sense of the longer-term evolution of management models

Emerging new concepts

As we noted above, the present is always difficult to see in historical perspective. This risk cannot be completely avoided, but we can manage it better if we are armed with a more robust theory of the forces shaping change. Our theory suggests that in aiming to interpret any given management innovation, we should ask: Is it responding to a technological revolution? Is it associated with a specific paradigm? Is it associated with a specific management model? But our theory also suggests that there is no quick way to arrive at a convincing answer to such questions: we need to parse carefully the four phases of the management innovation's development; examine the problems and opportunities that motivated an innovation's originators; identify where in the industrial landscape those problems and opportunities arose most forcefully, and where the emerging solutions found most enthusiastic reception. We need further to explore the similarities and differences with other concepts and models already on offer. It is only through such a multi-dimensional study that any given innovation can be characterized with much confidence. Not surprisingly, the study of present day innovations-in-progress is particularly difficult, clouded as our understanding must be by the lack of historical perspective.

With that huge caveat, let us see what light we can shed, first, on the concept of "open innovation." As we read the available research, it seems that the downsizing, outsourcing, and focus on core competences associated with Business Process initiatives of the 1990s had the unintended side effect of potentially limiting a company's' innovation-generating capacities to those available within. To overcome this limitation required a broader view of the communities of practice that could contribute to innovation generation (Fjeldstad et al., 2012). The success of open source (e.g., Linux or Apache) served as inspiration for companies in the ICT industries to adopt a new approach—open innovation (Chesbrough, 2003a, 2003b; Gassmann, 2006; Chesbrough and Appleyard, 2007). In contrast with prevailing "closed innovation" strategy, open innovation aimed to develop systems for linking internal and external communities of knowledge workers in inbound and outbound innovation activities (Huizingh, 2011). New ICTs facilitated communication and collaboration across these boundaries (Dodgson, Gann and Salter, 2006; Huizingh, 2011). The publicity given to these exemplary cases further contributed to the diffusion of open innovation (Chesbrough and Crowther, 2006). The concept of open innovation began to diffuse beyond high-technology industries where innovation was the primary driver of competitiveness, to industries such as in machinery, medical equipment, consumer goods, food, architecture, and logistics (Gassman, Enkel, and Chesbrough, 2010).

This reading suggests that we might see Open Innovation not so much as part of the primary, Business Process cycle, but as a management concept that belongs under the secondary, Knowledge Management cycle. Yes, Open Innovation encourages the dispersion of activity across organizations and embraces the Network paradigm; but its proponents are acutely aware that social ties of a community-of-practice type are critical to organizational effectiveness in that new paradigm.

Second, consider the concept of "coworking spaces." Here it is even clearer that the organizational and management problem that prompted the emergence of coworking spaces was created by the downsizing and outsourcing associated with Business Process initiatives. The result was that many knowledge workers found themselves as independent contractors and freelancers. Early Knowledge Management concepts addressed dysfunctions related to the Business Process model by establishing communities of practice *inside* and *across* companies; but this left many independent knowledge workers and freelancers *outside* companies without adequate communities to support their practice.

The innovative solution developed by the independent IT specialist Brad Neuberg in San Francisco was to offer the spatial and social infrastructure for a community of practice relevant to people like himself—to freelancers, entrepreneurs and other individual knowledge workers (Neuberg, n.d.; Hunt, 2009).[14] The theorization phase of coworking evolved rather differently from the theorization of prior concepts. Brad Neuberg (n.d.: para. 8), member of the open-source movement, suggested to his colleagues and friends to "take this idea, steal it, and make it your own." Two of Neuberg's colleagues, the social media consultants Chris Messina and Tara Hunt, were instrumental in conceptualizing the coworking idea by developing a coworking wiki and a Google groups list. The coworking concept diffused first within the San Francisco area, later within the US and then worldwide (Neuberg, n.d.; Hunt, 2009). Here, the means of diffusion were the coworking wiki, the online magazine Deskmag.com, national and continental "Global Coworking Unconference Conferences" (GCUC), and an increasing number of texts and books on coworking (Deskmag, n.d.).

This brief discussion suggests that we might see coworking, like Open Innovation, as a concept contributing to the creation of new types of communities of practice, and falling under the Knowledge Management model and the Network paradigm.

A longer-term trend?

In contrast to the image of a pendulum swinging, we have argued that the evolution of management models needs to be understood as part of a series of technological and organizational paradigm revolutions. Readers might therefore legitimately ask if our image of successive revolutions affords any greater insight into the longer-term direction of change across these revolutions.

[14] A similar development took place within the "Hub" in London (Deskmag, n.d.), where the initial focus was on social entrepreneurs.

Reviewing the evolution of both primary and secondary cycles across these waves suggests that they have both evolved towards an ever-broader "object" of the organization design and change process. The first of the primary cycles yielded a model that rationalized the role of the professional manager. The primary cycles of subsequent waves progressively widened the scope from the manager to workstations and factories, to corporations, and finally to processes that spanned interfirm boundaries. Likewise, the object of secondary cycles broadened over the successive paradigms from individual managers and workers, to teams, and then to communities of practice.

This widening scope implies not only quantitative expansion but also qualitatively greater "complexity"—heterogeneous activities, interlinked in a greater variety of ways, spanning entities under different ownership and control. The optimization of heterogeneous work processes synchronized in the factory represented a task of greater complexity than the professionalization of management in the railroads. The reorganization of the multi-divisional corporation aimed at mastering a more complex task than the optimization of the single factory. And the redesign of supply-chains across firms is a more complex task again than the reorganization of the individual corporation.

Moreover, reviewing our account of the actors involved in the various phases associated with successive waves and cycles, we also note a related, long-term trend. While management history has focused to date on consultancies as the key actors in the dissemination of new models of management (e.g., Clark and Fincham, 2002; Kipping and Engwall, 2002; Kipping and Clark, 2012), our historical sketch suggests that the community of actors involved has evolved towards a more complex and interdependent division of labor, one that now includes industrial innovators, theorists-gurus, government agencies, and industry peer networks. The interdependence among these actors with respect to model development and diffusion has grown over time and the boundaries between them have blurred.

This combination of growing complexity of the division of labor, growing interdependence among actors, and increasing scope of the corresponding integration and control efforts might plausible be read as indicators of what Adler (2012) calls the "socialization of production." Socialization, in this context, has both an "objective" and "subjective" dimension—that is, it operates at both societal and individual levels. Objectively, it consists in giving any one enterprise access to a wider range of capabilities through a wider array of denser ties to other enterprises and other sources of expertise—which we have just described. The subjective component corresponds to the more familiar use of the word: the process of acquiring this wider range of capabilities by the focal actor. Consider this thought experiment: a manager working in the early 19th century time-travels into the present, and is asked to work as a manager in a contemporary company: he or she would first need to master many of the lessons accumulated by the successive paradigms and models of the last century and a half. Developmental psychologists such as Vygotsky (1978) explain the mechanism that connects societal and individual development: The child masters the skills (speaking, writing, calculating, etc.) and cultural resources that their society has accumulated over the course of its history. Ontogeny does not "recapitulate" phylogeny (Gould, 1977), but the socialization of the individual involves the internalization of the collective, accumulated assets of a historically formed culture. (Later in their lives, in turn, some individuals develop innovations contributing new assets to that evolving culture.) We see a related process in management. Each of the models that has left its mark on the overall evolution of management offers a lesson for the individual who wants to master management as an activity.

We can summarize the lessons succinctly. Line-and-Staff: do not attempt to do everything alone—learn how to use professional assistance. Industrial Betterment: focus some of this professional assistance on the social aspects of the operation. Scientific Management: define everyone's tasks clearly and optimize how they are executed. Human Relations: attend to the motivation of the employees executing these tasks. Strategy-and-Structure: ensure your company's structure reflects the diversity of your customers and markets. Quality Management: organizational structure is not worth much if employees don't have the tools with which to ensure the quality of their products and services. Business Process: stay attuned the processes that span internal and external boundaries and the profitable opportunities provided by new technology to change those boundaries and the links across them. Knowledge Management: cultivate the communities of practice needed to sustain innovation in these dispersed value-chain activities.

We see these lessons as reflecting a (disruptable, reversible, open-ended) long-term trend of accumulation of management-related cultural assets across waves, cycles and phases. This trend is almost imperceptible in everyday life because lessons originating in prior revolutions are viewed as "common sense," while the challenges of the present technological revolution are far more salient in current experience and discussions. Figure 2 visualizes this longer-term perspective on our argument.

---Figure 2: The evolution of models over long period----

Our theory highlights the interplay of repetitive patterns and progressive patterns, an open-ended dialectical evolution, sparked periodically by technological revolutions. The complexity of this interplay perhaps helps explain why the question of "Where do new organizational forms come from?" (Suddaby and Greenwood, 2005: 35) is so difficult to answer.

CONCLUSION

Our theory of the evolution of management models differentiates three nested and interacting processes (four main waves, two cycles, four phases) driven by successive technological revolutions. We argued that this evolution represents the emergent result of bottom-up innovation and top-down selection driven by the tension between the possibilities opened up by technological revolution and the constraints created by established organizational paradigms and practices. Our theory thus combines "structural" and "agency" perspectives on change. Actors involved in creating, theorizing and diffusing organizational innovations play an important role in shaping management models and concepts, and thereby shaping organizational paradigms. Yet, once a management model or an organizational paradigm achieved a dominant position, it was seen as "common sense" and shaped human decision-making.

We have built on the neo-Schumpeterian work of Perez and others on technological revolutions, and we extended this work with a focus on the organization and management dimension of these revolutions. This line of argument suggests several issues and opportunities for future research.

First, while our analysis focused on some of the key models of organization highlighted by prior research, future research might usefully deploy our frameworks to explore the larger population of innovative management concepts (Birkinshaw, Hamel, and Mol, 2008; Mol and Birkinshaw, 2014; Volberda, Bosch, and Mihalache, 2014) in order to better understand why some garner more "market share" than others. The logic of our argument implies, for example, that a given management model is likely to inspire the creation of incremental innovation in the form of management concepts that are more tailored to specific applications: it would therefore be useful to draw more detailed genealogical charts. Our effort to group management concepts into higher-order models and to link the models to specific paradigms should be tested by more rigorous statistical analysis on a richer corpus of text.

A second set of issues flows from the limited attention we have paid to changes in institutional context. Some of these changes—most notably, wars—have had major effects on the evolution we address. The American Civil War (e.g., Clark, 2001), World War One (e.g., Bruce, 1995), and World War Two (e.g., Baron, Dobbin, and Jennings, 1986) all influenced the evolution of both technology and management models. Such historical contingencies are difficult to integrate into any general and simple historical theory such as we have tried to develop here. Other institutional changes, however, are less purely exogenous, and future research might useful attempt to integrate our insights with the literature on socio-economic regulation (e.g., Boyer, 1990) and social structures of accumulation (e.g., Gordon, Edwards, and Reich, 1982). Those two strands of scholarship bring into the foreground macro-contextual institutional changes that we addressed only marginally.

A third set of issues concerns the influence on the evolution of technology and management models attributable to the autonomous activity of actors in this field, such as engineers, consultants, gurus, or business schools. Such activity might help explain the emergence and exhaustion of these paradigms and models. Our simplifying assumption has been that these actors' strategies and impacts are subordinate to the opportunities and constraints created by technological revolutions. We acknowledge that this argument represents a strong claim that calls for theoretical nuancing and empirical testing.

Fourth, there are interesting issues to be explored at the firm level. Our paper followed Barley and Kunda (1992) in focusing the emergence of new concepts, models, and paradigms. But these persist over time, albeit under labels that might change, so at any given time, managers confront a range of ideas of different "vintages," and all of them, we noted in the previous section, have some bearing on the practice of management. Our Schumpeterian accounts implies that managers will pay more attention to those that fit their technological opportunities and constraints; but these vary across industry and indeed across firms within a given industry. How managers make sense of all this is an important question for future research. Jacobides, MacDuffie and Tae (2016) offer an exemplary case study along these lines.

A further limitation of our theory is that it is predominantly informed by the evolution of management models in just one country, the USA. Future research should assess how our theory needs to be expanded or modified if the focus broadens to include other countries. Such research can build on Guillén's (1994) work to explore differences in the development and adoption of management models in a broader international context. Where Guillén focused on the UK, Germany or Spain, today it is urgent to broaden our field of vision to other countries such as China, India, Brazil, Russia, Japan.

Finally, our study suggests we need a stronger integration of management and organization studies with technology studies. Our field often treats technology at a level of abstraction that makes it difficult to grasp the specific ways in which workers' and organizations' tasks are transformed by new technologies. Without a concrete enough understand of tasks and technologies, however, it is difficult to understand some of the more powerful forces that shape organizations and drive change in management models.

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Figure 1: Primary and secondary cycles

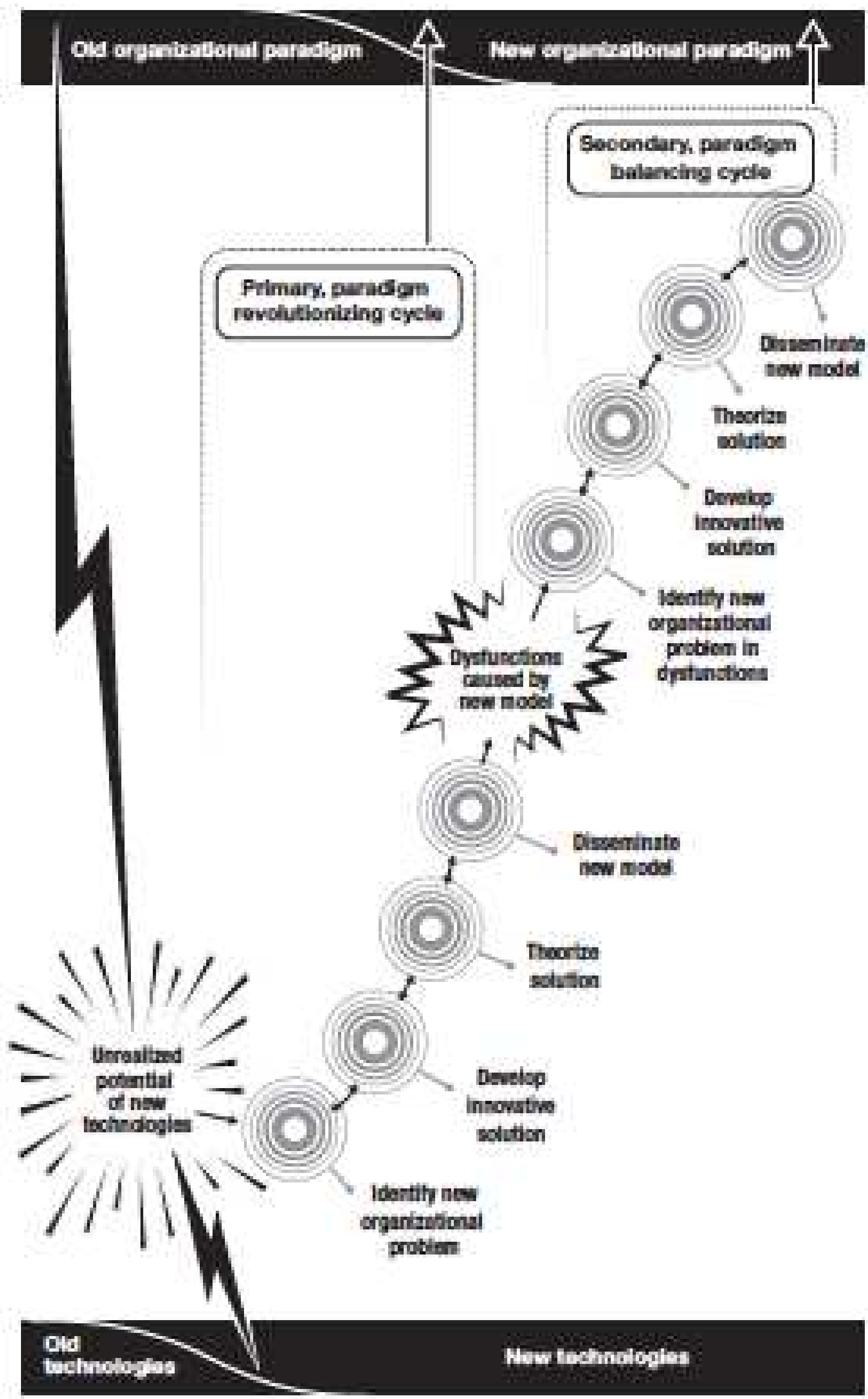

Figure 2: Revolutions, paradigms, and models over a long period (a simplified representation)

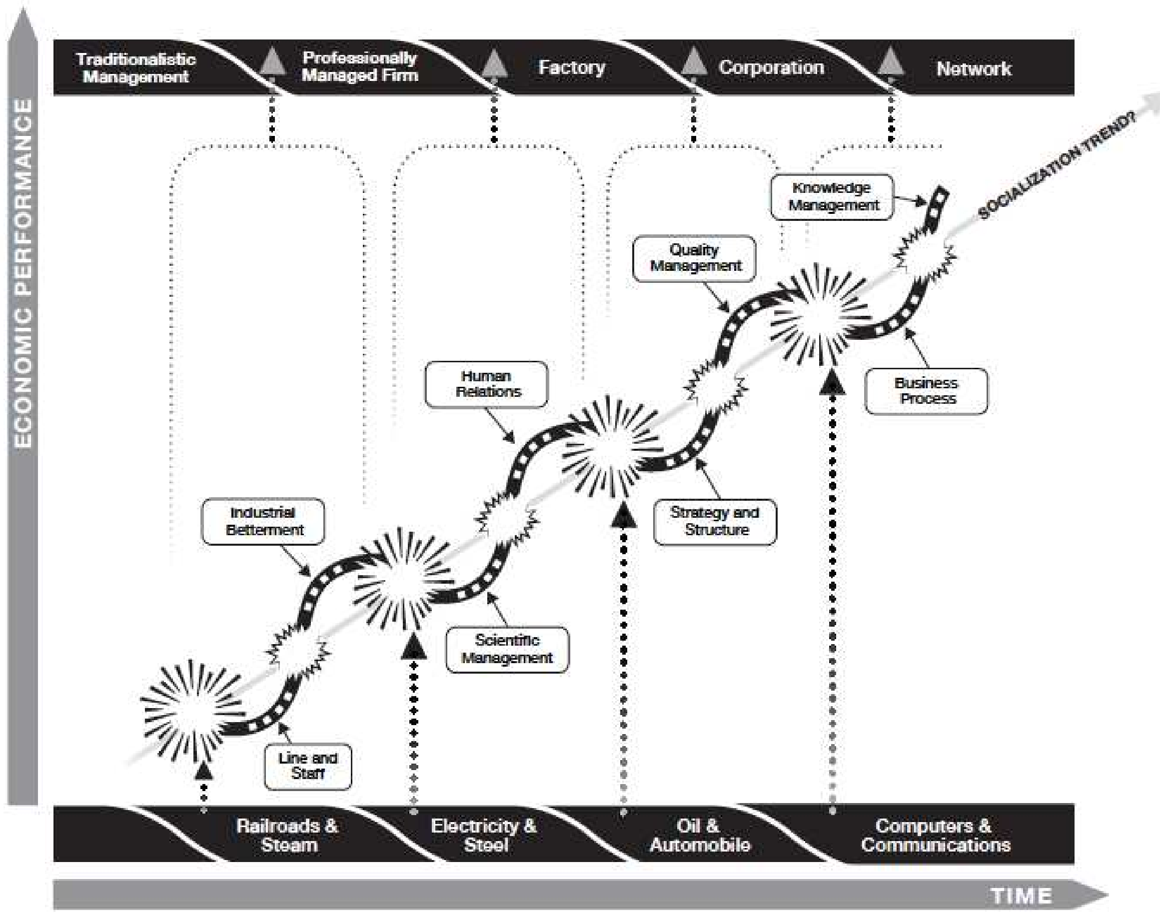

Table 1: Timeline of technological revolutions (adapting Perez, 2002)

Technological revolution	**Examples of dominant US companies (and year founded)**
1st wave: Water power and iron	
Incubation: 1750s-1770 Installation: 1771-1793 Crisis/turning point: 1793-1797 Deployment: 1797-1829 Exhaustion: 1830-1840s	
2nd wave: Steam power and railways	
Incubation: 1790s-1829s Installation: 1829-1848 Crisis/turning point: 1848-1850 Deployment: 1850-1873 Exhaustion: 1873-1890s	Baltimore & Ohio Railroad (1827) Erie Railroad (1832) Pennsylvania Railroad (1846)
3rd wave: Steel and electric power	
Incubation: 1850s-1875 Installation: 1875-1893 Crisis/turning point: 1893-1895 Deployment: 1895-1918 Exhaustion: 1918-1940s	Bethlehem Steel (1857) Midvale Steel (1867) Carnegie Steel (1872) (part of U.S. Steel as of 1901)
4th wave: Automobile and oil	
Incubation: 1880s-1908 Installation: 1908-1929 Crisis/turning point: 1929-44 Deployment: 1944-1974 Exhaustion: 1974-1980s	Ford (1903) General Motors (1908) Chrysler (1925) (predecessor Maxwell founded 1904)
5th wave: Computers and telecommunication	
Incubation: 1950s-1971 Installation: 1971-2001 Crisis/turning point: 2000/2008 Deployment: ? Exhaustion: ?	IBM (1911) Hewlett Packard (1939) Microsoft (1975) Apple (1976) Google (1998)

Table 2: Technological revolutions, models, concepts

Technology revolution	**Organizational paradigm**	**Dominant management model and key elements**	**Management concepts**	**Emergence[1]**
Steam power and railways	Professionally-managed firm: The rationalized management of geographically dispersed enterprise	Revolutionizing cycle: Line and Staff The establishment of specialized line and staff managers, unrelated to the owner, who would responsibly administer a large, complex firm	Staff and line	1861
			Line and staff	1869
			Organization chart	1889
		Balancing cycle: Industrial Betterment The addition of a social function among the staff responsible for improving workers' living and working conditions	Employee benefit*	1895
			Industrial betterment	1899
			Welfare work	1906
			Welfare secretar*	1913
Steel and electric power	Factory: The unitary, centralized organization structure	Revolutionizing cycle: Scientific Management Time and motion study, incentive wages, and workflow analysis as ways to optimize and accelerate production in a facility	Scientific Management	1896
			Taylorism	1900
			Standardization of methods	1914
		Balancing cycle: Human Relations Making line managers and staff specialists responsible for responding to the alienation induced by rationalized workstation operations	Human relations	1929
			Group dynamics	1945
			Personnel counseling	1945
Automobile and oil	Corporation: The multi-divisional mass-production corporation with strategic integration but operating autonomy in the	Revolutionizing cycle: Strategy-and-Structure Differentiating internal structure and strategy so as to support the production, marketing and sales of differentiated products to different types of costumers	Profit center*	1955
			Operations research	1956
			Corporate Strateg*	1965
			Multidivisional	1965
			Matrix structure*	1969
			Divisionalization	1971
			Management by objective	1972

	divisions	Balancing cycle: Quality Management Deploying a management system to involve personnel at all levels in continuously improving product and process quality	Job enrichment	1972
			Quality circle*	1979
			Corporate culture*	1980
			Organizational learning	1981
			Total quality management	1986
			Continuous improvement	1988
			Lean production	1992
Computers and telecommunication	Network: Linking and rationalizing processes across internal and external boundaries	Revolutionizing cycle: Business Process The redesign of business processes up and down the value chain, redrawing and bridging internal and external boundaries	Business process redesign	1991
			Outsourcing	1991
			Horizontal organization*	1991
			Process improvement	1991
			Business process reengineering	1992
			Core competencies	1993
			Business model*	1994
			Inter-firm network*	1995
			Supply-chain management	1996
		Balancing cycle: Knowledge Management The cultivation of communities of practice in order to regain, retain or improve the innovation capacity of dispersed employees	Knowledge management	1996
			Intellectual capital	1997
			Knowledge repositor*	1998
			Communities of practice	1998
			Agile [2]	1998
			Scrum [2]	2005

[1] Emergence date represent the year in which the frequency of the concept's use first accelerates, based on a search of ABI/INFORM complete, Hoover's Company Profiles, ProQuest Historical Annual Reports, American Periodicals, and ProQuest Historical Newspapers

collection.

[2] ("NEAR/5 software")

Table 3: Secondary cycles and their motivating problems

Primary, paradigm - revolutionizing model	**Key dysfunctions of primary model**	**Secondary, paradigm-balancing model's solution to the dysfunctions**	**Supporting text**
Line-and Staff	Growing gap between the management and the worker, arduous living and working conditions, strikes	Industrial Betterment: Establish welfare secretary (or social secretary) to addresses grievances of workers and prevent strikes	"In the old times master and man lived and worked together; there was a daily point of contact, a continuous personal touch. Today all is changed (...) the personal touch, the point of contact has been lost. (...) However, our American industrialists are beginning to realize that an intelligent regard and a tactful care for the labor part of the business is not only right, but a large factor in industrial peace and contentment (...) The problem which confronts the social secretary is how to improve the conditions of life and labor for the individual, not only in the factory and workshop where he spends the greater part of his working day but in his home and all other relations in which he meets his fellowmen." (Tolman, 1909: 48-50)
Scientific Management	High turnover and low morale of workers due to management control over how and how fast tasks were performed	Human Relations: Influence individual workers' attitudes in order to (re-) create greater harmony and sense of community within the company	"(...) pessimistic reveries, which culminate in disorder and unrest (absenteeism, high labor turnover, strikes) are relatively easily controlled provided that the management has a means of discovering the nature of its cause (...) The investigation of individual situations is more satisfactory than the inquiry into general or departmental situation (...) In by far the greater number of cases there is some unsatisfactory circumstance, usually of personal history or private life, which is a habitual topic of dispersed thinking or revery. Any monotony of occupation or unpleasantness in work tends to extend and emphasize this thinking (...) whenever pessimistic reflection emerges, the effect on productive efficiency is striking and immediate. (...) In a sense, this work involves an extension of that begun by the pioneer, whose name is honored by this society. Taylor confined his attention, upon the whole, to the irrelevant synthesis or mistaken coordination in our muscular apparatus. There is an urgent need to extend this inquiry to discover what irrelevant syntheses of emotions and ideas are imposed upon workers." (Mayo, 1924: 255-259)
Strategy-and-Structure	Poor quality and service, low worker	Quality Management: Train and	"The evidence is overwhelming that in the case of the color TV set, the Japanese do a more complete scrub down than do their competitors in the West. (…) In the West, the scrub down is less complete and the manufacturers

	involvement, lack of cooperation and political gamesmanship	involve teams in order to assure higher quality	are usually aware that the quality problems have not been fully solved. However, the decision is nearly always to go to market anyway because of the pressures of the schedule. (...) Manufacture is done by a few large companies. Marketing is done mainly by numerous independent distributors and retailers. Repair service is done mainly by numerous independent repair shops. In Japan, as in the West, manufacture is also done by a few large companies. However, marketing is done mainly by captive markets controlled by these same manufacturers. In addition, service shop networks are owned by the large manufacturers." (Juran, 1978: 11-13)
Business Process	Risks to the fabric of collective tacit knowledge among experienced employees and to the innovation-generating capacity of the firm	Knowledge Management: Strengthen and deploy the knowledge-producing capacity of communities of practice	"Of course, the real creators of reengineering weren't consultants or academics. They were real people with real problems to fix (...) experimenting with new uses of information technology to link processes that cut across functional boundaries (...) The rock that reengineering has foundered on is simple: people. Reengineering treated the people inside companies as if they were just so many bits and bytes, interchangable parts to be reengineered. But no one wants to "be reengineered." No one wants to hear dictums like, 'Carry the wounded but shoot the stragglers' - language that makes workers feel like prisoners of war (...) putting the company's veterans through their paces like they're just another group of idiots who 'can't think out of the box.'" (Davenport, 1995: 70-71)