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Perspectives on the productivity dilemma

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Editor's note

The authors of this paper presented an All-academy session at the 2008 Academy of Management annual meeting in Anaheim, California. We were excited by the dynamic nature of the debate and felt that it related closely to critical issues in the areas of operations management, strategy, product development and international business. We thus invited the authors to write an article offering their individual and joint views on the productivity dilemma. We trust you will find it to be stimulating and thought provoking. We invite you to add your voice to the discussion by commenting on this article at the Operations and Supply Chain (OSM) Forum at http://www.journalo-perationsmanagement.org/OSM.asp. – Kenneth K. Boyer and Morgan L. Swink

Introduction

David James Brunner, Bradley R. Staats, and Michael L. Tushman

For more than a century, operations researchers have recognized that organizations can increase efficiency by adhering strictly to proven process templates, thereby rendering operations more stable and predictable (e.g., Taylor, 1911; Deming, 1986). For several decades, researchers have also recognized that these efficiency gains can impose heavy costs (Abernathy, 1978; March, 1991). The capabilities that enable consistent execution can also hinder learning and innovation, leaving organizations rigid and inflexible. Many once-successful organizations collapse when they prove unable to adapt to environmental shifts. By optimizing their processes for maximum efficiency in the short term, organizations become brittle. In the *Productivity Dilemma*, Abernathy (1978) conjectured that short-term efficiency and long-term adaptability are inherently incompatible.

Abernathy's dilemma results from inherent dynamics of routinization. Organizational routines are a form of knowledge that guides organizational activity (Nelson and Winter, 1982). When organizations solve problems, they acquire knowledge that can be reused to solve similar problems in the future. This knowledge captures the essence of what worked (or did not work) in the past, enabling organizations to take short-cuts and avoid dead-ends, thereby abridging the problem-solving process (March and Simon, 1993). The more such accumulated knowledge guides organizational activities, the more

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routinized—i.e., stable, predictable and repetitive—those activities become. Routinization enables organizations to exploit their accumulated knowledge, increasing efficiency. At the same time, routinization creates a risk: when organizations are guided by old knowledge, they do not create new knowledge. If the environment has changed, the locations of shortcuts and dead-ends may have shifted and more attractive destinations may have appeared or become accessible. To adapt to environmental changes, organizations must seek out new knowledge. The choice between applying old knowledge and seeking new knowledge is often characterized as a choice between exploitation and exploration (March, 1991; Gupta et al., 2006). Exploitation leverages existing knowledge and capabilities, resulting in stable and efficient performance. Exploration creates new knowledge, enabling organizations to innovate and adapt to changing conditions (March and Simon, 1993).

The distinction between exploitation and exploration is complicated by the hierarchical structure of organizational routines. Routines are assembled from modular subroutines, and often "adaptation takes place through a recombination of lower-level programs that are already in existence" (March and Simon, 1993, p. 171). Thus exploration at a given level may involve exploitation at lower levels (i.e., the application of existing subroutines). Conversely, if change takes place only within subroutines, then low-level exploration can co-exist with high-level exploitation. For example, an assembly process might exploit a high-level task sequence, while exploring within individual process steps. Exploitation occurs when repeated instances of a process consistently follow a template stored in organizational memory; exploration occurs when such behavioral regularities are not present (March and Simon, 1993).

Maintaining a balance between exploitation and exploration turns out to be very difficult. In many contexts, payoffs from exploitation are earlier, more certain, and easier to achieve; consequently, organizations tend to favor exploitation over exploration (Levinthal and March, 1993). Left unchecked, this tendency can choke off learning, leaving organizations vulnerable to environmental change. Hence the importance of *ambidexterity*, the ability to sustain both exploration and exploitation (O'Reilly and Tushman, 2008). Various techniques have been proposed for achieving ambidexterity, such as differentiated exploratory subunits and meta-routines that modify underlying processes (Teece et al., 1997; Tushman and O'Reilly, 1997; Adler et al., 1999; Winter, 2003).

Ambidexterity requires operational processes that combine high levels of efficiency with the flexibility to evolve and improve over time. Thus, the perspectives of operations management are essential to understanding the mechanics of ambidexterity. Moreover, theories of ambidexterity raise important questions for operations management. This article synthesizes several recent perspectives on the dynamics of ambidexterity and the productivity dilemma. Tushman and Benner describe the mechanics and implications of the conflict between exploitation and exploration, while Winter proposes that structured and systematic innovation may render them complementary. Brunner and Staats posit that mature organizations can sustain exploration by selectively and strategically perturbing their own processes. Drawing on examples from Toyota, MacDuffie argues that the first step in achieving ambidexterity may lie in reframing tradeoffs so as to bypass dichotomies. Osono and Takeuchi describe how Toyota uses contradictory expansive and integrative forces to prevent the organization from becoming excessively stable and mature. Adler distinguishes between the dual roles of bureaucracy as a technology of coordination and a social relation of exploitation, and argues that bureaucracies designed to extract profits from the production process may hinder exploration. The conclusion integrates the perspectives and identifies emerging themes.

The productivity dilemma revisited: inherent conflicts between process management and exploration

Michael L. Tushman and Mary Benner[1]

More than 30 years ago, Abernathy (1978) suggested that a firm's focus on productivity gains inhibited its flexibility and ability to innovate. Abernathy observed that in the automobile industry, a firm's economic decline was directly related to its efficiency and productivity efforts. He suggested that a firm's ability to compete over time was rooted not only in increasing efficiency, but also in its ability to be simultaneously innovative (Abernathy, 1978, p. 173).

The necessity of balancing efficiency and exploitation with innovation and exploration has not lessened since Abernathy's initial observations (Gupta et al., 2006). Exploring how organizations might strike this balance has been a consistent theme across research in organizational adaptation (e.g., Brown and Eisenhardt, 1998; Burgelman, 1994; March, 1991). Finding the right balance is complicated by a wave of managerial activity and institutional pressures focusing on process management and control (e.g., Cole, 1998; Winter, 1994). Process management's success in improving manufacturing efficiency has led to its migration beyond operations to other parts of organizations, for instance, to adjacent processes for selecting and developing technological innovations (Brown and Duguid, 2000; Scott-Young and Samson, 2008). As the efficiency oriented focus of process management spreads to centers of innovation, it increasingly stunts an organization's dynamic capabilities (Cole and Matsumiya, 2007).

We have explored how both technological and organizational contexts moderate the relations between process-focused activities and organizational adaptation (Benner and Tushman, 2002, 2003). We argue that process management techniques stabilize and rationalize organizational routines, while establishing a focus on relatively easily available efficiency and customer satisfaction measures. While increased efficiency results from these dynamics in the short run, they also trigger internal biases for certainty and predictable results. The diffusion of

[1] This note is drawn from Benner and Tushman (2002, 2003).

process management techniques favors exploitative innovation at the expense of exploratory innovation. We argue that while exploitation and inertia may be functional for organizations within a given technological trajectory or for existing customers, these variance reducing dynamics stunt exploratory innovation (see also Christensen, 1997).

In a 20-year longitudinal study of patenting activity and ISO 9000 quality program certifications in the paint and photography industries, we found that increased routinization associated with process management activities increases the salience of short term measures and triggers selection effects that lead to increases in exploitative technological innovation, at the expense of exploratory innovation. In both industries, the extensiveness of process management activities in a firm was associated with an increase in exploitative innovations that built on existing firm knowledge, as well as an increase in exploitation's share of total innovations. Our results suggest that exploitation crowds out exploration. Indeed, in the photography industry, increases in process management activities were associated with a decrease in exploratory innovation. We suggest that these widely adopted organizational practices shift the balance of exploitation and exploration by focusing on efficiency at the expense of long-term adaptation.

What are the underlying mechanisms by which exploitation drives out exploration? O'Reilly and Tushman (2008) suggest that the inertia associated with variation-reducing activities is rooted in the increasingly tight coupling between a firm's structure, rewards, culture, competences, and identity, as well as in the demography of the senior team. Tightly interrelated activity systems actively impede anything but internally consistent change (e.g., Siggelkow, 2001; Sroufe and Curkovic, 2008). Dynamic conservatism comes from the system itself. It is not that inertial systems are stable. Rather, they act to dampen deviations from the status quo. Worse, there is evidence that exploitation-oriented problem solving practices diminish an individual's ability to explore. In a natural experiment where industrial engineers were randomly assigned to ISO 9000 training, Tilcsik (2008) found that ISO 9000 training was associated with increases in the engineers' efficiency at the expense of their creativity. These individual performance effects were accentuated for more uncertain tasks and the effects were stable over three years. Tilcsik (2008) suggests that these effects are rooted in diminished intrinsic motivation and stunted cognitive models associated with TQM training.

Structural ambidexterity as a dynamic capability

Abernathy (1978) highlighted the inconsistencies between activities focused on productivity improvements and cost reductions and those focused on innovation and flexibility. He questioned whether it was possible for organizations to pursue both types of activities simultaneously (p. 173). It may be possible to achieve high levels of productivity as well as innovation and flexibility. If so, the unit of analysis must shift from Abernathy's productive unit as the level of analysis to the business unit (though Adler et al., 1999, work is indeed at the factory floor).

Ambidextrous organizational forms are organizational architectures that build in internally contradictory subunits simultaneously (Tushman and O'Reilly, 1997; Bradach, 1997). Structural ambidextrous designs are composed of multiple subunits that are internally tightly coupled, but loosely coupled to each other. For example, at USAToday, the incumbent newspaper business was only connected to the exploratory dot com business through weekly cross-unit editorial meetings. Such targeted linking mechanisms permitted highly decentralized action that still took advantage of USAToday's core editorial content. Within subunits, the tasks, culture, individuals and organization arrangements are consistent, but across subunits, tasks and cultures are inconsistent and loosely coupled. Exploratory units succeed by experimenting, by creating small wins and losses frequently. In contrast, exploitation units succeed by reducing variability and maximizing efficiency. These contrasting, inconsistent units are physically and culturally separated from each other, have different measurement and incentives, and have distinct managerial teams (Raisch and Birkinshaw, 2008).

These highly differentiated but loosely coupled subsystems must be strategically integrated by the senior team. Such strategic linkage is anchored by a common aspiration and a senior team that is rewarded based on common fates measures, and a senior team that provides slack to the experimental subunits and holds the differentiated units to fundamentally different selection and search constraints (O'Reilly and Tushman, 2008). To be effective, ambidextrous senior teams develop their own processes such that they can establish new forward-looking cognitive models for exploration units, while allowing backward-looking experiential learning to rapidly unfold for exploitation units (Smith and Tushman, 2005).

In sharp contrast to contextual ambidexterity, where the locus of exploitation and exploration is throughout the firm (Gibson and Birkinshaw, 2004), structural ambidexterity separates out exploratory from exploitative activities. Strategic options are created in multiple small exploratory units that are buffered from exploitative units. The top management team selects out from the multiple experiments a variant from which they then move towards greater exploitation. Thus organizations evolve through continuous incremental change in exploitative units and through punctuated change driven by results of the exploratory units as the business moves toward greater scale. Such highly differentiated units in the context of activist senior management teams permit the firm to simultaneously explore even as it exploits. O'Reilly and Tushman (2008) and Harreld et al. (2007) provide examples of structural ambidextrous designs at the business unit and corporate levels of analysis.

The requirement for building organizations that are simultaneously efficient and innovative seems to be more than a dilemma. These contrasting, paradoxical activities of exploration and exploitation may be important at the individual, team, and organization levels of analysis (e.g., Gibson and Birkinshaw, 2004). But the individual and organizational processes associated with productivity and efficiency crowd out the ability to innovate and explore. If

these forces for inertia are so strong, these contrasting activities must be separated and only loosely coupled to each other. If there are no synergies between the exploitative and exploratory activities (as in a product substitution), then the units can be spun out from each other (e.g., Christensen, 1997). If, however, there are complementarities across these contrasting activity systems, the linkage must be structurally targeted within the firm and the tradeoffs made at the senior team level (Smith and Tushman, 2005). This structural ambidexterity may be a practical way out of Abernathy's productivity dilemma and Christensen's (1997) innovation dilemma (O'Reilly and Tushman, 2008).

Skills, routines and disciplined progress

Sidney G. Winter[2]

Tensions between short-run efficiency objectives and long-term innovation objectives are a fact of organizational life – a fact by now much remarked and carrying several labels. There is also, however, something in the way of a tool kit for dealing with these tensions – and again we have a choice of observers, theories and labels. On both sides of the question, complex causal mechanisms play out in diverse ways in diverse situations. This might imply that we should not be aspiring to general conclusions with respect to the overall question, but rather seeking to sort out the mechanisms and the contingencies.

Among the many tempting targets presented by this discussion, I choose to highlight ones that have deep and long-standing connections to my own work – considering that the obvious objections on grounds of ego-centricity are here outweighed by considerations of comparative advantage. I re-examine issues related to the discussion of organizational routines in my book with Nelson (Nelson and Winter, 1982), inter-weaving three major themes that offer discussion opportunities of the "compare and contrast" kind. These are (1) past to present, i.e., the origins of the ideas and what happened to them, (2) individuals to organizations, i.e., skills to routines and capabilities, and (3) stasis to change—which is (partly) aligned with "exploitation vs. exploration" and the other versions of the focal question here.

The picture of organizational routines that Nelson and I presented drew elements from several sources. In the book, the (organizational) routines chapter followed the (individual) skills chapter, and of course we had in mind that the former would be read in the light of the latter. In retrospect that seems to have been a naïve expectation. Perhaps the result is partly attributable to the fact that the routines discussion became widely cited and this may have led people to dip into the book at Chapter 5.

Certainly our discussion of routines was strongly grounded in the prior contributions of the Carnegie School and other scholars of organizations. In its relationship to individual skill, however, it was also grounded in the insights of Michael Polanyi (Polanyi, 1964) and other close observers of repetitive individual performance (e.g., Schank and Abelson, 1977). These perspectives offer a different view of human possibilities than is suggested by the Carnegie term "bounded rationality." When witnessing the exercise of impressively high skill, it is not so much the "boundedness" that seems salient, but the virtual impossibility of reconciling what is observed with an inner process that is subjectively familiar to the observer as a process of "choice," "deliberation" or (conscious) "calculation." It looks like the skilled performer is performing too well and too fast for that sort of thing to be going on. As it turns out, this judgment is basically correct.

Psychological research subsequent to 1982 confirmed the existence of a performance system that is grounded in procedural memory (a.k.a. "skill memory"), a system that is physiologically distinct in the brain, and quasi-independent in function, from declarative memory and the slow processes guiding deliberate choice (Cohen and Bacdayan, 1994). Highly skilled performance is to a large extent "played" out of procedural memory, not "chosen" in detail, and it is available for playing by virtue of prior learning and practice. It contributes to creativity by limiting the scope of slow "choosing" to "what should be played now?" and "how can that last attempt be corrected or improved?" The realized achievement depends on an indispensable time investment by the learner, which cannot be substituted by a virtually costless transfer of mere symbols. The investment is irreversible not only in the sense that the time investment cannot be recovered by "cashing in" the acquired skill, but also in the sense that the effect of learning is to create behavioral channels that are partly sub-conscious and typically difficult to resist or remove. Thus it happens that skilled performance is associated with a characteristic failure mode, "doing the wrong thing well," that occurs when learned programs "fire" on inappropriate occasions (Cohen and Bacdayan, 1994). That similar mechanisms operate in the domain of perception has long been noticed, e.g., in Gestalt psychology, and has recently acquired additional confirmation the physiological level (Rizzolatti et al., 2008).

The recent psychological evidence vindicates the earlier judgments of Polanyi and many others (including followers such as NW), regarding the quasi-independent role of skill. Among those precursors, we would now cite an important one we previously neglected, Dewey (1922). Dewey saw human behavior as constituted by varying mixes of three components: habit (which reflects prior learning and thus encompasses skill), intelligence (or deliberation), and impulse (affect, or emotion). We know a great deal more about the physiological basis of these components than we did in Dewey's day, and we know something about what happens when one or another of these components is severely impaired in an individual. His scheme stands as a call to action for today's social scientists, challenging us in two ways: first, to develop a balanced view of the sources of behavior; second, to attend to the crucial but complex question of how the interfaces work when the components are jointly expressed in behavior (Cohen, 2006, 2007; Adler and Obstfeld, 2007).

Among the advantages of the conceptual juxtaposition of skills and routines is the evaluative tension induced by

[2] I am indebted to Paul Adler, Michael Cohen, and John Paul MacDuffie for helpful comments on an earlier draft.

the terminology. It is easy to be "against routine" because the term has some negative connotations, but it is harder to be "against skill."[3] Yet there are strong connections between the two levels, involving at least four important elements—logical isomorphisms between the choice problems facing the actors,[4] causal reduction opportunities because of the role of individual skills in routines, causal relations in the opposite direction by virtue of the shaping of individuals by the social context, and fruitful analogies suggested by the perspective, "individuals are complex organizations too." In that perspective, the conscious mind is in the role of top management, deliberating and setting directions, while innate or learned neuronal patterns do the implementation – often doing enormously complex things that the mind is not aware of and could not do itself. The mind is, however, involved in important choices about which skills are worth acquiring, and in guiding the halting performances that ensue at the early stages of learning. The investment analytics relevant to those conscious activities of the individual are formally equivalent to those for top management decisions about strategic extension of capabilities, and the subsequent consequences that flow from the economic logic of sunk costs (e.g., competency traps) are also equivalent. Once the learning investment is made, it can be quite rational to continue exercising the acquired skill even in environments that would no longer justify the investment. (It "can," but need not, of course.)

Given these connections, it can be instructive to take an offered case "against routine," find a parallel in the domain of individual skill and see how the argument sounds there. In my view, the parallel cases are easy to find and the reexamination tends to make the case against routine sound less persuasive.[5] Take the issue of discipline, for example. At the individual level, we can identify cases where regimes of disciplined practice are a clearly-marked part of the path to innovation, creativity and general excellence: Prominent examples like gymnastics, musical performance or fluent command of a foreign language have innumerable counterparts in the specialized skills exercised in the workplace. It is true that creativity and even competence can be impaired if discipline is overdone. Also, there are certainly domains where brilliant "improvisation" is much admired, though close inspection often reveals a fundamental role for practice, and micro-repetition, in improvised performance.[6] These observations do not significantly qualify the typical foundational and *enabling* role of disciplined practice, considered as the basis of individual skill.

Turning to the organizational level, what is it that would lead one to expect a different pattern? Why should it be surprising or paradoxical to find a highly disciplined organization at the forefront of world competition in its domain (Brunner et al., 2008)? An overdrawing of the genuine distinction between "mindful" choice and "mindless" routine may be implicated here. It tends to leave out of account the role of procedural memory and practice as the basis of high competence, including the dynamic forms of competence that provide resistance to inertia.

Organizational competence in the realm of change has in recent years become associated with the term "dynamic capability." While there are broader understandings of this term, it is often understood, at least in part, as referring to the systematic exploitation in the domain of change of the kinds of learned-competence advantages commonly associated with routines (Zollo and Winter, 2002). This immediately highlights a key conceptual issue about change: What, exactly, is changing? A succinct evocation of this issue was once presented by Dr. Ralph Gomory, who responded to a mention of "innovation in semiconductors" with the comment, "Innovation in semiconductors? I am not sure there *is* such a thing as innovation in semiconductors. They just keep doing the same thing over and over."[7] Of course, Gomory was well aware that successive generations of semiconductor devices do display impressive novelty, and that they impart a fundamental dynamic to the world we live in. But the process by which Moore's Law is enacted is indeed quite repetitive in many respects.[8] A second key issue is implicated in the first: How, exactly, do we assess the degree of innovativeness – or novelty, or creativity – in a performance? In particular, do we look primarily to the magnitude of the impact on the environment, or focus on the boldness with which the actor has overcome internal and external constraints, or defied expectations? Intel has consistently produced a lot of impact; whether there was similarly consistent boldness/creativity is more questionable. As with Intel, so perhaps with Toyota.

Needless to say, organizations involve mechanisms and phenomena that are little suggested at the level of individuals. There are, in particular, key issues of motivational alignment between choosers and enactors; workers generally surpass neurons and muscles in their recalcitrance (see Adler's section of this article). Undoubtedly, this fact is a key contributor to the element of genuine paradox identifiable in the performance of highly disciplined organizations like Toyota; understand how that alignment happens and you will understand a great deal.

[3] Only belatedly did we firm up the terminological proposal and advocate that "skills" might conveniently be *reserved* to the individual level, and "routines" to the organizational level (Dosi et al., 2000). Cohen has argued that the connotations of "routine" induce misunderstandings that burden the discussion at the organizational level (Cohen, 2007). While the complaint has some force, it is my view that no clearly superior term is available – and, as noted, the provocation has some value.

[4] The isomorphism is most apparent when the management of an organization is conceived as a unitary actor, which is traditional in economics.

[5] The same can be said about the case favoring "mindfulness;" see (Levinthal and Rerup, 2006). The familiar phenomenon of "clutching" is one illustration of the counterproductive consequences of excessive mindfulness (Gladwell, 2000).

[6] This point is familiar in the context of jazz improvisation. On organizations, see Miner et al., 2001.

[7] Spoken at a meeting in which we both participated in 1983, quoted by permission. Gomory was then the VP for R&D at IBM.

[8] See Winter, 2008 for detailed discussion of this example, and of the general issues raised in this paragraph. For an appreciation of quality management as systematic improvement of organizational routines, see Winter, 1994.

There are also important issues of differential complexity, and of scale, and key differences in the mechanisms of perception. In my view, these distinctively organizational features are most fruitfully addressed in terms of how they modify patterns and conclusions familiar – and more readily researched – at the individual level, particularly those involving phenomena grounded in procedural memory. Nowhere is this approach more helpful than in understanding competence in the domain of change.

Perturbations and dynamic efficiency

David James Brunner and Bradley R. Staats

Abernathy's (1978) productivity dilemma arises because mature processes provide few natural opportunities for learning. In mature processes, activities proceed according to plan, accidents and exceptions are rare, and external stimuli are filtered and buffered to prevent them from disrupting routine operation. For example, work-in-process inventory buffers insulate manufacturing activities from problems in upstream processes. When processes are stable and predictable, organizational activity validates existing knowledge, but provides no new information to enable knowledge creation (Peng et al., 2008). To sustain learning under these conditions, organizations must intentionally re-introduce variance into mature processes. We term this *deliberate perturbation* (Brunner et al., 2008).

Our theory of deliberate perturbation emphasizes dynamic efficiency. By sacrificing some efficiency in the short term, organizations may be able to sustain innovation and adaptability. If innovation yields increased efficiency in subsequent periods, then deliberate perturbation may be a dominant strategy leading to both higher efficiency and higher adaptability (Fine and Porteus, 1989). To achieve this, deliberate perturbation must be selective and strategic. Some processes have little scope for improvement, because their performance is and will likely remain nearly optimal. Perturbing these processes is unlikely to increase dynamic efficiency. Some perturbations indicate bottlenecks or opportunities, while others are simply distractions. Deliberate perturbation is most likely to increase dynamic efficiency when it leads directly to the creation of new knowledge that improves operational performance.

While perturbations are necessary to spark exploration, they are not sufficient. Organizations can ignore perturbations or work around them, in which case perturbations only reduce static efficiency. Alternatively, organizations can attempt to understand the causes and implications of perturbations. This choice is analogous to the decision of how to respond to a crash in a software application. A user can simply reboot the computer system, hoping the problem will not reappear, or the user can debug the application in order to understand and resolve the problem. In organizations with streamlined, stable processes, most perturbations carry valuable signals from which the organization can learn. Why did a defect appear in the output? Why did a design task require more time than expected? Why did a new product exceed sales forecasts? Many organizations assume that such perturbations are chance occurrences and ignore them, thereby passing up valuable opportunities to learn and adapt to changing environment conditions. Organizations learn from perturbations through *exploratory interpretation*, the process of interpreting perturbations as opportunities to explore new possibilities.

Exploratory interpretation requires the active engagement of organization members in detecting, analyzing, and drawing inferences from failures and discrepancies. Indeed such engagement is a key element of many improvement methodologies such as TQM and lean production (Flynn et al., 1994). The more organization members participate in exploratory interpretation, the greater the potential for learning. Engaged *en masse*, learning by front-line personnel can make substantial contributions to high-level organizational performance (Flynn et al., 1994; Loch et al., 2007; May, 2007). Since interpretation begins within the minds of organization members, it cannot be dictated or micromanaged. To ensure that exploratory interpretation advances organizational goals, members must be committed to those goals (Nonaka, 1994; Loch, 2008). Otherwise, the learning that results from perturbations may be irrelevant or even counterproductive (for example, learning to game incentive systems).

Even as variance reduction leads to the productivity dilemma, it also facilitates deliberate perturbation. When processes are under tight control, the effects of perturbations can be seen more clearly, enabling organizations to better identify and understand the causal relationships between organizational activities (Jaikumar and Bohn, 1992; Bohn, 1995; Schroeder et al., 2008). This knowledge guides the design and interpretation of subsequent rounds of deliberate perturbation, and also enables even tighter control over the underlying processes. Variance reduction, targeted re-introduction of variance, and analysis of the results form a virtuous cycle that increases efficiency and sustains adaptability.

Together, deliberate perturbation and exploratory interpretation provide mechanisms for achieving superior dynamic efficiency. When the organization deliberately perturbs a process, the resulting variance reduces static efficiency. Exploratory interpretation and ensuing problem-solving activity also imposes costs on the organization. However, the new knowledge deriving from the perturbation can be used to improve the efficiency or efficacy of the process. Our companion paper uses Toyota to illustrate how an organization uses deliberate perturbation and exploratory interpretation to attain exceptional dynamic efficiency (Brunner et al., 2008). For example, Toyota shrinks work-in-progress inventory buffers to identify the weak links in its supply chain. By focusing attention on strengthening these links, Toyota can efficiently reduce the total inventory in its supply chain (Fujimoto, 1999; Fullerton and McWatters, 2001). Based on Toyota's performance, it appears that the learning occasioned by the perturbations quickly outweighs the costs of the resulting brief disruptions. The increase in dynamic efficiency more than compensates for the decrease in static efficiency.

Deliberate perturbation need not be mindful. Organizations can create routines that induce perturbations

automatically, without conscious choices by employees. MacDuffie describes how processes at Toyota are designed to draw attention to problems and occasion learning (this article). Toyota's operating system generates a constant stream of perturbations that employees are tasked with interpreting. Winter theorizes that such routines can underpin dynamic capabilities (this article). While routines that automatically induce perturbations can certainly help sustain exploration, consciously induced perturbations may also be essential, especially for high-level exploration. Radical new product development initiatives like the Lexus luxury brand and the Prius hybrid are not triggered by shrinking buffers or andon cord pulls; rather, they derive from intentional actions by senior managers (Dawson, 2004; Osono et al., 2008).

The problem of achieving dynamic efficiency is further complicated by the relationship between process adaptability and high-level exploration. When processes are adaptable, they semi-autonomously reconfigure themselves to support changes in high-level strategy and in other interdependent processes. Thus adaptability in a process increases dynamic efficiency not only by improving the performance of the particular process over time, but also by contributing to better system-level performance. When implications for system-level performance are taken into account, deliberate perturbation may be efficiency-enhancing even when the costs outweigh the value of learning for a particular process in isolation.

The challenge for organizations is to design systems that increase dynamic efficiency through deliberate perturbation and exploratory interpretation. In contrast to static efficiency, which can often be framed as a deterministic optimization problem, there are many approaches to deliberate perturbation with the potential to increase dynamic efficiency. Experimentation may be the only way to determine whether a particular approach works. The theory clearly predicts, however, that the absence of perturbations or the failure to learn from them will prove suboptimal over time.

Expansion and integration: how contradictory forces sustain productive tension at Toyota

Emi Osono and Hirotaka Takeuchi

The productivity dilemma emerges from the inherently contradictory natures of exploration and exploitation. Based on empirical research that includes over 200 interviews in 11 countries, we find that Toyota transcends the productivity dilemma by seeking a higher-order resolution to conflicting forces (Osono et al., 2008).

During the course of our 6-year research, we discovered that unearthing Toyota's inner workings was like peeling an onion and never reaching the center. After peeling many layers and making seemingly conflicting observations, we realized the company actively embraces and cultivates contradictions instead of passively coping with them. Toyota actually thrives on paradoxes; it harnesses opposing propositions to energize itself.

The breakthrough occurred when we realized that these contradictions, opposing characteristics, and paradoxes were central to our investigation. While other companies still function according to the logic of the industrial age and stamp out such differences, at Toyota they are a way of life. As a car manufacturer, Toyota is the quintessential industrial firm, represented by the famous Toyota Production System (TPS), its quality management system, its supply chain management system, and its differing approaches to product development (e.g., concurrent engineering and heavy-weight project managers). At the same time, it is staging a successful transition to the postindustrial, knowledge age.

In the industrial age, contradictions were commonly viewed as characteristics to be avoided or eliminated. In the knowledge age, however, new knowledge is created by reconciling our unique perspective with those of others who disagree with us (Nonaka and Takeuchi, 1995; Takeuchi and Nonaka, 2004). Recognizing opposing insights is essential to understand the organic whole. Toyota deliberately forces contradictory viewpoints within the organization and challenges employees to find solutions by transcending differences rather than by resorting to compromises.

During the first phase of our research, we uncovered six major contradictory tendencies.

(1) Toyota moves slowly, yet it takes big leaps.
(2) Toyota is frugal, but it splurges on key areas.
(3) Toyota's operations are efficient, but it uses employees' time in seemingly wasteful ways.
(4) Toyota grows steadily, yet it is a paranoid company.
(5) Toyota has a strict hierarchy, but it gives employees freedom to dissent.
(6) Toyota insists internal communication be simple, yet it builds complex social networks.

Once we realized that contradictions are central to Toyota, we tried to identify the underlying forces that cause them. After we had written six case studies, a pattern finally emerged. We identified six forces that cause contradictions inside the company.

Three of the six forces of expansion lead Toyota to instigate change. They force employees to think about how to reach new customers, new segments, and new geographic areas as well as how to tackle the challenges of competitors, new ideas, and new practices. Not surprisingly, they make the company more diverse, complicate decision making, and threaten its control system. To prevent the winds of change from blowing the organization apart, Toyota also harnesses three forces of integration. They stabilize the company, help employees make sense of the complex environment in which they operate, and perpetuate Toyota's values and culture.

Forces of expansion

"This is how we do things here" is a common refrain in every organization. Established practices become standardized and create efficiencies. Over time, however, those methods can prevent an organization from exploring new ideas and trying new things (Osono et al., 2008). Toyota prevents rigidity from creeping in through the following three forces of expansion:

Impossible goals

Toyota sets goals for itself that most would consider impossible to achieve, knowing full well that the means to achieve them may not exist. For example, President Katsuaki Watanabe has said that his goal is to build a car that makes the air cleaner, prevents accidents, makes people healthier and happier when they drive it, and gets you from coast to coast on one tank of gas. By setting near-unattainable goals, Toyota's senior executives push the company to break free from established routines.

Experimentation

Toyota's eagerness to experiment helps it clear the hurdles that stand in the way of achieving near-unattainable goals. Toyota has found that a practical way to achieve the impossible is to think deeply but take small steps—and never give up. It operates on the premise that every original plan for a project is imperfect and incomplete, as it found out when it set out to develop what is now known as Prius in 1993. The first hybrid engine would not start. When a subsequent model did, the prototype moved only a few hundred yards. In later models, the battery pack shut down whenever it became too hot or cold. If the original plan does not work, the project team learns from the experience, modifies the plan, and tries again and again. By encouraging employees to experiment, Toyota moves out of the comfort zone and into uncharted territory.

Local customization

Toyota does not adapt its automobiles to local needs, nor does it consolidate its products and operations to a global standard. It customizes both products and operations to incorporate the sophistication and diversity of local markets around the world, as in the case of Scion in the U.S., Yaris in Europe, and the IMV (Innovative International Multipurpose Vehicle) in Asia. The IMV-based cars were the first that Toyota produced overseas (in Thailand, Indonesia, Argentina, and South Africa originally) without first making them in Japan. They rendered the Made-in-Japan label irrelevant, which many executives thought was too risky since it had become synonymous with quality. However, Akio Toyoda, then in charge of sales and production in Asia, launched a personal crusade to persuade employees that the company should replace Made-in-Japan with Made-by-Toyota.

Forces of integration

While the forces of expansion extend Toyota's organizational, geographical, technological, and knowledge boundaries, three forces of integration weave the company together and keep it from spinning out of control. The following three forces perpetuate its culture and stabilize the company's expansion and transformation:

(1) Founders' philosophies

While Toyota is not alone in having core values originating with its founders, it is unique in the way it inculcates and ritualizes them in practices designed to test and reinforce their relevance every day. Core values are born from the historic words of the founders, such as the following:

- "*Bear a hundred times, strengthen yourself a thousand times, and you will complete your tasks in short order*," by Sakichi Toyoda, who created the parent Toyoda Automatic Loom Works.
- *"Customers first, dealers second, and factory last,"* by Shotaro Kamiya, who developed the company's sales network.
- *"Ask 'why' five times,"* by Taiichi Ohno, the creator of TPS.

Toyota began to organize and document these values and eventually published them in *The Toyota Way 2001* handbook as a tool to help its employees cope with the uncertainties of constant change. These core values have withstood the test of time to define, shape, and give stability to Toyota's corporate culture.

(2) Nerve system

Toyota's intricately layered network of open communication, referred to within the company as the "nerve system," tries to preserve a small-town feel throughout Toyota's vast organization by ensuring "everybody knows everything." Information flows freely up and down the hierarchy and across functional and seniority levels, extending outside the organization to suppliers, dealers, and customers. What is unique in this day and age of digitization is the fact that the company has created this "interconnected" world primarily through analog means, mainly through face-to-face personal interactions. What is also unique is the fact that its communication system is open to criticism. Employees feel safe, even empowered, to voice contrary opinions and contradict superiors. Every employee enjoys the prerogative to ignore the boss's orders or not take them too seriously. Confronting your boss is accepted and bringing bad news to the boss is encouraged.

(3) Up-and-in human resource management

In the conventional up-or-out human resource management practice, employees are expected to achieve, and poor performers are weeded out. Toyota's up-and-in treatment of employees guarantees them long-term employment and emphasizes continuous development of employee skills and experience. Employees are allowed to fail, and performance evaluation emphasizes learning over immediate results. A quintessentially Toyota measure of manager performance is persistence or resilience. The company sees this as part of its DNA, describing it as *nebari tsuyosa,* which translates literally as adhesive strength. Toyota's evaluation criteria are particularly relevant in automobile manufacturing, where various types of expertise are essential to success. It is not the kind of company where a few shine. Up-and-in human resource management ensures the stability of the workforce and fortifies corporate memory, as employees stay longer within the organization.

The six forces of expansion and integration complement each other in opposition and create complex dependencies that drive Toyota to a state of disequilibrium. Any change in one of the forces disrupts this state, creating a tension that serves as a catalyst to send the company off to a new trajectory.

One of the main reasons why companies fail today is their tendency to kill contradictions, opposites, and paradoxes by sticking to old routines created by their

past success. In contrast, Toyota relentlessly pits opposing forces against each other to realize continuous improvement and constant renewal. As a mature organization, Toyota tries to remain dynamic by being a "green tomato," in which the potential to develop still lies ahead. This is a mirror of human creativity – always growing and always incomplete.

When times are good, the six contradictory forces are self-generated and deliberately imposed. They drive Toyota to the "extreme," a state of disequilibrium where radical contradictions coexist, propelling it away from its comfort zone and creating healthy tension and instability within the organization. When times are bad, as is now the case, market forces drive Toyota to the extreme. This tension becomes the catalyst to find new solutions beyond contradictions. Not in compromise or balance, but in higher levels of resolution.

Exploration, exploitation, and continuous learning: Toyota and bypassing dichotomies

John Paul MacDuffie

The need to balance exploration and exploitation is a powerful imperative in literature on strategy, organizations, and operations management, evoked to explain why the strengths of thriving firms can become weaknesses. As articulated by Abernathy (1978), the "productivity dilemma" occurs because firms persist in improving efficiency with respect to the capabilities that originally made them successful. The resulting rigidities of mindset, routines, and expertise drive out exploratory innovations that could spur adaptation to environmental change (Benner and Tushman, 2003). From this perspective, process improvement is the handservant of exploitation and the enemy of exploration.

A contrasting argument is that firms following a particular organizational approach can utilize process improvement to achieve exploration/exploitation balance. Adler and Borys (1996) agree that a coercive bureaucracy will ossify routines as standard operating procedures that become rigid mindguards, but argue that an enabling bureaucracy will instead utilize meta-routines (routines for changing routines) to avoid "iron cage" bureaucratic constraints. Brunner et al. (2008) claim that disciplined organizations can deliberately perturb organizational routines to force fresh interpretations of problems and move from exploitation back to exploration.

Toyota provides a valuable empirical context for assessing this debate. The Toyota Production System (TPS) does rely on meta-routines that prompt changes in routines, stimulate organizational learning, and yield considerable exploration. Still, in my view, Toyota's approach is far removed from the Brunner et al. notion of deliberate perturbations. Instead, Toyota eschews dichotomies like "exploration/exploitation" conceived as tradeoffs. Toyota's managers look past tradeoffs to find new ways of framing issues, using metaphors that frame opposing forces as integrally related. In the words of Chamberlin (1965, original is 1890), "the mind becomes possessed of the power of simultaneous vision from different standpoints" (p. 756); integrative solutions emerge that are not "either-or" but transcend the distinction (Martin, 2007).

Consider the tradeoff between productivity and quality, as taught to generations of students in OR/OM courses. Joseph Juran's "cost of quality" model showed how failure costs can decline with attention to quality until they are overtaken by the increasing costs of appraisal and prevention, at which point total costs begin to rise. The point at which reduced failure costs intersect with rising appraisal costs may fall well short of achieving 100% conformance quality.

Toyota's Ohno took a different approach (1988). He conceived of the production system as having one overarching goal: the reduction of *muda,* the Japanese word for waste. If quality defects are viewed as one form of waste, then the same processes that would eliminate cost inefficiencies – waste of motion, materials, or space – would also eliminate defects. What this reframing does is to shift the tradeoff point to the right, creating a large space in which to achieve "win–win" gains of improved productivity *and* improved quality; in essence, this accumulation of capabilities shifts the performance frontier outward (Cole, 1992; Flynn and Flynn, 2004).

How does Toyota's bypassing of dichotomies apply to the exploration-exploitation dichotomy? Toyota pursues continuous learning in every aspect of how its organization operates. This approach advances both exploitation (i.e., smarter, better, more efficient utilization of established products, processes, capabilities) *and* exploration (i.e., creative search in domains far from existing routines that stimulates adaptive change and achieves breakthrough problem-solving that expands performance frontiers), without differentiating these goals.

Toyota bypasses this particular dichotomy by relying on five mechanisms for continuous learning. Learning at Toyota is **ubiquitous** (across the entire organization and all the time), **automatic** (occurring without direct management intervention), **iterative** (following a disciplined movement between phases of standardization and experimentation), **gap-driven** (where the gap is defined by the space between the "current situation" and the "ideal state"); and **framed around "problems as opportunities"** (stimulating positive cognitive biases and legitimizing difficulties and failures as valid inputs to the learning process).

Ubiquitous: Continuous learning is based on the premise that all organizational members can and should be active cognitive contributors. At Toyota, this occurs through the process known as *kaizen*, or "continuous improvement." *Kaizen* does not acknowledge any distinction between exploitation and exploration; nor do managers decide when to initiate *kaizen* through deliberate perturbation. The incremental improvements that emerge virtually without interruption cumulatively yield substantial adaptations incorporating new knowledge, not static exploitation. These small steps also provide the foundation for big jumps, which Toyota calls *kakushin*, that are more immediately recognizable as innovation. *Kaizen* and *kakushin* are not two different processes based on the intended magnitude of change (Womack and Jones, 1996)

but different outcomes from the same process, dependent on how problems are framed.

Automatic: Automaticity of learning at Toyota starts with the belief that the status quo should be automatically, continuously, and skeptically scrutinized to assess whether it is the best course for the future. This belief, fundamental to *kaizen*, resonates strongly with the writings of Pragmatist philosophers such as John Dewey (Helper et al., 2000). Consider the Toyota Production System's (TPS) focus on elimination of waste, or *muda*, and its belief that all buffers (e.g., inventories of parts and in-process units; post-process repair areas; utility workers; backup machines) are *muda*. Buffers represent a cost, but the real reason buffers are *muda* is that they hide problems. An ample inventory of spare parts allows a defective part to be quickly replaced, providing no pressure to find out exactly why that part was defective. In contrast, TPS's "zero buffers" policy, which keeps parts inventory very low, forces problems immediately and continually to the surface.

Another source of automaticity at Toyota is the principle of *jidoka*, also known as "autonomation", in which manufacturing equipment is designed to stop automatically if a problem occurs. An organizational equivalent to technology-based *jidoka* is provided by authorizing workers to "stop the line" when they spot a quality problem, triggering immediate problem-solving. Management's responsibility is not to direct employees on when to stop the line, but to make sure automatic responses do not degrade; for example, a decline in the number of line stops is cause for concern because it means problems are staying hidden. Administrative processes are also designed for *jidoka*, with similar attention to making problems automatically and immediately visible. In contrast with routines that reinforce fixed templates for action, these processes generate knowledge that is "new" because it would not otherwise be surfaced.

Iterative: One paradox of the Toyota Production System is that it is at once an extreme application of the principles of Taylorism, yet at the same time, it overturns key aspects of Taylorism. A premise of TPS is that to improve a process you must understand it, and that you cannot understand it without fully specifying it. The TPS methodology of "standardized work" specifies details of operational routines that would make Taylor proud (Adler, 1993b). Yet contrary to Taylorism, thinking by workers is encouraged, not discouraged. Line workers and team leaders, not specialists, do the industrial engineering to standardize processes. Once a process is standardized, anyone can suggest ways to change the standard to improve its performance vis-à-vis various metrics (e.g., cost/quality/safety). This is approached as an experiment (Spear and Bowen, 1999), with "before" and "after" data rigorously analyzed; engineers have an important role here. If the proposed countermeasure demonstrably leads to better performance, it becomes the new standard.

Toyota's rigorous approach to evaluating countermeasures proposed by employees foreshadowed the increasing analytical precision in the evolution of quality management methodologies, e.g., from TQM to Six Sigma (Zu et al., 2008). But under TPS, this cycle does not end with implementation of the best experimental results. Establishing the new standard is the signal that new proposals for change are again invited.

Gap-driven: Toyota repeatedly applies its PDCA learning cycle (Plan, Do, Check, Action) at both operational and managerial levels (Osono et al., 2008). This approach, rooted in the quality prescriptions of W. Edward Deming, is often associated with an incremental problem-solving approach. But at Toyota, it can also provide the basis for exploration rather than exploitation. The critical step results from pinning down the Current Situation and then envisioning the Ideal Situation, to define the gap. When the Ideal Situation is envisioned as very far distant from the Current Situation, the resulting gap definition can be very wide indeed. Definition of the gap and induction from the problem determines the appropriate countermeasures and the range/reach of their impact. When executives apply this approach to challenging, often ambiguous business challenges, with an ambitious Ideal Situation as part of gap definition, the process stimulates exploration, not least by highlighting the inadequacy of countermeasures based on exploitation. Ultimately, the process of PDCA problem-solving blurs the line between "explore" and "exploit" because of underlying commonalities in how countermeasures are sought after the gap is defined – whether that gap is large and strategic or small and operational.

"Problem as opportunity": At Toyota, problems are seen as learning opportunities. When problems occur, whether internal or external, accidental or the result of plans gone awry (Fujimoto, 1999), Toyota's managerial philosophy encourages managers to pursue them as chances to learn. At many organizations, this is difficult because individuals and groups fear bringing forward problems for which blame could be assigned. Toyota aims to remove the stigma associated with identifying or causing a problem in order to provide psychological safety (Edmondson, 1999). The dissecting of failures and exploring of past "dead ends" is encouraged to find new ways to tackle complex problems. This activity leads to more motivating job design, by boosting skill variety and task identity as well as self-efficacy and work facilitation (de Treville and Antonakis, 2006). The "problem as opportunity" framing triggers positive cognitive biases (wider search, more information-sharing) in comparison with "problem as threat" framing (MacDuffie, 1997). Supporting this framing is a culture of high awareness about unresolved problems. This culture grows partly from Toyota's predilection for setting ambitious, near-impossible goals; for example, "zero defects" in terms of quality, "zero buffers" in terms of inventory management. This preoccupation with unaddressed problems helps prevent complacency (Liker, 2004; Osono et al., 2008).

What Toyota teaches us: Toyota teaches us that there are many advantages in bypassing the "explore-exploit" dichotomy to focus on continuous learning. Rather than managers having to make frequent choices about when and where to undertake deliberate perturbations, Toyota finds it simpler and more powerful to develop ubiquitous learning, triggered automatically, that iterates between standardization and experimentation. Toyota's process of gap definition yields a mix of exploit and explore, without

actually making this distinction. The subsequent process of inductively finding countermeasures is fundamentally the same in either case, even though a gap definition that points toward "explore" demands a different cognitive process than a gap addressed by "exploit." Finally, Toyota's culture sees "problems as opportunities" and helps overcome natural human and organizational biases against being linked to failure.

At a moment in time when Toyota has just passed General Motors to become the largest automaker in the world (and when General Motors is threatened with possible bankruptcy), we can draw broader implications from this analysis. Toyota teaches us that capabilities matter but that dynamic capabilities matter most. Toyota invests in the human resource practices that boost employee motivation, skill, and adaptability; provides extrinsic and intrinsic rewards for participating in *kaizen*; creates a culture of psychological safety around the surfacing of problems; and makes a strong and visible commitment to employment stability. In return, Toyota's employees make the transcending of the exploitation/exploration dichotomy possible through their cognitive contributions – skeptically scrutinizing and improving routines; addressing gaps, large and small, between current practice and a desired future state; and internalizing a high aspirational level for individual and collective goals.[9]

Furthermore, Toyota is perhaps the best existing example of the adage that "processes trump products" with respect to long-run competitiveness. Toyota's slogan "Good Thinking, Good Products" (dating back to 1953, just as the company began to emerge from its own brush with financial collapse) suggests that good processes are a precondition for good products. While a brilliant inventor can provide the product idea that can rocket a firm to success, it is through the systematizing of processes that a company manages to get beyond the boom and bust cycles of unpredictable product markets. Managing processes effectively, as a dynamic capability, means orchestrating a complex combination of people and their motivation; knowledge and skill situated throughout the organization; coordination grounded in how well underlying relationships are managed (Gittell, 2002); and technology which, approached through a continuous learning mindset, can appreciate in value over time rather than depreciating (Shimada and MacDuffie, 1998). In our enchantment with "explore", we tend to lionize product innovators. Toyota suggests that we should expect the lifetime achievement awards to go to process innovators.

[9] Toyota's dramatic increase, in recent years, in its percentage of temporary and contract workers raises questions about how much this will imperil the distinctive TPS problem-oriented culture. Toyota claims that these "impermanent" workers are trained with "permanent" workers, integrated with them in terms of work tasks, and expected to participate in *kaizen*. Yet it seems likely that the psychological contract with the temporary/contract workers must be different in ways that could undermine both the quantity and quality of their cognitive contributions.

Ambidexterity as a solution to Abernathy's productivity dilemma: a Marxist view

Paul S. Adler

Recent research has argued that the productivity dilemma described by Abernathy–the trade-off between efficiency and innovation, between exploitation and exploration – can be overcome by organizational ambidexterity. There is an emerging consensus that while such ambidexterity is hard to achieve, it is not, *pace* Abernathy, impossible. Toyota' provides an existence proof that such ambidexterity is indeed feasible (e.g., Brunner et al., 2008).

The present note challenges the established understanding of why such ambidexterity is hard to achieve. I think that this understanding reflects the combination of (1) a **correct** assumption that efficiency requires a bureaucratically structured organization, and (2) a **widely accepted but incorrect** assumption that bureaucracy is antithetical to innovation.

In a series of studies, I have built on Gouldner (1954; 1955) to argue that bureaucracy can be compatible with innovation so long as bureaucracy takes an "enabling" form – so long as it is designed and used as a tool rather than as a weapon or as a ceremonial mask (see Adler, 1993a, 1999, 2001; Adler and Borys, 1996; Adler et al., 1999). The productivity dilemma view assumes a one-dimensional spectrum of organization design alternatives which contrasts organic/innovation-oriented and bureaucratic-mechanistic/efficiency-oriented structures; I argue that we are better served by a model with two independent dimensions—the degree of formal structuring (low versus high bureaucratization) and the type of social structure (low versus high trust). Where tasks are more routine, then, to be sure, we need relatively more bureaucratic structuring; but even where the key tasks are much less routine, such as is the case where the main goal is exploration and radical innovation, there is still much that bureaucratic structuring can contribute to both efficiency and creative effectiveness – so long as bureaucracy takes this enabling form based on high levels of trust.

This formulation, however, is inadequate: it does not capture the deep ambivalence that field researchers have repeatedly documented when they ask workers about their experience of bureaucracy (e.g., Adler, 1993a). To take a specific example at Toyota: the "standardized work" process for involving workers designing their jobs is a powerful learning meta-routine, and workers appreciate – and typically reciprocate – the trust invested in them by managers who mobilize workers in this process; but that trust is easily undermined when workers on the assembly line find that the process has led to intensified work as non-work time is progressively eliminated. Taiichi Ohno – a key figure in the development of the Toyota Production System – had a nickname, Taiichi "Oh no!" because whenever he visited a plant, workers would stiffen in anticipation of yet another round of workforce reductions, yet another turn of the screw in the never-ending intensification of work that is such a central feature of the Toyota Production System (Wickens, 1993).

Perhaps, therefore, it is not surprising that serious field research continues to debate whether "lean production" is

in practice enabling and empowering or functions as a coercive means of domination and exploitation[10] (e.g., Schouteten and Benders, 2004). I propose that we take this continued debate as a replicated finding: some organizations may use bureaucracy one way more than another for a given period of time; but the evidence, taken as a whole, tells us that bureaucracy is essentially (actually or potentially) two-sided, both enabling and coercive. If so, we need a way to theorize this ambiguity.

In looking for a better theory, my recent work follows Gouldner back to Marx. My reading of Marx (Adler, 2007) leads me to suggest that if bureaucracy is by nature both enabling and coercive, it is because bureaucracy is simultaneously a technology for coordination – thus part of what Marx calls the "forces of production" – and a social relation of exploitation and domination – and thus part of what Marx calls the "relations of production."[11] These two aspects of bureaucracy coexist in a form that Marx calls a "real contradiction."[12]

The real contradiction between the forces and relations of production pulls bureaucracy simultaneously in opposite directions, creating a tension that is felt every day by managers and workers in the real world of work:

(1) The forces of production tend to develop towards ever-higher levels of effectiveness, stimulated by the capitalist relations of production. Capitalist competition between firms and exploitation/domination within firms drive industry to incessant innovation of both radical and incremental kinds. Insofar as bureaucracy is a tool – a technology for coordinating a complex division of labor – it figures as part of the forces of production, and we should expect bureaucracy to develop along with these other forces of production. Bureaucratic systems in the form of Taylorism represented a huge advance over the prior craft and initiative-and-incentive systems: bureaucracy here focused primarily on routine manufacturing and clerical tasks. Developments over the subsequent century, including those pioneered at Toyota, introduced bureaucratic systems not only for kaizen in these routine tasks, but also for the management of improvement and innovation projects, R&D organizations, highly flexible operations, and open innovation systems.

(2) But capitalist relations of production also limit and distort the development of the forces of production. Profit pressures sometimes stimulate the development of new material and organizational technologies, and they sometimes encourage the intra- and inter-firm cooperation needed to support this development; but these profit pressures are brutal, and they just as often undermine this cooperation by turning the tool of enabling bureaucracy into a coercive weapon. Community and trust between workers and managers and between firms are required to ensure that bureaucracy is enabling; but such community and trust are very precarious given the conflictuality inherent in the intra-firm employment relation and given the rivalry and unpredictability inherent in the inter-firm relations of competition. Insofar as bureaucracy is also means of domination and exploitation, **lean** production under profit pressure can easily degenerate into **mean** production (Harrison, 1994). The enabling quality of lean production is thus always a precarious and ambiguous accomplishment.

The implications of this Marxist approach to ambidexterity are that (a) we do indeed have reason to assume that achieving ambidexterity is difficult, but (b) this is not because the more routine part of the task-set requires bureaucracy – which it does – and not because bureaucracy stifles innovation – which it does not, necessarily – but because the capitalist nature of the firm constantly risks undermining the cooperation and trust required to ensure that bureaucracy functions as a tool rather than as a weapon or as mask.

Ambidexterity is a capability that requires sophisticated, enabling-oriented use of bureaucratic structures. Toyota has been particularly effective in refining this organizational technology. But the market imposes its brutal discipline on Toyota as on other firms, and as an instrument of private profit accumulation, Toyota plants are always at risk of undermining ambidexterity by using bureaucracy in coercive ways.

Conclusion

David James Brunner, Bradley R. Staats, and Michael L. Tushman

Organizations often find themselves torn between contradictory and conflicting goals. The productivity dilemma highlights the tension between a particular pair of widely held goals: efficiency and adaptability. The tension exists in many – perhaps most – organizations, though it may be obscured by temporal distance. Efficiency is observable almost immediately, while adaptability manifests itself over years or decades. Obscure or not, organizational survival depends on successfully managing this, as well as often other, sets of conflicting goals. As the perspectives in this article indicate, no simple solution has

[10] Note that here I am using "exploitation" in the Marxian sense (appropriation of value) rather than the Marchian sense referred to earlier. I see no connection between the two; but both usages are so widespread that we must simply accept the ambiguity. To avoid confusion, I will use the couple exploitation/domination when referring to the Marxian meaning.

[11] In Marx, the "forces of production" are the material means of production, the knowledge that is embedded in them, and the knowledge in the hands and heads of workers who use these means of production. The "relations of production" are the relations of ownership and control over these forces: capitalist "relations of production" are based on private property over the means of production, and thus competition between firms and exploitation of workers within firms. In this schema, "work organization" is part of both the forces and the relations of production. Note that this interpretation of bureaucracy is close to Weber's too, although Weber would replace "relations of production" with a broader construct of "authority relations".

[12] Marx gets the idea of a "real contradiction" from Hegel. We usually think of contradiction as a property of logic propositions. Hegel saw contradiction as a feature of the real world, not just of our assertions about it. This is a rather fruitful way of thinking about the complexity and dynamism of social structures, although the risks of obscurantism are considerable.

yet been found for managing toward contradictory goals, but much is known about the nature of such tension and possible approaches to handling it.

The perspectives in the article identify two dimensions to the tension between efficiency and adaptability. One dimension relates to the dynamics of organizations as complex systems. Inasmuch as organizations consist of networks of coordinated, interdependent subsystems, efficiency and adaptability are fundamentally contradictory. As Tushman and Benner argue, "Tightly interrelated activity systems activity impede anything but internally consistent change ... Dynamic conservatism comes from the system itself." Brunner and Staats attribute such dynamic conservatism to the tendency of tightly coupled systems to actively suppress the perturbations required for learning and exploration.

The second dimension of the tension relates to the two-sided nature of bureaucracy. Adler argues that the structuring, systematizing, and rationalizing associated with bureaucracy can enable creativity and innovation. However, creativity and innovation in such a tightly coupled system requires cooperation among interdependent participants, which depends in turn on a foundation of trust. This trust is always threatened by the possibility that profit pressures may "undermine this cooperation by turning the tool of enabling bureaucracy into a coercive weapon." If managers use bureaucracy as a weapon against the laborers to expropriate value, community and trust will collapse. Even a production system as carefully designed as Toyota's carries the seeds of its own destruction.

Fortunately, the conflict between exploitation and exploration can be managed. Winter observes that the conflict between efficiency and adaptability may be overdrawn: refined, efficient routines provide the building blocks for innovation. He calls attention to "the role of procedural memory and practice as the base of high competence, including the dynamic forms of competence that provide resistance to inertia." On a theoretical level, Brunner and Staats propose that organizations can reconcile exploitation with exploration by intentionally destabilizing their own processes through deliberate perturbation, and by ensuring that disruptions are translated into learning and knowledge creation through exploratory interpretation. These arguments suggest that the dynamic conservatism identified by Tushman and Benner may be, at least in part, a property of inferior administrative technologies, rather than an inevitable consequence of disciplined processes.

In practice, cognitive frames provide one way to avoid dynamic conservatism. MacDuffie argues that a well-chosen frame may bypass the conflict, enabling the organization to pursue a single strategy that inherently balances the contradictory goals. In the case of Toyota, he suggests that continuous learning provides such a frame. Consistent with Adler's conception of an enabling bureaucracy, MacDuffie emphasizes the importance of active worker participation in both standardization and innovation. Osono and Takeuchi describe how setting impossible goals drives Toyota to move beyond existing routines.

Organizational routines offer a second way to sustain exploration in the midst of intense exploitation. Osono and Takeuchi highlight the roles of experimentation and local customization in pushing Toyota beyond the domain of Tushman and Benner's internally consistent change. MacDuffie shows how the PDCA learning cycle, the TPS "zero buffers" and "zero defects" policies, and *jidoka* trigger exploration. Challenging economic conditions will no doubt test the robustness of these routines as well as Toyota's commitment to enabling bureaucracy: at the time of this writing, Toyota was preparing to report its first operating loss in 70 years (Maynard, 2008).

In conclusion, the several perspectives are generally consistent in emphasizing the importance of coexisting with contradictions. Osono and Takeuchi make this point explicitly: "Toyota deliberately forces contradictory viewpoints within the organization and challenges employees to find solutions by transcending differences rather than by resorting to compromises." Such an active embrace of tension and conflict can be understood as a way to disrupt or perturb the organizational equilibrium, shaking apart tightly coupled subsystems and breaking the hold of dynamic conservatism. Combined with a disciplined but cooperative bureaucracy capable of exploratory interpretation and continuous learning, such a state of disequilibrium may sustain both efficient practice and innovation.

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