Executive Summary

A turbulent business environment is characterized by unpredictability arising from unexpected changes in market demand and consumer preferences, new technology developments, and technological breakthroughs. Our research shows that there are three types of IT-enabled business capabilities that influence strategic advantage in such turbulent environments: operational capabilities (ability in process execution), dynamic capabilities (the planned ability to reconfigure operational capabilities), and improvisational capabilities (the learned ability to spontaneously reconfigure operational capabilities). The higher the turbulence of the business environment, the more critical the enterprise’s dynamic and improvisational capabilities become.

Historically, IT departments have focused on supporting operational capabilities. Shifting the emphasis to IT-enabled dynamic and improvisational capabilities has significant implications for how the IT function needs to be managed. Our insights into those implications flow from our research into the relationships between an enterprise’s IT infrastructure capabilities and the three proposed IT-enabled business capabilities. IT infrastructure capabilities are an awareness of what functionalities the IT infrastructure has to offer, an understanding of when and how to use them, and, when using them, of taking advantage of specific IT functionalities and their combinations.

We describe three types of emerging IT infrastructures—event-drive, service-oriented, and self-learning—that enterprises will need to embrace to support IT-enabled dynamic and improvisational capabilities. Finally, we provide guidelines for CIOs as they seek to overcome the hurdles they face in turbulent business environments.

THE BUSINESS CAPABILITIES TRIFECTA

In an age in which process execution matters, it is commonly accepted that an enterprise’s operational capabilities can provide a strategic advantage. However, this contention becomes problematic in turbulent environments because current operational capabilities may no longer match the rapidly changing environment.

Environmental turbulence is the unpredictability that arises from unexpected changes in market demand and consumer preferences, new technology developments, and technological breakthroughs. In such environments, enterprises must rapidly innovate, adapt, and reconfigure themselves to match the changing environment. To reconfigure their operational capabilities to better match the changing environment, enterprises need two other sets of business capabilities: dynamic capabilities and improvisational capabilities. Together with operational capabilities, dynamic and improvisational capabilities form a collaborative trio of business capabilities needed to successfully compete in turbulent environments (see Figure 1). We call the combination of these

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1 Carol Brown is the accepting Senior Editor for this article.
2 An earlier and different version of this article was presented as a paper at the SIM Academic Workshop held in Milwaukee, December 2006. We would like to thank the workshop participants and Carol Brown, Bob Zmud, and Jeanne Ross for helpful comments and insights. We are also grateful for the helpful interviews granted by the following CIOs in 2007: Erik Krogh, Ashwin Rangan, Duane Rankine, Douglas Shook, David Sunker, and James Sutter. We are also very grateful for the helpful guidance that Carol Brown and the two MISQE reviewers have provided in revising this article.
three sets of winning business capabilities the business capabilities trifecta.3

**Dynamic capabilities** are the ability to effectively reconfigure existing operational capabilities to match the changing business environment. The need for change can be triggered by changes in the external environment (e.g., market changes, consumer needs, new technologies, competitors’ strategies) and in the internal enterprise environment (e.g., enterprise triggers, internal crises, development of new products, new IT applications).4 Based on the work of Teece et al., we have developed a measurable model of dynamic capabilities.5,6 This model has four dimensions:

1. **Sensing the environment**—the ability to spot, interpret, and pursue the need for changing the enterprise’s operational capabilities by understanding market needs and identifying new internal and external opportunities.7

2. **Learning**—acquiring, assimilating, and developing new knowledge needed to revamp operational capabilities with new knowledge and skills.

3. **Integrating knowledge**—embedding new knowledge into the new operational capabilities by creating a shared understanding and collective sense-making.

4. **Coordinating activities**—orchestrating and deploying discrete reconfigured tasks, resources, and activities embedded in the new operational capabilities.

We define **improvisational capabilities** as the learned ability to spontaneously reconfigure existing resources in real time to build new operational capabilities that better match novel environmental situations.8 Improvisation occurs frequently in enterprises that operate in highly turbulent environments, because there is often insufficient time for formal planning; managers must spontaneously adapt to new conditions on-the-fly by acting outside their formal plans. However, improvisation is not ad-hoc problem solving.9 Enterprises realize that they often need to improvise in new contexts, and they learn how to improvise and become adept at improvising in novel situations. Since enterprises face many novel situations in turbulent environments, improvisation is likely to be a repeated activity that is enhanced with practice.

Evidence from product development suggests that enterprises engage in improvisation in an organized manner, and they become adept at improvising.10 Some innovative enterprises have even developed formal procedures for improvisation. Examples include The Groop (a multidisciplinary design firm specializing in brand strategy),11 Novell (a provider of enterprise infrastructure software and services), IDS

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3 Trifecta is a slang term used to describe any successful phenomenon that comes in threes. It was originally a horse racing term for when a bettor wins by selecting the first three finishers of a race.


7 Sensing ability is similar in spirit to the idea of “capability monitoring,” the distinct ability to spot outdated or rigid operational capabilities that no longer match the environment (see Schreyogg, G., and Kleisch-Eberl, M. “How Dynamic Can Organizational Capabilities Be? Towards a Dual-Process Model of Capability Dynamization,” Strategic Management Journal (28:9), 2007, pp. 913-933.

8 This definition is based on the work of Ciborra, who describes improvisation as the ability to generate new combinations of resources to match turbulent circumstances. See Ciborra, C. “The Platform Organization: Recombining Strategies, Structures, and Surprises,” Organization Science (7:2), 1996, pp. 103-118.

9 Winter has argued that improvisation is not a highly patterned and repetitious routine because of its idiosyncratic nature. However, Weick explains that improvisation is a patterned, deliberate, and repeatable process that is repeated in response to novel situations, and it can be enhanced with practice. See Winter, S. “Understanding Dynamic Capabilities,” Strategic Management Journal (24:10), 2003, pp. 991-995, and Weick, K. E. “Improv as a Mindset for Organizational Analysis,” Organization Science (9:5), 1998, pp. 543-555.


11 See http://www.thegroop.net/wordpress/?p=189 where the company describes a business process called “the scrum.”
Scheer (which provides business process management software), and Entergy (an integrated energy company).  

Dynamic and improvisational capabilities are distinct means for facilitating reconfiguration and change. The former emphasize planned and well-timed reconfiguration of operational capabilities; the latter emphasize the spontaneous and intuitive recombination of resources in real time to build new operational capabilities in response to a novel situation. Dynamic capabilities stress disciplined flexibility, while improvisational capabilities require creativity and intuition. The planning involved in dynamic capabilities focuses on how to best respond to an anticipated situation, whereas improvisational capabilities require the enterprise to learn how to be prepared to respond to any novel situation. Dynamic capabilities thus rely on the “logic of opportunity,” while improvisational capabilities are based on the “logic of responsiveness.”

Figure 2 depicts how IT infrastructure capabilities can enable the business capabilities trifecta, which in turn influences a business’s strategic advantage when environmental turbulence is high. There is an important distinction between IT infrastructure and IT infrastructure capabilities:

- **IT Infrastructure** is the sets of IT hardware, software, and networks, including applications software and database management software, that are available to the enterprise.
- **IT infrastructure capabilities** are the enterprise’s ability to be aware of what functionalities the IT infrastructure has to offer, to understand when and how to use them, and, when using them, to take advantage of specific IT functionalities and their combinations.

We discuss below what we have learned about the relationships depicted in Figure 2 and what this means for business and IT executives.

**PRIORITIZING THE CAPABILITIES IN THE TRIFECTA**

In turbulent environments, enterprises are faced with making a trade-off between focusing on their dynamic and improvisational capabilities (for transformation and change), and their operational...
capabilities (for efficient day-to-day operations). Our research suggests that an organization’s dynamic and improvisational capabilities are the primary predictors of its long-term strategic advantage in turbulent environments. Operational capabilities can only offer a series of short-term temporary advantages that are likely to be fleeting as the environment changes and new contingencies emerge. Turbulent environments erode the long-term potential of existing operational capabilities and render them ineffective when the environment changes. In contrast, dynamic and improvisational capabilities are designed to reconfigure ineffective operational capabilities that no longer fit the changing business environment. The more turbulent the environment, the more valuable an enterprise’s dynamic and improvisational capabilities become.

Consider, for example, the case of IndyMac Bank’s e-MITS system, which was introduced in 1998. This system provided one-stop automated mortgage loan application and vetted approval that linked the front-end application process to the back-end securitization process on Wall Street. e-MITS greatly reduced the firm’s exposure and allowed customers to apply for various types of loans simultaneously. The decade-long strategic advantage IndyMac achieved was largely based on its IT systems being continuously improved, even when the firm was successful. As competitors started imitating IndyMac’s initiatives, the firm continued to reconfigure its existing operational capabilities and to enhance its IT-enabled dynamic and improvisational capabilities.

As the environment changes quickly, CIOs must focus on fostering a culture that both recognizes and is comfortable with change. The more turbulent the environment, the more resources are needed to build and enhance an enterprise’s operational capabilities—and those resources are provided by an enterprise’s dynamic and improvisational capabilities.

These capabilities influence an enterprise’s strategic advantage by reconfiguring its operational capabilities so they better match the environment.

Our research has shown that:

- In moderately turbulent environments, dynamic capabilities are the primary influential capability in reconfiguring existing operational capabilities.
- In highly turbulent environments, improvisational capabilities completely dominate the reconfiguration process.

Although our research data does not discern the exact tipping point, we do know that as turbulence increases to very high levels, improvisation capabilities become more influential than dynamic capabilities.

We also found that there are several cultural adjustment and social acceptance issues associated with the notion of improvisation. In corporate America, improvising is often viewed as indicating a lack of planning, even though that may not necessarily be the case. Managers may therefore be reluctant to display a learned ability to engage in improvisation, even if it is common practice and is exercised well. This barrier can be overcome by changing managerial mindsets about the merits of improvisational capabilities in highly turbulent environments.

**TURBULENT ENVIRONMENTS REQUIRE IT TO BE WOVEN INTO THE ENTERPRISE FABRIC**

During the last 20 years, the changing nature of IT and the way it’s used in business has changed the relationship between IT infrastructure and the business context. The form and intensity of contextual coupling has changed from what we call connection, first to immersion, and finally to fusion.

In the 1970s, IT was viewed as a tool that supported business processes, and it was connected, but not necessarily integral, to the business. This form of coupling between IT infrastructure and the business context and environment was therefore not a crucial issue. In the 1990s, as networks became interconnected

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16 Although these research findings are specific to the context of new product development, we believe they are generally applicable. See Pavlou, P. A., and El Sawy, O. A. “From IT Leveraging Competence to Competitive Advantage in Turbulent Environments: The Case of New Product Development,” *Information Systems Research* (17:3), 2006, pp. 198-227.

17 See Krogh, E., El Sawy, O. A., and Gray, P. “Managing Online in Perpetual Perfect Storms: Insights from IndyMac Bank,” *MIS Quarterly Executive*, December 2005. When the U.S. mortgage sub-prime loan crisis hit the industry in August 2007, IndyMac initially reconfigured its operational capabilities on-the-fly by hiring experienced retail loan officers from the bankrupt American Home Mortgage Investment Corporation. However, its improvisational capabilities were ultimately insufficient to shield it from the massive mortgage meltdown, and it was taken over by federal regulators in July 2008. Its problematic loans were not those vetted by e-MITS, but loans that were not vetted or that were purchased from other lending institutions.


19 The six CIOs we interviewed (see Footnote 2) expressed that view.

and the Internet became ubiquitous, enterprises started to view IT infrastructure as a business enabler, and contextual coupling between the two became more intense. People perceived themselves as immersed in an IT-intensive business environment where work processes and IT were highly interdependent. With immersion contextual coupling, IT is seen as part of the business environment; it alters the ways in which people work and execute business processes, both within the enterprise and with business partners and customers.

Most recently, the relationship between IT and the business context has fused. Fusion contextual coupling means that IT and the business context become indistinguishable; IT becomes part of the integral fabric of an enterprise. When the IT infrastructure is intimately woven into the fabric of the enterprise, IT and work processes cannot be separated.

Our research has shown fusion is the most effective form of IT-business coupling in turbulent environments. Managers cannot decree that IT becomes part of the enterprise’s business fabric, but achieving fusion does require direct top management involvement and commitment, and a shared mindset at both the CEO and CIO levels.

The necessary shared mindset is most common in progressive enterprises in industries that are undergoing major IT-enabled business transformation. For example, when the distribution industry was attempting to transform its business models through the Internet in the late 1990s, the CEO of Marshall Industries proactively shaped the company’s IT vision together with the CIO, rather than just endorsing an IT vision developed by the CIO. Similarly, fusion could be observed in the early 2000s in the financial services industry when it was undergoing major IT-enabled transformation.

We have some evidence that fusion is currently occurring in other industries that are undergoing major IT-enabled transformations. Examples include health care (driven by cost containment and the use of electronic medical records) and entertainment (driven by convergence and technology innovations in media and digital platforms).

If IT is part of the business fabric—that is the business environment and IT are inextricably coupled—it is much more likely that the IT infrastructure has a responsive leveraging effect on the business capabilities trifecta when the business environment is turbulent.

**EMERGING IT INFRASTRUCTURES FOR TURBULENT ENVIRONMENTS**

Given that IT infrastructure capabilities can affect an enterprise’s strategic advantage, albeit indirectly by enhancing its business capabilities, it is important for enterprises to be aware of the emerging IT infrastructures that are suitable for turbulent environments.

As noted earlier, IT infrastructure capabilities are the ability to be aware of what functionalities the IT infrastructure has to offer, to understand when and how to use them, and, when using them, to take advantage of specific IT functionalities and their combination. Our research shows that IT infrastructure capabilities influence all four dimensions of dynamic capabilities introduced earlier. Specifically, IT infrastructure capabilities help an enterprise to:

- Stay responsive to market intelligence by effectively sensing the environment.
- Acquire, assimilate, and use knowledge by effectively coding, synthesizing, and sharing knowledge to generate new learning.
- Make information visible and accessible, facilitate information sharing and support rich communication, which in turn enhances the enterprise’s ability for integrating knowledge.
- Allocate resources to tasks, monitor performance, and identify synergies among people and tasks, thus enhancing the enterprise’s ability for coordinating activities.

IT infrastructure capabilities also influence improvisational capabilities. Turbulent environments create more possibilities of being exposed to new opportunities or crises that require improvisation. IT infrastructure capabilities can improve an enterprise’s awareness of internal and external conditions by:

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Providing access to information
• Providing enhanced information flows that enable the information to be shared
• Enhancing collaboration.

An enterprise’s improvisational capabilities can thus be enhanced by IT infrastructure capabilities that facilitate the sharing and building of colleagues’ ideas through brainstorming and real-time interaction.24

Superior IT infrastructure capabilities in today’s turbulent environments are derived from emerging reconfigurable IT infrastructures. There are several promising IT infrastructures that have characteristics suitable for turbulent environments, and we describe below three architectures that are particularly relevant in the context of enhancing the business capabilities trifecta. Emerging IT infrastructures based on these three types of architectures (and there will be more) promise to enhance an enterprise’s dynamic and improvisational capabilities.

Event-driven Architectures
Event-driven architectures have been pioneered in the financial services and securities trading sector to help create real-time enterprises that can react quickly to market events.25 They started with a “publish/subscribe” architecture that enabled information about business events to be distributed in real time across private and public networks on an exception basis. Event-driven architectures are based around the techniques and tools of complex event processing in distributed enterprise systems.26 They grew over time to encompass electronic dashboards, business activity monitoring software, business process management, and IT infrastructures that enable vigilant information systems.27 (Figure 3 provides more information about vigilant information systems.)28

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26 See, for example, Luckham, D. *The Power of Events: An Introduction to Complex Event Processing in Distributed Enterprise Systems*, Addison-Wesley, 2002.


While many of these IT infrastructure requirements can be addressed through “stitched together” approaches with generic components or can be satisfied through software-only features, there are also specialized IT hardware architectures that address these requirements from vendors, such as TIBCO (www.tibco.com).

Service-oriented Architectures

Service-oriented architectures (SOAs) are based on Web services that allow applications to be more modular (“Lego-like”). Dividing large monolithic applications brings several advantages for enhancing IT-enabled dynamic and improvisational capabilities in turbulent environments, and coping with the time pressures and costs of dynamic change. First, when the environment changes, an SOA allows different flexible configurations of smaller modules to be more easily enabled and activated. An application built from Web services is much more robust than a large monolithic application. Second, the domain knowledge needed to outsource the development of a smaller application module is much less, resulting in much faster application development time. Third, an organized approach to getting things done quickly yields higher quality applications than when “fighting fires” under time pressure.

Using an SOA and Web services is an effective way of conserving IT investments because it removes the need for massive integration and re-integration expenditures when requirements change. But moving to an SOA and Web services will require an enterprise to restructure its business processes to be more modular, which requires organization-wide redesign. It also requires architects in the enterprise who can search for Web services and can configure them and integrate them. Thus, although the resulting applications will be more robust, moving to an SOA and Web services creates a whole new set of enterprise requirements.

Self-learning Architectures

As the environment becomes more turbulent, the more advantage there is in embedding self-learning capabilities into architectures so that, for example, each time a business process is executed, the architecture can “learn” on-the-fly. A self-learning architecture thus expands the knowledge-creating capacity of business processes and enriches the interactions between processes and all who touch them—capabilities that are valuable in turbulent environments.

The IT system used for real-time customer support at Dot Hill (a provider of flexible data storage solutions) is a good early example of a self-learning architecture. It was designed around an architecture that adaptively learns through its interactions with customers. The system is based on a software-based problem-resolution architecture that links problems, symptoms, and solutions in a document database. All problems are analyzed through the symptoms in incident reports. Resolutions are fed back into the knowledge base in the form of solution documents and new knowledge is created and synthesized. The system automatically prioritizes solution documents according to “usefulness/frequency of use” in resolving specific problems; the higher-priority solutions rise to the top of the list.

Dot Hill’s knowledgebase “learns” through well-structured, dynamic feedback loops that are managed by the problem-resolution architecture. This makes it possible for the knowledge base to change its structure dynamically on-the-fly as it gains new knowledge from those who interact with it.

Managing the IT Function in Turbulent Environments

For IT infrastructure capabilities to have an effect on business capabilities as the environment changes, the IT infrastructure needs to be intelligently linked and coupled to the business context. This is true for the whole spectrum of reconfigurability for IT infrastructures—from relatively brittle architectures with low levels of reconfigurability to the more flexible and malleable architectures described above.

However, the IT infrastructures typically implemented in enterprises today are encumbered by legacy architectures. To make the IT-business coupling more effective in turbulent environments, CIOs need to make changes in both the application infrastructure and the IT human resources (HR) infrastructure.

The Application Infrastructure

In addition to changing the mindset of CEOs and senior IT executives to view IT as integral to the enterprise’s fabric, CIOs can also take operational steps at the application infrastructure level to cement more effective contextual coupling. The application

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infrastructure is the layer that is closest to the business context, which requires it to be the most dynamic.

For example, one enterprise views its IT framework as four layers: IT infrastructure, ERP/transactions, data capture/processing, and “venture systems,” which is the application layer that is closest to the customer. This means the venture layer needs to be the most dynamic and highly configurable, and customers will likely be willing to pay a premium for customized value—thus justifying the enterprise’s investment in reconfigurability. Thus, if the preferred shipping method changes for a group of customers, an easily reconfigurable application that can achieve this is worth having. Some IT application infrastructure vendors are providing such reconfigurability at the top layer (see, for example, www.ramco.com) rather than at the ERP/transactions layer. This type of reconfigurability has been termed “simultaneous loose/tight coupling.”

In turbulent environments, effective management of the IT applications infrastructure requires simultaneous loose/tight control. The core of the IT applications architecture needs tightly controlled specifications and requirements, and a disciplined way of maintaining architectural integrity as modifications are made in response to business requirement changes. For effective implementation of such loose/tight coupling, there also needs to be a mutual accommodation across the business units, the IT department, and IT vendors.

One approach is to have an acceptable level of user-controlled reconfigurability in applications sensitive to changes in the business environment, to minimize IT department interventions when such changes occur. For example, pricing applications in the car rental industry are designed to be flexible. The flexibility enables business users to change pricing rules and parameters in the software without the intervention of the IT department. Such user-generated changes allow a car rental firm to adapt quickly to pricing innovations by competitors, or abrupt changes due to storms and bad weather, or one-time promotions. However, providing this flexibility also requires very tight architectural specification and modification discipline for the core of the applications, to ensure that dynamic changes made by users do not compromise architectural integrity.

Providing user-controlled reconfigurability may be more necessary—and difficult—in some industries and contexts than others. For example, in the health care industry there are specialized application vendors and policy regulations that make it very hard to implement reconfigurable applications. Conversely, in the context of application software used by other industries to support new product development, reconfigurability is not a major concern, given that the application is both generic and not sensitive to business environment changes. In this context, there is no need for loose/tight coupling.

Finally, in some contexts where standardized software applications are used in a best-of-breed fashion, the tendency is to spend more resources on, and devote more attention to, what some call the “connective tissue.”

The IT Human Resource Infrastructure

There are also HR issues that require the CIO’s attention. The IT fusion mindset requires that system developers receive extensive training on the business context, and that business users are trained to be savvy about IT in the application context. Our research found that, in enterprises in highly dynamic environments that worried the most about contextual coupling at the application level, system developers were continually trained to act as business partners, rather than just as problem solvers and requirements translators.

There is also a tendency when modifying applications under time pressure to “cut corners” to speed up development time. This approach backfires in turbulent environments; a “slowing down to go faster” principle is most important when the pace is frenzied. This principle is adopted by many enterprises that have mature software development capabilities but that operate in demanding business environments. An environment of constant pressure and change requires not only a project discipline that maintains inner calm, but also changes to HR policies. Developers should be rewarded and valued for professional follow-through under time pressure, flexibility, and, most of all, for having the resilience to spring back from a difficult experience. This is especially crucial for IT developers who interface directly with demanding business customers, who, in turn, are using their dynamic and improvisational capabilities.

31 See Krogh, et. al op. cit., 2005.
32 The term “connective tissue” was coined by Douglas Shook, CIO, Marshall School of Business, University of Southern California.
CIO GUIDELINES FOR OVERCOMING TURBULENT ENVIRONMENT HURDLES

A summary of the hurdles that enterprises face in turbulent environments and our proposed guidelines and suggested actions for CIOs are provided below.

**Hurdle No. 1: IT Seen Primarily as an Enabler of Operational Capabilities**

Many enterprises still see IT as primarily an enabler of operational capabilities; they do not see the potential of IT to enable dynamic and improvisational capabilities. According to CapGemini, a focus on short-term operational topics and poor internal capabilities for managing transformation are two key barriers to achieving change with IT.

**Guideline for overcoming hurdle No. 1.** Enterprises should put dynamic and improvisational capabilities in the foreground and relegate operational capabilities to the background.

**CIO actions.** To move away from a mindset where IT is seen primarily as an enabler of operational capabilities, CIOs should:

1. First change their own mindset in terms of the potential of IT-enabled dynamic and improvisational capabilities to deliver competitive advantage in turbulent environments.
2. Next, convey this vision to IT and business managers, emphasizing that IT-enabled advantages are more likely to be found in processes that deal with reconfiguration and change.
3. Then identify such processes and determine how emerging IT infrastructures can support them, and work with IT vendors and internal development teams to implement such IT infrastructures.
4. Track emerging IT infrastructures that would enhance the enterprise’s dynamic and improvisational capabilities, particularly in turbulent environments.

**Hurdle No. 2: Improvisation Seen as Unacceptable**

Improvisation is still not socially acceptable in most managerial circles since it is seen, erroneously, as implying a lack of careful planning. Most managers who are trained to develop formal plans often see improvisation as arbitrary and chaotic. There is also some confusion about the difference between improvisation—spontaneous activity outside of formal plans—and improvisational capabilities—the planned ability to repetitively engage in spontaneous activities effectively. Hence, managers do not have enough guidance on how to improvise effectively when necessary.

**Guideline for overcoming hurdle No. 2.** Enterprises should develop improvisational capabilities for highly turbulent environments.

**CIO actions:** To assist their enterprises in developing improvisational capabilities for highly turbulent environments, CIOs need to:

1. Accept that improvisational capabilities are likely to have a role in the enterprise’s repertoire of business capabilities.
2. Convey the notion that it is acceptable to improvise when formal planning is either impossible due to time constraints or too difficult and costly due to the difficulty in predicting new environmental contingencies.
3. Promote a culture that accepts and fosters improvisation. In highly turbulent environments, improvisational capabilities may be the only means for adapting to new contingencies, and enhancing these capabilities with IT infrastructures that support improvisation will be valuable when the need for improvisation inevitably emerges in highly turbulent environments.
4. Enhance the enterprise’s ability to sense and interpret the environment with the aid of IT. Business intelligence applications geared to sensing market signals can help here, as can business processing monitoring applications (such as IBM’s supply chain Control Tower). Business practice thought leaders are also putting forward ideas for better preemptive ways of managing emergent processes and solutions.

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**Hurdle No. 3: IT Not Woven Into the Enterprise’s Business Fabric**

Enterprises often see IT as a separate and detached set of tools that either support or drive business processes. They do not view IT as an indistinguishable and inseparable part of the enterprise that is intimately woven into its business fabric. The difference is subtle, but there are substantial implications for being able to respond faster in a turbulent environment.

**Guideline for overcoming hurdle No. 3.** Enterprises should consider IT as integral to the business fabric.

**CIO actions:** To promote the notion that IT is integral to the business fabric, CIOs should:

1. First adopt and promote a *fusion* view of the contextual coupling between the IT infrastructure and the enterprise’s business processes. CIOs need to reinforce the point that their enterprises will be more responsive and can better adapt to changes in the environment when the IT infrastructure is part of the business fabric.

2. Then, work with the CEO and top business managers to jointly develop a shared vision for IT that is woven into the enterprise’s overall strategy and accepted throughout the enterprise.

3. Consciously work with IT staff members to collectively build a better understanding of the enterprise’s business processes, and consciously work with business users to ensure they are comfortable with using IT applications as an integral part of their work.

**Hurdle No. 4: Limited Availability of IT Infrastructures for Supporting Dynamic and Improvisational Capabilities**

There are still a limited number of IT infrastructures that can cope with the reconfiguration and change needed to enable dynamic and improvisational capabilities in turbulent environments. It is also difficult to convince top business management of the need for such environments. A case in point is JetBlue—a leader in the use of IT for operational and strategic advantage. When ice storms hit the U.S. East Coast in 2007, this airline was unable to reschedule passengers effectively and had to cancel over 500 flights. While JetBlue is a model of lean efficiency, it was unable to respond effectively as it did not have sufficient flexibility in its operations and alliances. Typically, it takes both a crisis and reflective action to make dynamic and improvisational capabilities a priority.

**Guideline for overcoming hurdle No. 4.** Enterprises need to focus on leveraging the effects of their IT infrastructures on dynamic and improvisational capabilities, rather than on operational capabilities.

**CIO actions:** To ensure that enterprises can effectively leverage the effects of their IT infrastructures on dynamic and improvisational capabilities, CIOs need to:

1. Convince their enterprises of the potential benefits of reconfigurable IT infrastructures that can help them cope with change in turbulent environments.

2. Consider the use of IT infrastructures that go beyond operational capabilities and a focus on cost reduction and quality, and instead include agility objectives for dealing with transformation and change.

3. Devote more attention and resources to deploying such IT infrastructures, rather than focusing on those that enhance operational capabilities.

**Hurdle No. 5: Difficulty of Funding Emerging IT Infrastructures for Business Agility**

CIOs find it hard to obtain the funding for new emerging IT infrastructures geared to supporting business agility.\(^{35}\) Justifying the need for such infrastructures may require significant effort, particularly in terms of convincing the enterprise of the need to have specific business objectives for agility and to invest in new types of emerging IT infrastructures that are suitable for turbulent environments.

**Guideline for overcoming hurdle No. 5.** Enterprises should embrace emerging reconfigurable IT infrastructures sooner, rather than later.

**CIO actions:** To convince their enterprises of the need to move to reconfigurable IT infrastructures sooner, rather than later, CIOs need to:

1. Direct more enterprise attention to reconfigurable IT infrastructures that are likely to help the enterprise succeed in turbulent environments.

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2. Establish agility and change objectives that will demonstrate the payoff from investments in such IT infrastructures. Establishing these objectives will best position the CIO to fund the acquisition and implementation of cutting-edge IT infrastructures sooner rather than later.

3. Look out for new types of reconfigurable IT infrastructures. In addition to the three described above (event-driven, service-oriented, and self-learning), there are additional types that are likely to proliferate in the near future, and CIOs should be alert to the opportunities they will provide and embrace them promptly as learning pilots.

**Hurdle No. 6: Resistance to Loose/Tight Coupling**

Embedding IT department processes into business units through simultaneous loose and tight control may be resisted by business users who are unwilling to assume the responsibility of learning and managing IT applications. The IT department may also be unwilling to delegate authority to business users to configure IT applications themselves.

**Guideline for overcoming hurdle No. 6:** The IT department should embed IT processes into the enterprise’s business units.

**CIO actions.** To convince enterprises of the value of embedding IT processes into business units, CIOs should:

1. Allocate time to convincing business users that they can better deal with environmental turbulence if they have the opportunity to reconfigure the IT application infrastructure directly themselves.

2. Promote the benefits of user-controlled reconfigurable IT applications that can be easily configured by business users themselves with minimal interventions by IT staff members.

3. Encourage investment in designing flexible IT applications that will allow business users to make changes without the need for intervention by IT staff members.

4. Ensure that IT applications are flexible so that they can be adapted quickly in response to changes in the business environment, while also ensuring there is inherent discipline in the application infrastructure to prevent chaos.

**Hurdle No. 7: The Temptation to Cut Corners**

When operating under time pressure in turbulent environments, there is a tendency for IT developers to be less disciplined and cut corners to ensure timely delivery—but at the expense of quality and cost. There is also an increased risk of burn-out and stress among IT staff members.

**Guideline for overcoming hurdle No. 7.** Enterprises should implement IT HR policies that foster inner calm and discipline.

**CIO actions.** To ensure their enterprises have IT HR policies compatible with turbulent environments, CIOs should:

1. Ensure that both business and IT people are trained to appreciate the constant pressures associated with turbulent environments and to be comfortable with and resilient to change.

2. Devise and implement HR policies that promote a partnership between business and IT people by rewarding professionalism and a focus on quality under time pressures.

**APPLYING THE LESSONS OF OUR RESEARCH IN PRACTICE**

In turbulent environments, CIOs face two fundamental trade-offs when considering how IT infrastructure capabilities can leverage the business capabilities trifecta, which comprises operational, dynamic, and improvisational capabilities.

The first trade-off is between IT support for short-term efficiencies in the enterprise’s existing operational capabilities and processes, and support for its dynamic and improvisational capabilities. Over-emphasizing short-term efficiencies runs the risk of neglecting the role of IT in enabling the enterprise’s dynamic and improvisational capabilities.

The second trade-off is between reconfiguring existing operational capabilities by leveraging dynamic (planned reconfiguration) capabilities and improvisational (spontaneous reconfiguration) capabilities, versus deploying IT infrastructures that enable these capabilities. Although our research has discovered less about managing this second trade-off, it has shown that improvisational capabilities are especially critical when the business environment is highly turbulent, and that more attention needs to be
given to developing improvisational processes and the IT infrastructures to support them.

Taken together, this article has provided CIOs and IT practitioners with an understanding of the importance of IT infrastructures that can help contribute to an enterprise’s strategic advantage in turbulent environments and has described the types of IT infrastructure capabilities that can be used for this purpose.

ABOUT THE AUTHORS

Omar A. El Sawy

Omar El Sawy is Professor of Information Systems at the Marshall School of Business at the University of Southern California (USC). From 2001 through 2007, he was also the Director of Research, Center for Telecom Management at USC. His interests include redesigning and managing IT-based value chains, IT-enabled capabilities for dynamic environments, business models for digital platforms, business process transformation, and designing vigilant information systems for fast-response environments.

El Sawy holds a Ph.D. from Stanford Business School, an M.B.A. from the American University in Cairo, and a B.S.E.E. from Cairo University. Prior to joining USC in 1983, he worked as an engineer and manager for 12 years, first at NCR Corporation, and then as a manager of computer services at Stanford University. He has lectured, consulted, and carried out research in four continents, has been an information systems advisor to the United Nations Development Program in Egypt, and a Fulbright scholar in Finland.

El Sawy is the author or co-author of over 100 papers, and his writings have appeared in both information systems and management journals. He serves on the editorial board of MIS Quarterly Executive and is a six-time winner of the Society for Information Management’s Paper Awards Competition. One of his publications with Paul Pavlou won the Association of Information Systems’ 2007 Publication of the Year Award, as well as the 2007 Best Published Paper Award in Information Systems Research.

Paul A. Pavlou

Paul Pavlou (paul.pavlou@ucr.edu) is Associate Professor of Information Systems, Marketing and Management, and a Staufer Senior Research Fellow at the Fox School of Business, Temple University. He received his Ph.D. in 2004 from the University of Southern California. He focuses on information systems strategy, electronic commerce, and online auctions. His research has been published in MIS Quarterly, Information Systems Research, Journal of Management Information Systems, Journal of the Association for Information Systems, Journal of the Academy of Marketing Science, Communications of the ACM, and Decision Sciences, and it has been cited over 500 times by the Institute of Scientific Information, and over 2,000 times by Google Scholar. Pavlou has won many Best Paper awards, including the Information Systems Research Best Paper award in 2007 and the 2006 IS Publication of the Year award. He also won the 2003 MIS Quarterly ‘Reviewer of the Year’ award. Pavlou sits on the editorial boards of MIS Quarterly, Journal of the Association for Information Systems, International Journal of e-Collaboration, Electronic Commerce Research and Applications, and DATABASE.