

Technology forecast

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Message from the editor



Every four years, the Olympic competition in the decathlon crowns what many call the “world’s best athlete.” For many of us in this day and age of highly paid single-sport athletes, the basis for calling the winner of the decathlon the best athlete has been lost. But consider the challenge decathletes face.

They must have the strength for events such as the shot put, discus, and javelin, while being flexible enough for the high jump and pole vault. They must have sufficient power in their legs to excel in the 100-meter dash and the 110-meter hurdles without the muscle mass in their legs (and upper body) destroying their chances in the 400-meter and 1500-meter races. In short, they cannot train their bodies to be absolutely the most efficient for any one event. They have to find a way to optimize for all events simultaneously to be effective overall. And they face a never-ending conundrum of tradeoffs during their training. In many ways, the best description of the winner of the Olympic decathlon is the world’s most *agile* athlete.

Today’s enterprises increasingly face business and economic challenges that result in conundrums similar to those facing decathletes. In a stable world of infrequent change, the pursuit of absolute efficiencies has no downside. In a rapidly changing world, management needs a new model for enterprise optimization. Management must engage with the conundrum between efficient operations and strategic flexibility.

In the last two issues of the *Technology Forecast*, we examined how agility is the deliberate combination of standardization and flexibility that prepares a company for change and allows it to proactively shift course with minimal disruption. We also explained the importance of developing a business agility model for anticipating market changes and their impact on existing operations.

This issue of the *Technology Forecast* explores the future of enterprise applications and their role in creating a foundation for agility in an era of accelerating change. The first article describes how the gap between strategy and operations is a significant barrier to the pursuit of agility. It examines a quandary for management: every investment in standardizing for efficient operations comes at the cost of adaptability in the face of change. This creates an even bigger divide between a rapidly changing strategic planning process and the way the enterprise actually operates with each new application. That’s because today’s enterprise applications

are great at managing and tracking transactions, but not so good at managing the business. We offer a rationale for extending the capabilities of enterprise applications further into management of the business and to bridge the gap between strategy and operations. This will allow enterprises to operationalize agility by creating an enduring and responsive connection between strategy and operations.

The second article describes the technological requirements of a new generation of enterprise applications focused on closing the strategy-operations gap. These business management applications will define one part of an emerging three-layer environment that enables agility. The operational applications layer focuses on efficiencies and enforcing standards in process and structured data. The emerging business management applications layer focuses on flexibility and offers analysis, modeling, collaboration, and decision support for evolving strategy and policy. The interaction between the two types of applications is enabled by an information mediation layer that reconciles semantic differences and creates an enduring and responsive operational connection between the two.

This issue concludes with two examples that illustrate the three-layer environment and the emerging business management applications. Each example highlights the advanced capabilities the specific application demonstrates that are representative of business management applications.

These emerging business management applications and a supporting information mediation capability can bridge the gap between strategic intent and operational reality. Doing so will deliver significant competitive advantage in the pursuit of higher performance, agile strategies, and agile behavior.

During our research, we spoke with industry leaders at application providers E2open, Oracle, SAP, and Workday. These companies operate in different areas of the enterprise software industry, and each in its own way arms its customers with an agile and responsive approach to business demands. Jonathan Becher of SAP Business Objects emphasized the need for applications to shift focus toward effectiveness to complement efficiency by extending support to management functions and processes. Andrew Salzman, Rich Becks, and Rob Schoenthaler of E2open shared how mediating with an information hub allows them to create agility for their customers in their supply networks. Edward Abbo of Oracle explained how a new layer of abstraction above applications that supports process modeling and semantic matching can deliver on the promise of agility. Stan Swete of Workday noted how agility is enabled by decoupling data semantics as used in applications from data storage in relational databases.

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And as always, we welcome your feedback on this issue of the *Technology Forecast* and your ideas for where we should focus our research and analysis in the future.



Paul Horowitz
Principal
Technology Leader

Crossing the big divide between strategy and operations

An information mediation layer is the key to operationalizing agility and bridging the gap between strategy and operations.



To meet the demand for their products, most large original equipment manufacturers (OEMs) rely on extended global supply chains that have thousands of trading partners. Inventory shortages, delays, forecast-commit mismatches, and other operational changes are common and usually cause havoc. Many enterprises manage such disruptions with standalone exception processes. Implementing sudden changes throughout the operational systems can consume days or months, becoming an obstacle to achieving agility in an ever-changing business environment.

In contrast, imagine a service that enables customers to achieve a high level of agility by seamlessly incorporating sudden changes into an overall supply chain process. This service facilitates operations among trading partners by aggregating data and information and by providing shared visibility across extended supply chains. By using the information hub the service provides, customers and their partners can use standardized operational applications to run supply chain processes and can tap into business management applications to support functions that handle changes in operations. The hub enables *information mediation* by aggregating data from internal and external sources, by making it available for analysis, and by connecting the operational applications and business management applications. (See Figure 1.)

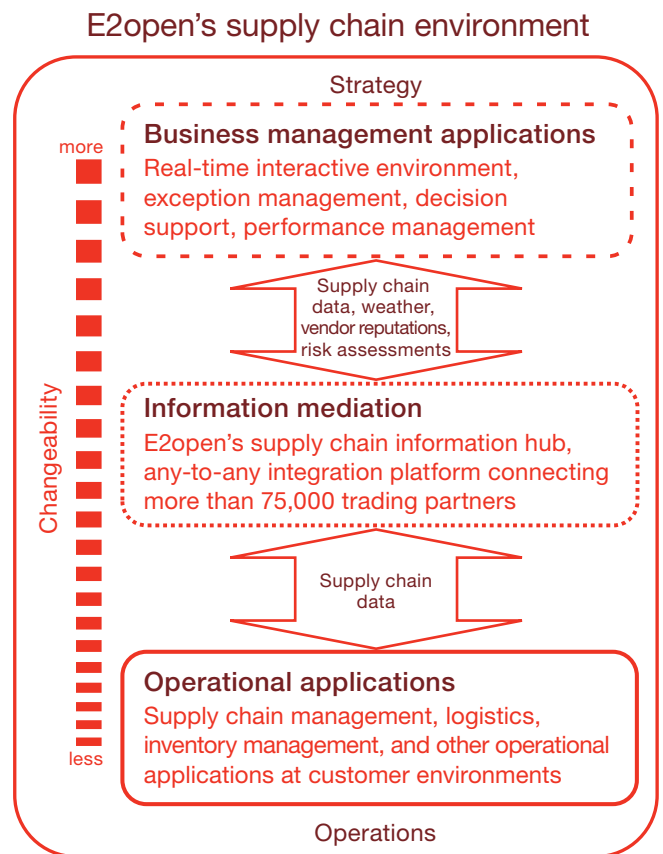


Figure 1: The agility-oriented enterprise application environment and how E2open's supply chain service fits in

This supply chain service exemplifies the importance of information mediation in bridging the divide that exists between operational applications and business management applications. Bridging this divide is essential to achieving agility. Specifically, information mediation is the key to creating a process that makes an enduring and responsive connection between strategy and operations so changes in one are reflected in the other. PricewaterhouseCoopers (PwC) calls this *operationalizing agility*.

To achieve agility, an organization must have the proper combination of standardization and flexibility.

The service in the example just described is E2open. And we single it out for the sake of illustrating and emphasizing the role of information mediation in achieving operational agility. As E2open suggests, information mediation enables a clear separation of duties between applications that support standard operations and those that require flexibility to handle changes. It resolves semantic differences between data and information used by all applications. It gives managers real-time shared visibility to aid timely decision making. And it enables operational connections between operational and business management applications to keep them in sync. These mediation features provide the balance needed in the pursuit of agility.

In this issue of the *Technology Forecast*, PwC advocates a new model for the enterprise application environment to achieve agility. The model illustrated in Figure 2 comprises three distinct layers:

- Operational applications to provide standardization
- Business management applications to provide flexibility
- Information mediation to facilitate the connection between them

In this model, operational applications designed for efficiency are insulated from needing to be changed frequently. Business management applications are flexible and easier to change; they support collaboration, analysis, and decision support. To achieve agility, an organization must have the proper combination of standardization and flexibility.

The big divide

All enterprises aspire to be agile. Many confuse agility with mere speed and then find themselves accelerating into a brick wall because they couldn't change course when needed. Others are so intent on efficiency that they've become great at doing one thing cheaply and quickly, but they have no ability to adapt to market changes or seize new opportunities. Agility is elusive.

All companies have strategies, and they all have operations. Changes in the business environment affect both. To meet strategic objectives, operations should reflect the enterprise strategy, but that seems rare. In a study of 1,854 large enterprises between 1988 and 1998, Chris Zook and James Allen found that seven of eight enterprises did not meet the targets for profitable growth they had set for themselves.¹ In another study, Harvard Business School professors David Norton and Robert Kaplan reported that more than 95 percent of employees are unaware of or do not understand their enterprise strategy.² These studies would indicate that strategy and operations are not in sync.

1 Chris Zook and James Allen, *Profit from the Core*, Harvard Business School Press, 2001.

2 David P. Norton and Robert S. Kaplan, "The Office of Strategy Management," *Harvard Business Review*, Oct. 1, 2005.

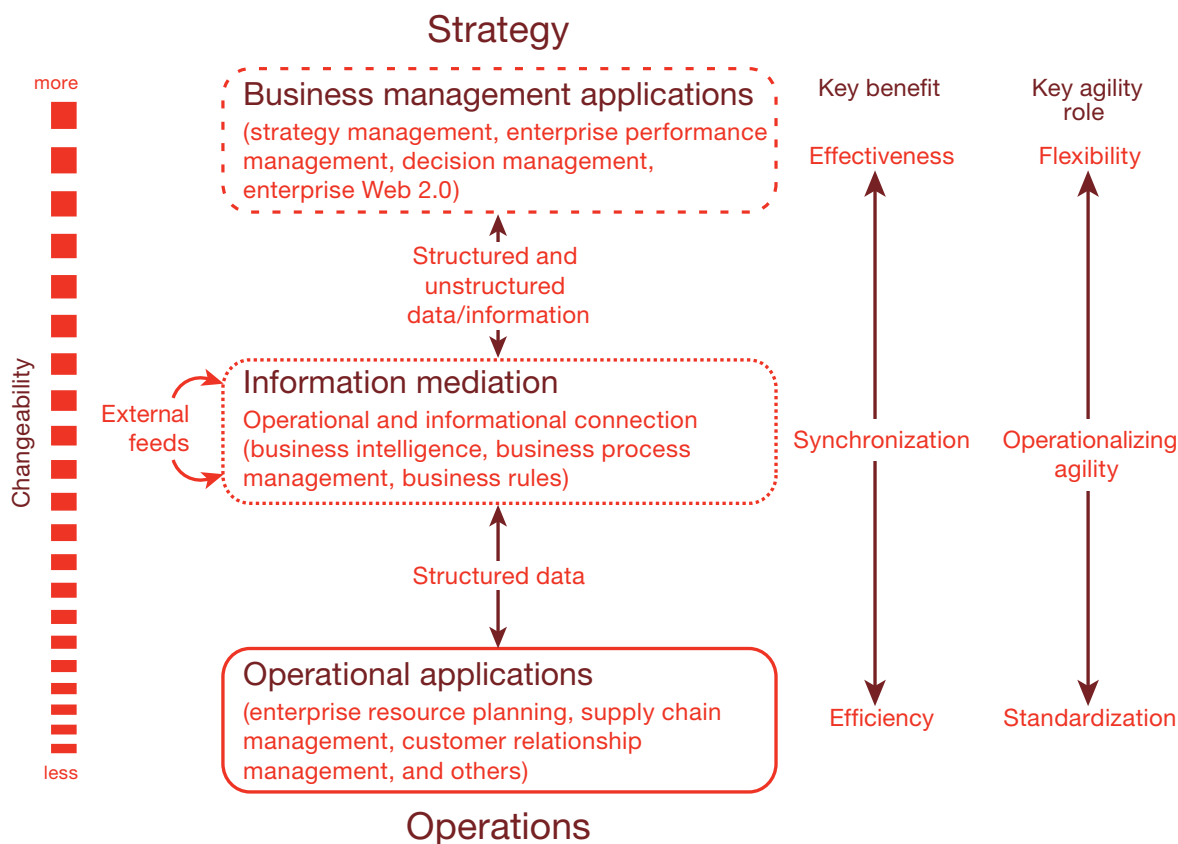


Figure 2: An agility-oriented view of an enterprise application environment—three layers with three distinct roles that support agility

Strategy anticipates the future and pursues agility,³ but operations are standardized and designed to be consistent. Strategy requires extreme flexibility in making choices and changes frequently, while operations take considerable time and expense to change. So there’s a big divide between strategy and operations, as shown in Figure 3. This divide is a primary barrier to agility because changes in strategy are not reflected in operations quickly enough, and operations are not always aligned with strategic intent.

At the same time, most enterprises have invested in enterprise resource planning (ERP), supply chain management, and other enterprise applications to achieve operational efficiency. For strategy, most enterprises are investing in decision support, analytics, modeling, dashboards, and performance management tools that provide feedback on how the operational environment is performing. As the big divide suggests, what is lacking is an approach to connect the two to allow changes mandated by strategy to be brought into operations without the massive reengineering efforts that frustrate companies and cause senior managers endless grief.

3 In the Fall 2008 issue of the *Technology Forecast*, in the article “Modeling value and agility”, we explained business agility modeling, an emerging approach that lets organizations bring agility into their business strategies.

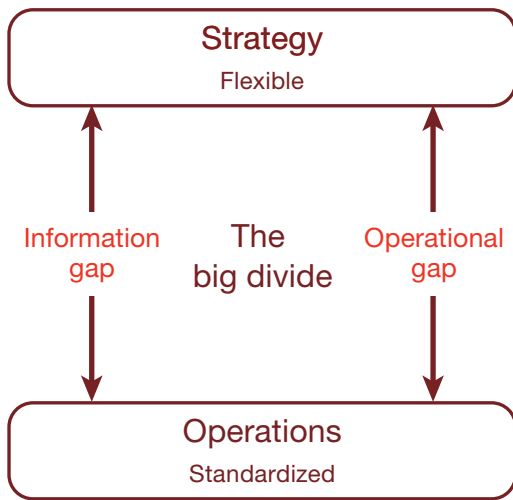


Figure 3: The big divide between strategy and operations and the main gaps

E2open’s model illustrates an approach for how enterprise application environments can enable agility. “Typically, planners spend an inordinate amount of time each day finding information—not thinking about what the information means,” says Rob Schoenthaler, senior vice president of deployment at E2open. “For example, planners are constantly seeking information from a raft of suppliers regarding their ability to commit to orders of varying magnitudes. Half their week, they chase down stuff and the other half they fill out inordinately complex spreadsheets to generate forecasts. By the time they’re done, the information is stale and they get trapped in a circle of firefighting.”

E2open’s platform overcomes these obstacles in various ways. The service offers more than 80 hubs, encompassing more than 75,000 trading partners from which customers can choose. Each hub aggregates data and information from internal and external sources, and provides visibility and enables responsiveness across these supply networks. This mediation layer gives OEMs the ability to anticipate changes—such as inventory delays—before they occur by analyzing data across the supply chain. Because of the linkage to operational systems, OEMs can respond to events with automated changes to processes—such as establishing new vendor relationships or placing new orders—thereby avoiding potential disruptions or minimizing their impact.

When reacting to disruptive changes, OEMs can share pertinent information with suppliers in a real-time interactive environment that supports applications capable of modeling change scenarios, providing decision support, managing exception management, and other functions. For instance, when a forecast-commit mismatch or inventory buildup occurs, OEMs can respond by sourcing from an alternate supplier or automatically generating change orders communicated in real time.

The higher-impact change of adding trading partners takes a long time for most OEMs, because the partners must harmonize their data semantics to integrate disparate systems. With E2open, however, bringing on a trading partner is a plug-and-play activity. Because it has an any-to-any heterogeneous environment, E2open operates in a world of varied semantics and has constructed its interfaces to expect no predefined semantics.

“Our approach is to be highly flexible and agile and not worry too much if something doesn’t conform to what was expected. Our design instead is set up to not expect anything,” says Schoenthaler.

Information mediation for operationalizing agility

In the model illustrated by Figure 2, information mediation plays two key roles. One is to manage the semantics so applications can share and integrate information in a plug-and-play manner. The other is to operationalize the connection between strategy and operations to keep the respective applications in sync—changes in one are coordinated with changes in the other. This is what we call operationalizing agility.

The motivation to operationalize agility is simple. Today, most enterprises are set up to deal with change as something infrequent. Handling change as an episodic project-oriented activity, however, is often distracting and requires considerable time and expense, sometimes holding a change hostage.

“Right now the [operational] applications play too prevalent a role in saying we’re not going to make that change because we couldn’t afford to change the app. That needs to be eliminated,” says Stan Swete, chief

technology officer of Workday, a vendor of human capital management applications.

As the pace of change accelerates in the broader business environment, enterprises need to address change as they do any other business process—as an operation, as measurable, as improvable over time, and as something subject to best practices with the possibility of creating market differentiation.

Swete shares a similar view. On behalf of its customers, he says, Workday “can do changes as business transactions rather than coding exercises and database restructurings, and that leads to massive improvements in agility for the customers and in speed of development for us.”

This approach suggests another way to view operational agility: the ability to handle changes as transactions—as a link in an ongoing process rather than as a special project.

Edward Abbo, senior vice president of application development at Oracle, suggests operationalizing agility by handling changes in a layer of abstraction separate from the applications. “The abstraction layer allows companies to quickly define processes built on top of the underlying applications and to change those processes without tinkering with the individual applications that are below the abstraction,” he explains.

Frequent and continual changes are not limited to supply chains. Product development, sales, customer support, IT, marketing, and all other functions in an enterprise operate in an environment of accelerating change. The enterprise application environment needs to play a role in operationalizing agility. We also expect operationalizing agility to play a greater role in existing and emerging enterprise applications, creating an opportunity for enterprises and application vendors.

Strategy requires extreme flexibility in making choices and changes frequently, while operations take considerable time and expense to change.

A deeper understanding of the big divide between strategy and operations provides a sharper view of how information mediation might be constructed and the characteristics it would embody.

Understanding the big divide

A major reason for the big divide is that the processes and the information for strategy and those for operations differ in fundamental ways, as shown in Figure 4. Processes closer to strategy are semi-structured, ad hoc, often constructed on the fly, usually involve manual work, and rely on collaboration. Processes in operations are well-defined, well-sequenced workflows. Processes closer to strategy use structured and unstructured information, whereas operations largely rely on the structured data from transaction systems built with relational databases.

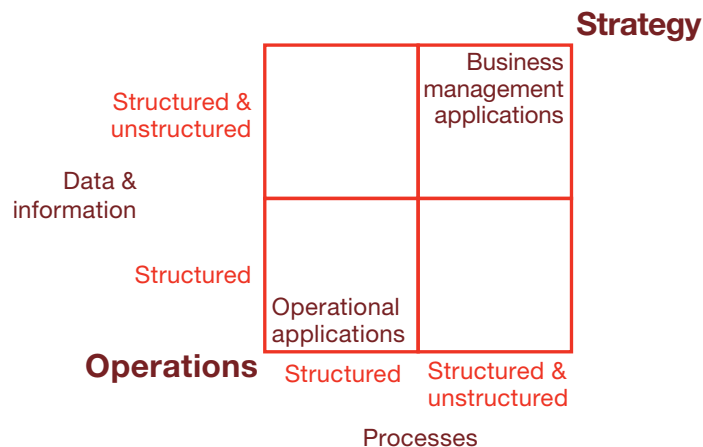


Figure 4: **Difference in characteristics of processes and information in strategy and operations**

As Figure 3 illustrates, the big divide consists primarily of two gaps:

- **Operational gap**—Activities are not integrated between strategy and operations. Changes in one must be communicated and synchronized with the other without delay. The challenge is to create an operational connection between structured processes and semi-structured or ad hoc processes.

- **Information gap**—Decision makers are deprived of the right information and the ability to derive insight from it to anticipate potential change, to model the implications of those changes on the business and its operations, and to implement the desired changes to operations in a nondisruptive way. The challenge is to do this with unstructured and structured information.

“If you have strategy with no execution, that’s a waste of time. But, on the other hand, if you have execution with no strategy, how do you know you get somewhere?” asks Jonathan Becher, senior vice president of marketing for SAP Business Objects. He uses an analogy to explain the big divide between strategy and operations: “If you think about your car, your dashboard tells you if you’re operating your car well, how fast you’re going, how much gas you have left, and so forth. It doesn’t tell you if you’re going to the right destination, if a traffic jam is going to show up, if you need to detour. It tells you that your car is efficient, but not if you’re headed in the right direction.”

In enterprise operations, dashboards that monitor efficiency are useful because operational efficiency is crucial. But as the car analogy suggests, organizations lack the equivalent of navigation systems and access to road information—an information gap—and the methods for using that knowledge to redirect the enterprise in response to changes in the business environment.

Operationalizing agility: bridging the big divide

In the agility-oriented view shown in Figure 2, the layers of emerging business management applications and information mediation will bridge the big divide and operationalize agility. (See the article, “Rise of business management applications,” on page 24.)

To better understand how agility is operationalized in bridging the gap, consider how the security software maker McAfee responds to continual changes in virus threats by leveraging an arrangement that mimics the agility-oriented environment we advocate.

The PC operating system provides a standard operational environment for personal computers, and major upgrades to new versions happen every few years. The operating system is designed to protect against all known threats and viruses when it is released, but it cannot be upgraded feasibly each time a new virus threatens computers.

McAfee and other providers have made agility a core part of their operations by developing a business management application—antivirus solutions—that can be changed easily and frequently, thereby shielding the operational application—the PC operating system—from needing to be changed frequently.

McAfee and others deploy a business management application on customers’ computers, which is designed to accept updates frequently—many times a day if needed. In its hosting environment, McAfee operates the equivalent of a mediation layer, which allows it to identify new viruses and develop remedies and protections. Then updates are pushed and installed by the business management application on each personal computer.

In this case, the separation of standardization and flexibility into two distinct applications enables agility. The response to change is internalized by an information mediation layer that detects and pushes changes in either direction. As a result, the response to new viruses happens quickly without disrupting customers.

In general, business management applications capture strategy in the form of policies, rules, objectives, and initiatives. Emerging commercial solutions, such as strategy management, are starting to provide frameworks for aligning strategic intent with operations.

“If you have strategy with no execution, that’s a waste of time. But, on the other hand, if you have execution with no strategy, how do you know you get somewhere?” —Jonathan Becher of SAP Business Objects

As Figure 4 suggests, the true test of the ability to bridge the divide will be based on the capabilities of applications to handle semi-structured or unstructured information and processes.

Such techniques are still evolving, and their full potential lies in the future, but we already see business management applications taking advantage of mature technologies that analyze, support, measure, and facilitate unstructured information and processes. Some examples are detailed in the article, “Closing the strategy-operations gap: two examples,” on page 44.

As for information mediation, several vendors are developing individual components of what we foresee as a coordinated set of solutions that creates an intelligent business performance platform (IBPP)⁴ to operationalize agility, including complex event processing (CEP), business process modeling, business rules management, and operational business intelligence, all of which are already in use in some industries.

Efforts to operationalize agility can take advantage of these technologies, depending on the architectures and technology standards of the existing environment. However, a loose coupling is essential to maintain flexibility. SAP’s Becher explains: “Think of it as a producer/consumer model,” he says. “One layer could publish changes that it thought were appropriate to be consumed by another, and each layer has its own governance rules that decide whether it’s going to accept them. When it chooses not to accept them, despite the fact they were published, then it communicates the rejection, the reason, and so forth, and the business management app learns incrementally what it does well. It’s not a tight coupling. If we couple too tightly, then the danger is that we anchor this [operational application] to that [business management application], and it no longer has the flexibility necessary.”

Another example that highlights the operationalization of agility is Amazon.com, which has demonstrated agility by innovating on many fronts in online retail. (See the sidebar, “How Amazon.com operationalizes agility,” on page 12.)

4 For additional details on IBPP, please see “Bringing order to chaos”, PricewaterhouseCoopers *Technology Forecast*, Summer 2008.

Conclusion

Companies face rampant change, and it’s clear they must manage this change as a continual reality, not as a series of occasional episodes they can wait to address in some “big initiative” way. Business leaders are constantly assessing and experimenting with their strategies to take advantage of change or to minimize its negative effects. Faced with such dynamics, enterprises and vendors have the opportunity to develop solutions and approaches for operationalizing agility by creating an enduring and responsive connection between strategy and operations.

The big divide between strategy and operations is the main obstacle. Strategy relies heavily on unstructured processes and information, whereas operations rely exclusively on structured processes and data. Over time, as strategy experiences an accelerating change environment and operations remain stable and standardized, they become increasingly disconnected, expanding the big divide between them.

Agility is finding the right balance between standardization and flexibility. Enterprise applications that support each will be distinct; operational applications will provide standardization and business management applications will provide flexibility. An information mediation layer will bridge the gap between these applications and keep them in sync.

Our concept of business management applications and information mediation is still emerging, and it will mature in the coming years as techniques and experiences in handling structured and unstructured data and processes improve.

Enterprises that can leverage existing and emerging applications to create the right balance between standardization and flexibility, and then operationalize agility, will create sustainable market differentiation from their rivals. And there is clearly an opportunity for vendors to help bridge these gaps; those that do so early will have an advantage with customers.

For more information on the topics discussed in this article, contact Kurt J. Bilafer at +1 408 817 5883 or Sanjeev Dutta at +1 408 817 4122.

How Amazon.com operationalizes agility

A few companies aren't waiting for the technology to evolve to support information mediation before they move toward operational agility. Amazon.com, for example, has already taken broad strides.

The ever-changing devices and the socioeconomic forces that affect consumer shopping behavior have a big impact on how Amazon does business. So the online retail giant has developed instruments for its Web site that extensively mine data to understand and analyze customer behavior.

Amazon constantly experiments to understand which Web interfaces create a better consumer experience and make consumers more likely to buy. The instruments allow Amazon to measure results quickly and judge the effectiveness of changes.

Figure 5 shows how Amazon's approach reflects the three-layer model we foresee as the enterprise application environment that will deliver agility.

At the operational layer, Amazon has order management, inventory management, and fulfillment and logistics systems that handle millions of transactions each day.

In the information mediation layer, Amazon aggregates structured data from internal and external sources. Internal sources include data from the operational systems. External sources would be competitors selling the same products. Amazon also aggregates unstructured information from internal and external sources, such as customer reviews and discussions, product descriptions and professional reviews, and links to pertinent sites. This layer also maintains the business rules that govern the operational processes.

The business management applications are those that define the customer experience, analytics, and applications that allow business managers to view

performance and get feedback on the experiments they run. Amazon has designed its business management applications so experiments can be quickly developed and deployed on the Web site.

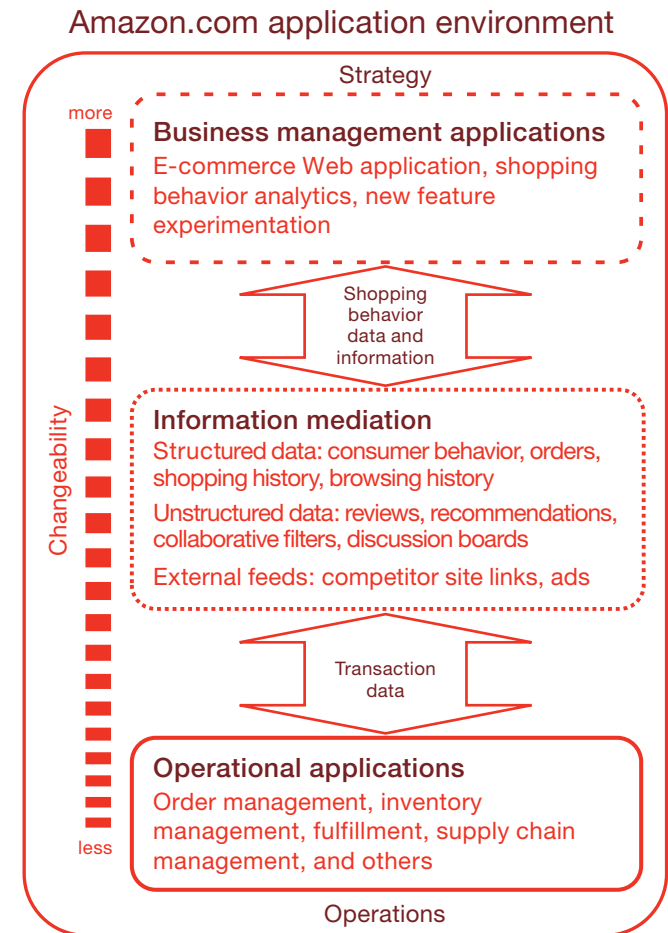


Figure 5: How Amazon.com applications fit the three layer agility-oriented application environment

At the strategy level, the business management applications interact with the information mediation layer to design new features and experiments, and to analyze scenarios. For example, when an experiment to evaluate the impact of free shipping on the propensity to buy has been finalized, it is released to the operational environment in the form of new business rules that govern the operational processes. The operational systems reflect the change by taking appropriate action during checkout to calculate the correct shipping cost. The mediation layer also starts collecting additional data on the new feature to inform further analysis and decision support. All this can happen without changing any of the operational applications.

Amazon's business management applications define the end customer experience, support the modeling and simulation of experiments, and allow frequent and rapid changes to interfaces (layout of the site), features (such as free shipping), and other experiments on a daily basis in support of customer-focused strategies. Amazon's core operational systems are changed much less frequently and continue to provide efficient support for order management, fulfillment, and inventory management.

Amazon has adapted these systems to enter new markets; most recently it used the same systems to become a supplier of digital content and a provider of computing resources. By operationalizing agility across strategy and operations, Amazon has become more effective than most e-commerce sites.⁵

5 This analysis relied on the following sources:

- "SAS Analytics Test Effectiveness of Variety of Amazon.com Features," *CRM Today*, <http://www.crm2day.com/library/EEppEIEkVuBHCMBqjb.php>.
- "Jeff Bezos' Risky Bet," *BusinessWeek*, Nov. 13, 2006, http://www.businessweek.com/magazine/content/06_46/b4009001.htm.
- Meredith Levinson, "Amazon.com's IT Leader Leaving Huge Customer Service Infrastructure as Legacy," *CIO*, Oct. 17, 2007.
- "Reprogramming Amazon," *BusinessWeek*, Dec. 22, 2003, http://www.businessweek.com/magazine/content/03_51/b3863115_mz063.htm.
- Julia Kirby and Thomas A. Stewart, "The Institutional Yes," *Harvard Business Review*, October 2007.

From efficiency to effectiveness

Jonathan Becher of SAP Business Objects discusses the role of applications in linking strategy and execution to bring effectiveness to businesses.

Interview conducted by Vinod Baya and Kurt J. Bilafer

Jonathan Becher is senior vice president of marketing for SAP Business Objects. He is responsible for championing a wide range of solutions that help organizations optimize business performance, including business intelligence (BI), enterprise performance management (EPM), and governance, risk, and compliance (GRC). Becher joined SAP from its acquisition of Pilot Software, now SAP Strategy Management, where he was president and chief executive officer.



In this interview, Becher shares his views and insights on the future of enterprise applications, business intelligence, and how to bridge the gap between strategy and execution.

PwC: What is new and different in the world of enterprise applications? Where are they headed?

JB: We believe there are two fundamentally different kinds of applications: execution applications and management applications. One of the big stories that you may have seen from SAP last year is the closing of the gap between strategy and execution. In the early 1990s, people started talking about the difference between efficiency and effectiveness. I think our industry lost sight of that conversation, because much of the last 15 years of enterprise software has been all about efficiency. That's why lots of software categories have the word automation after them—i.e., sales force automation, supply chain automation. It was taking an existing process and trying to figure out how to do it faster, quicker, with less waste, all that kind of stuff. And it's absolutely great to do more with less, to reduce your supply chain. At SAP, we're the process-centric company—hire to retire, order to cash, if you're a

retailer, sheep to shirt. We've spent a lot of time helping enterprises figure out how to be efficient with their processes. However, in most organizations, management processes still are not automated and are not well supported by enterprise applications. Those processes are managed by phone calls, by consultants, or maybe by desktop tools such as Outlook. At SAP we're bringing these two worlds together: efficiency and effectiveness.

PwC: How does the shift in focus to effectiveness relate to the need for agility or the need to deal with accelerating changes in the business environment?

JB: Because of the shifts in the rate of change, people are recognizing that hardening their processes and making them more efficient isn't enough. In some cases, they've optimized the wrong processes, and now

they're going back to something that business schools talked about in the late 1980s and businesses started talking about in the early 1990s but forgot about—that is, maybe I'm doing the wrong processes in the first place and I need to think about being more effective. People say efficient and effective, not realizing that they're fundamentally different words. Effective asks the question "which one of these things should I do?" And especially in this economic downturn, you can't fund everything. Efficiency is now the priority, and the key question a business needs to ask is, "Is this the right one to do and am I doing it in the right way?"

Very simply, it is the difference between doing work in the right way and doing the right work. Our customers are saying, "You've helped me optimize the heck out of my back office, but I don't know whether there's a match between what I say I'm going to do and what I end up doing." We think that's the next big frontier for enterprise applications.

PwC: Does addressing this frontier require new kinds of apps? What is the role for the execution apps?

JB: You can't have one without the other. If you have strategy with no execution, that's a waste of time. But, on the other hand, if you have execution with no strategy, how do you know you get somewhere? Dashboards became popular as a metaphor. People thought dashboards were a management philosophy. They aren't. If you think about your car, your dashboard tells you if you're operating your car well, how fast you're going, how much gas you have left, and so forth. It doesn't tell you if you're going to the right destination, if a traffic jam is going to show up, if you need to detour. It tells you that your car is

efficient, but not if you're headed in the right direction. So, in the last few years people added navigation. They [the car manufacturers] put them in your dashboard, but the information the navigation purveys is not necessarily metrics. We think the same thing should happen in business.

PwC: What could be an example that relates to enterprise applications?

JB: I'll use a very simple example: expense reports. Sometimes people complain about their expense reporting software. Whenever people complain to me about it, I encourage them to talk to their accounts payable department. And then they go talk to them and they tell me, "They love SAP expense reporting." I say, "This is the difference between execution apps and management apps."

From the point of view of accounts payable, they get hundreds of expense reports a day. They want to make sure you don't fly business class when you were supposed to fly coach, you don't buy a dinner that's too expensive, and so on. They want conformity. They want efficiency. They want exceptions kicked out, and that's it. As a business traveler, you don't even want an expense report, right? You have expenses that don't occur in the same week. You book the hotel a month ahead of time, the flight three weeks ahead of time, and you remember the cab fare after you submit the expense report. You have this very disconnected, chaotic process.

You can't make the same application appeal to the accounts payable person and to the traveler. At SAP, that's why we have a separate division to deal with that distinction. Obviously, the two applications need to communicate and share data, but designed around a different use case.

Agility-oriented enterprise application environment

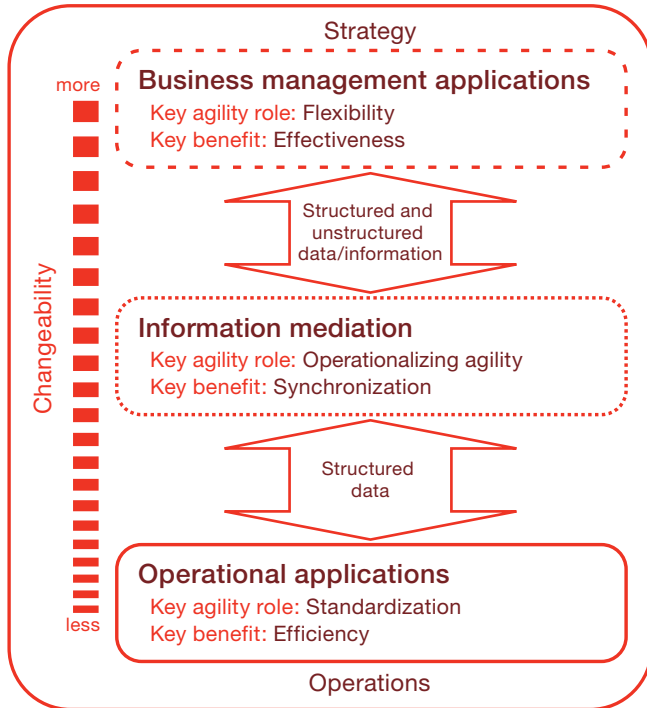


Figure 1: Agility-oriented view of the enterprise application environment

PwC: Our research is leading us to conclude that from an agility perspective, the application environment should be organized into three distinct layers [see Figure 1]: a layer of execution apps, a layer of what we are calling business management applications, and a flexible information mediation layer that brings together the other two layers. Does that fit your view of the future?

JB: I basically agree with you. Where I differ is that it's not that you have to be more flexible in the information services layer. It's the fact that the execution apps and the business management apps aren't in sync. The changes in one have to be reflected in the other appropriately, because if they aren't, then what you say you want to do and what you end up doing don't

match. And that's where the challenges really come. Then when you learn about what works and what doesn't work, that knowledge needs to feed back to the business management apps in some way, so you make better decisions the next time.

I worry that right now that loop never closes, and so the top level affects only a subset of people and doesn't change the fundamental processes. The way we close the books—that's statutory reporting through core ERP [enterprise resource planning]—may be different from the way we do management reporting. But we still use just the ERP. Unless we make the next step and synchronize, we're not really changing the business process.

PwC: What form will the synchronization you are talking about take? Is it a tight coupling? Is it a loose coupling?

JB: Think of it as a producer/consumer model. One layer could publish changes that it thought were appropriate to be consumed by another, and each layer has its own governance rules that decide whether it's going to accept them. When it chooses not to accept them, despite the fact they were published, then it communicates the rejection, the reason, and so forth, and the business management app learns incrementally what it does well. It's not a tight coupling. If we couple too tightly, then the danger is that we anchor this [operational app] to that [business management app], and it no longer has the flexibility necessary.

PwC: Where is the world of BI [business intelligence] headed? Do you think BI really belongs in the information mediation layer?

JB: Part of it depends on what the definition of BI is in your world. BI seems to be migrating into three parts. There's what I call the information management part: collecting, cleaning up, and storing the data. Not just the warehouses, but where they came from, ETL [extract, transform, and load], the business process, and so on. There's the very simple tool base of BI as well, the information discovery, if you will. And there's

“How do you make a decision? You don’t just read a report and make a decision, right? You talk to friends, you go to the Web, you do some research, you think about your history. BI helped you make that decision, but you didn’t make your decision using just BI. That’s the next BI, one that lets you talk to friends, do research, and provides the broader context necessary to make the decision.”

the delivery of information to phones and other devices. That’s the high-growth part of BI during the last couple of years. The part that’s really underserved, amusingly enough, is the original idea of BI. Remember when the category was called decision support? Who builds a decision support tool anymore? Most people don’t. They build an information presentation tool now.

Analytical apps are important, but technology that is not just reporting needs to come into BI. Let me give you an example. How do you make a decision? You don’t just read a report and make a decision, right? You talk to friends, you go to the Web, you do some research, you think about your history. BI helped you make that decision, but you didn’t make your decision using just BI. That’s the next BI, one that lets you talk to friends, do research, and provides the broader context necessary to make the decision.

PwC: So the reporting applications have to support collaboration to support decision making, right?

JB: Today, application user interfaces are typically designed for one particular person at one particular point in time. I sit and look at a screen to learn something or make a decision. But if you think about the reality, at least the way I work, it’s rarely one person doing anything. Most organizations are consensus driven, requiring different points of view from different people focused on their respective area, so these apps must be designed for multiple people who have slightly

different points of view but come together to make decisions. In the software industry, we don’t really know very well how to design apps that way. It’s not a wiki, because a wiki is something you write, and then I come along later and I change it, and then he doesn’t like what I said, and he changes it. That’s not collaborative. The last one in wins, right? True collaboration is where we each see each other’s point of view and then jointly agree on the right answer.

PwC: How good is the industry at this stage in bringing together structured and unstructured information? And how good do you think it needs to get?

JB: It’s pretty well known that unstructured data is in its infancy when it comes to business intelligence. Some interesting things are happening. We have a product—it’s now called Text Analysis—that does sentiment analysis from unstructured text. We’ve pointed it at job boards, for example, and used it to figure out which verticals are growing, what kind of jobs are in the highest demand. My point is that Text Analysis is finding interesting semantic meaning that can be overlaid on the structured data. The problem with using BI and structured data is that structured data is a bunch of numbers, and unless you’re the expert who understands the numbers, you don’t really know what the meaning is. If we can overlay unstructured data on the structured data, that’s where the big win is.

“If we can overlay unstructured data on the structured data, that’s where the big win is.”

PwC: Often the semantics of information is tied to a particular use. Data models or schemas are defined for a particular report and transactions that feed the data model are captured. When the same information is to be used in a new application, new data mapping or transformation is usually necessary. For agility sake, do you think it’s important to separate the semantics of the information from its use, so that unintended uses are possible in the future?

JB: I would think about it this way. Applications in the execution layer are designed with process at the center of the universe. Services in the information mediation layer are designed with information at the center of the universe. And things in the business management layer are designed with users at the center of the universe. Designing software from a user point of view, from an information point of view, and from a process point of view are completely different.

Historically, we, as an enterprise software company, would say, “Yes, let’s tag this data as many ways as we can possibly imagine so that we have the widest use.” I submit that’s the wrong way to think about it. Let’s say a user is using an app, and describes his or her request. That application context will have some number of content tags and so forth, and the request gets pushed down to the information layer and says, “Give me the information that I need based on the request.” If it’s not available, then the true self-describing data will then go back to the application and figure out what else. The concept of predefined doesn’t exist anymore. Now, maybe you’ll want to do some caching, so you’ll pre-create some of these

things, much like people did in the query days. But if you really want this to be flexible, the vast majority of the requests can’t be predefined there. So I would say you want to store data so that you do not assume any potential use in the future.

PwC: Would you say it’s sort of like IP [Internet protocol] networks in how they decouple transport from the applications that use them? The IP network does not assume anything about which applications will use them in the future, resulting in open and unconstrained innovation in applications.

JB: Exactly right. You can divide them and reassemble them on the fly, and it doesn’t matter. And if you lose a few packets, it doesn’t matter. I think that’s a great analogy. Unfortunately, it’s opposite of things like multidimensional analysis,¹ which was developed for predesigned hierarchies and specific use cases. The problem with multidimensional analysis is you have to do all this heavyweight design ahead of time. If you got it right, it’s phenomenally good, but what happens the minute you get something new?

PwC: Before coming to SAP, you led Pilot Software, which provided a strategy management solution. What role do strategy management solutions have in bridging the gap between strategy and operations?

JB: First, let me clarify that there is a difference between strategy development and strategy management. I don’t see any time in the near future where software will do much to replace strategy development. It can help automate and document it, and all the management tools will help, but at the end of the day somebody has to do some deep thinking and say, “Do we go into Russia? Do we go into India? Do we build blue products?” And so on.

¹ From Wikipedia: In statistics, econometrics, and related fields, multidimensional analysis is a data analysis process that groups data into two basic categories: data dimensions and measurements.

“Application processing is a commodity. What's not a commodity is real-time changeability, and the thing that should influence the changing is the information that you learn as time goes on.”

One fundamental problem I think most people overlook is that after you decide what to do, the number of people who decide what to do is miniscule compared to the number of people who have to do it. Here at SAP, we now have more than 50,000 employees. The number of people involved in creating our corporate strategy document is fewer than 100. So how do you get that knowledge that was dynamically involved in 100 people into the heads of the 50,000 so that the knowledge correctly impacts this thing down in the execution layer? That was the original problem that we tried to tackle with strategy management.

I used to joke at Pilot: “Strategy is trapped in the boardroom.” And yet the whole reason you come up with a strategy is to actually execute on it. How do you formalize that? How do you translate that strategy document into something that means something to everybody else as per their daily functions?

We believe there are three fundamental components that you have to focus on. There are objectives—it's the what you want to do. There are initiatives—it's the how you're going to accomplish what you want to do. And then there are KPIs [key performance indicators] or measures or metrics—which are whether you're making progress on those first two things. And the strategy management metaphor says if you do KPIs first, which is everyone's temptation, you're less likely to succeed. Because you're immediately keeping score without telling people what game they're participating in.

PwC: How will enterprises differentiate in the future, and what role will enterprise applications play in that differentiation?

JB: The closer you get to the users, the more differentiated you are. Let me give you a very rough analogy. On one hand, every retail store is the same. You could claim there's no way to create differentiation, because they all have store shelves, they all have scanners, they have cash registers in the front, they all have lights ahead, they all have roughly the same shape. If you use that as an analogy for ERP, then you'd say there's no difference between a Kmart and a Lowe's and a Saks Fifth Avenue. But we know that's not really true, right? They are highly similar in some ways, but they put different items on their store shelves and they interact with the users differently. Even those guys that have the same item interact with their customers in completely different ways. That's the beauty of putting together execution systems with management systems. You get the scale, repeatability, and trustworthiness of ERP with the decision-making and strategy components of management systems. You're differentiated and close to the users. ■

Agility from information mediation

Executives from E2open discuss how mediating in the cloud creates agility in the demand and supply network operations of their customers.

Interview conducted by Vinod Baya and Bud Mathaisel

Andrew Salzman is E2open's chief marketing officer, responsible for managing all worldwide company operations related to corporate and product marketing, demand generation, sales support, field marketing, public relations, and analyst relations.



E2open is the leading provider of multi-enterprise value network solutions delivered on demand as a working business process in a pay-as-you-go model. E2open delivers end-to-end visibility, collaboration, and responsiveness in global value networks with faster time to value, lower total cost of ownership, a continuous value road map, and easier integration between internal enterprise applications and trading partners, including suppliers, customers, distributors, and logistics providers. More than 71,000 trading partners worldwide currently use E2open.

Rich Becks is responsible for leading E2open's product strategy and development of demand and supply network solutions. Becks focuses on translating customer needs into leading-edge products that rapidly deliver value.



In this interview, Salzman, Becks, and Schoenthaler share their insights on how information mediation and real-time shared interactive views provide a foundation for agility for their customers in their demand and supply network operations.

Rob Schoenthaler is E2open's senior vice president of deployment in charge of the company's deployment strategy and resources. The deployment team provisions E2open's solutions for customers.



PwC: How do you define agility, and how does E2open enable agility for its customers?

RB: One aspect of agility is customer responsiveness. Companies that are well behind the curve talk about measuring their response time to their own commitment. That might be step one, but agility is really the response time to the original customer's request.

AS: Some people think of agility as being reactive. A lot of what we do is to help companies to be proactive, seeing issues that could arise and being able to solve those issues before they do arise. For example, you might set min/max parameters for a day's stock on certain products and if a company or a key supplier falls below certain minimum or maximum levels, then you

“This loose coupling effect [of information mediation] is so powerful because it allows a company to rapidly reconfigure assets, especially when mergers and acquisitions occur.”—Rich Becks

would have secondary or tertiary tiers of alternative sources you could go to on a go-forward basis. This approach enables you to proactively anticipate and solve issues in the demand or supply network before they ultimately arrive.

We pay a lot of attention to the word “network” at E2open instead of “chain.” Instead of a classical one-to-many model, we’ve built our architecture on a many-to-many model—a multi-nodal model, if you will—that recognizes the interdependencies across different players in the chain. This architecture has the ability to sense problems and opportunities and then automate the set of actions that need to be taken to solve issues as they arise.

RS: There are three levels to the concept of agility. The first one we talked about was execution agility: While you’re in the course of running your business, you’re more agile. Next, the people with whom you do business—suppliers, trading partners, customers, whatever—change from time to time. The ability to plug and play them into this business process helps you be more and more responsive and also address a new business relationship. A third dimension is the pace at which you can change even bigger things. For instance, if you’re buying an asset to be part of your company, how do you plug that into how you operate? Your ability to plug and play that asset into your operational structure architecturally is far better with E2open versus on your own, because of how we are architected. We provide one data pipe into your ERP [enterprise resource planning] system or systems, and we do the work for you through our SaaS [Software-as-a-Service]-based managed service model. You can absorb and

integrate major changes in your business model a lot faster when you have an E2open infrastructure behind the scenes rather than an ERP infrastructure.

PwC: What is it about E2open that makes it possible to get these benefits?

RS: Fundamentally, an in-the-cloud approach to connecting business processes must assume that every node will be different, as opposed to assuming every node will be SAP. Now, we’ve become very good at connecting to Oracle and SAP, because we’ve done it a lot, but the E2open platform also talks to many disparate ERP systems or inventory systems. It may not be an ERP system; it could be a best-of-breed or some legacy system that plays a role. On the other side, we also talk to trading partners via the customer’s supplier. Our approach is to be highly flexible and agile and not worry too much if something doesn’t conform to what was expected. Our design instead is set up to not expect anything. We’re good at dealing with differences on the back end, whereas most IT architectures assume some sort of consistency, which isn’t always there when a company makes an acquisition, for example.

RB: Going one level of abstraction higher, when I was at Seagate, I dealt with some situations that I think illustrate what Rob is trying to say from an architecture perspective. In other words, E2open was one hub to me; I didn’t have to maintain 256 connections to all of my suppliers when we upgraded our ERP system from one version to another. It was a weekend event. While the in-house connections that were wired directly to customers took six months, the E2open connections to

the suppliers happened in one weekend on the inbound side. And then I had the same experience when Seagate bought Maxtor. We onboarded all of Maxtor's distributors the same way we had all of Seagate's distributors, and again, that happened in a matter of weeks. This loose coupling effect is so powerful because it allows a company to rapidly reconfigure assets, especially when mergers and acquisitions occur. In fact, a large portion of our customers are spinoffs. And why does that happen? It happens because of this plugability issue. The E2open platform is managing all of that onboarding complexity and the change. That's what makes it so powerful from a flexibility and agility perspective.

PwC: You defined one aspect of agility as allowing your customers to anticipate disruptions. How does that happen, and can you provide some examples?

RS: Planners typically spend an inordinate amount of time each day finding information, not thinking about what the information means. For example, planners are constantly seeking information from a raft of suppliers regarding their ability to commit to orders of varying magnitudes. Half their week, they chase down stuff and the other half they fill out inordinately complex spreadsheets to generate forecasts. They do that so they can make sense of the information. By the time they're done, the information is stale and they get trapped in a circle of firefighting. Often they don't know a supply problem has hit them until it arrives; they can't predict it. And when it does hit them, they often need to build spreadsheets that reflect sourcing from many different suppliers. When they start using us, the first level of improvement is that the same brainpower has now spent more time analyzing the information as opposed to finding the information. The system provides accurate and timely information, so planners can see that something is going to be a problem before it becomes a problem. One step further, we're not only presenting to them the problem. We help manage by exception. You can have a thousand parts you're responsible for, but you may have only five that are a problem. Now they can fireproof instead of firefight.

PwC: E2open mediates between trading partners and handles considerable information as a result. Does this information allow you to enable agility for your customers?

RS: Think about all of the different people who contribute to creating the value that a company delivers. Perhaps a company has outsourced manufacturing and design to someone. There's also a heavy use of third parties to move goods around the earth. The more that other parties contribute to the value that's created, then the information a company needs to be really good at producing probably is not within its four walls. To be agile in making business decisions, our customers need high-quality data from a lot of other folks. By mediating between the trading partners, we are a source of this high-quality data.

PwC: Do your customers benefit from information that they would not have access to if they weren't using the E2open platform?

RS: We have access to inventory positions at various suppliers. For example, say I have something multi-sourced, a demand signal just changed, and I'm trying to determine whether to resource from a supplier in Asia or a supplier in Eastern Europe. If I know what their answer might be before I ask whether they can do it, then I might save a cycle of trying options. On the sales side, we can provide high-quality, auditable information about what the sell-in, sell-through, and sell-out has been through distributors. That information can help companies solve revenue-recognition challenges. We can provide third-party information that companies have trouble getting to and that they need to make better decisions. Access to this information allows customers to make better decisions quickly in handling changes.

RB: Another thing to keep in mind is that an ERP approach is built around a general-ledger view of the world—the assets and liabilities for that corporation. The reality is that in some supply chains, the entire product lifecycle occurs outside of the firewall. All the customer really does is design and market it. The business solutions that are needed to run that kind of a network can hardly be expressed in a behind-the-

firewall general-ledger approach. The ERP system would assume that once the product is sold to the distributor, it belongs to the distributor. The reality is that we know a certain amount of that product is going back anyway. So, our business solutions aren't hardwired into this asset liability paradigm. Instead, we are free to create a process that gives you the visibility that you really need multiple tiers down the chain.

PwC: Can customers now perform analyses that they would have been unable to do if they weren't your customers?

RS: Yes. We can manage a forecast and commit process, for example. A lot of ERP systems don't have a place to store the commit. Some of our customers work with forecast waterfalls and look at the changes week over week to determine what's really happening. There's nowhere you could even get the data in your ERP system, much less do the analysis. As soon as they use us to manage that process versus whatever they've been doing, they have not only the data but also the analysis. It is such a quick win.

AS: Another example is spend consolidation. Say you have a company that grew through acquisitions and has more than 16 different operating companies. Do they know if they're paying the lowest price on a component across that whole network? E2open can provide the glue between those operating companies. We can aggregate that information, compare it against the price book, do an exception alert, and tell them they have a lower price they've already negotiated. That's an example of a quick win even within a company, because they have similar ERP systems all over the place.

PwC: How does E2open and the mediation it provides fit into an end-to-end process of a particular customer?

RB: Traditionally, your ERP system would create the order, and then you need to communicate the order to your partners. The twentieth century guys are still doing that with mail and faxes, and the twenty-first century guys are trying to do that electronically. So, you have the order. What is the response from your supplier? Do you have a commitment from the supplier today that is not going on a spreadsheet? Because, as Rob said

earlier, there's no place to put it in the ERP system. Now you've gone from the order to the commit, and you're going to then ship against that commit, right? That's a different department altogether. You probably have some shipping software, and maybe the ERP system is generating a shipping release, but you're probably performing warehouse management functions in totally different applications. When the product is ready to ship, then it's in the hands of logistics and the carrier who uses another application. You're only in transit now. You haven't even reached the destination, where it's going to go through that whole process in reverse: being received, being stocked, and so on and so forth and all the changes that are happening along the way. To make all of these connections from inside your firewall through SOA [service-oriented architecture] or through any other way is going to be a really big challenge. Technically it could be done, but why would you want to do it?

PwC: You advocate the value network concept. What benefits does the concept of a value network bring to the industry and your customers?

RB: This may seem obvious, but it's really powerful. It's the ah-ha moment, frankly, for our customers when they understand the system or process concept. Here's what happens: I could log you in today to your trading partners' network, for example, and show you that there are some exception conditions—red conditions that mean that they're going to stock out of something, or they're going to run short, or something bad is going to happen. This is a real-time, interactive environment, and the partners you depend on are looking at it simultaneously. You and I could log into that same screen tomorrow, and that red item would be green. It would be green because they were watching it while we were. The data didn't need to be downloaded into some application that was being handed to a data warehouse that had to be extracted by a report that had to be put into a spreadsheet. Instead, we were all looking at the data at the same time. Our hypothesis is that this is a vital function for a modern demand and supply network. There needs to be a network that orchestrates, coordinates, and transforms this information between parties, and there is nobody better equipped to do that, because you have to live in the network to do it. ■

Rise of business management applications

The emerging capabilities of these applications are crucial to closing the gap between strategy and operations in pursuit of agility.



Confronted with accelerating change in the business environment, all enterprises aspire to become agile. But a big barrier to agility at most companies is the divide between strategy and operations. This gap exists, in part, because the enterprise applications that companies rely on to run many of their processes focus on operations, not on strategy.

While these operational applications contribute greatly to the automation, efficiency, scalability, and standardization of processes, they separate users from business strategy. Changes in strategy are not quickly reflected in operations, and changes in operations are not always aligned with strategy. Operational applications do not have the flexibility to meet the demands of a frequently changing business environment.

However, a recent trend portends new directions for enterprise applications. Considerable vendor consolidation has occurred in business intelligence (BI), performance management, and decision support. Vendors of financial, human resources, supply chain, and other traditional enterprise applications have sought to broaden their footprint by acquiring companies in the BI and performance management market. IBM acquired Cognos; Oracle acquired

Hyperion, Interlace Systems, Primavera, and others; and SAP acquired Business Objects, OutlookSoft, Pilot Software, and others. PricewaterhouseCoopers (PwC) believes this acquisition activity, the emerging focus on strategy management, and efforts by enterprises to use software to close the strategy and operations gap are leading to the rise of a new class of applications that we call business management applications.

Business management applications are distinct from operational applications. Instead of focusing on efficiency, business management applications focus on effectiveness by aligning with strategy. Instead of handling only structured data and processes, these applications handle unstructured information and messy processes. Instead of being standardized, they're flexible, enabling the anticipation, experimentation, analysis, modeling, and management of changes, and thereby shielding operational applications from frequent changes.

Business management applications and operational applications complement each other. And with proper mediation between them, they will increasingly provide the basis for *operationalizing agility*. This article describes some of the technical developments that enable this trend.

Business management applications and operational applications complement each other. And with proper mediation between them, they will increasingly provide the basis for operationalizing agility.

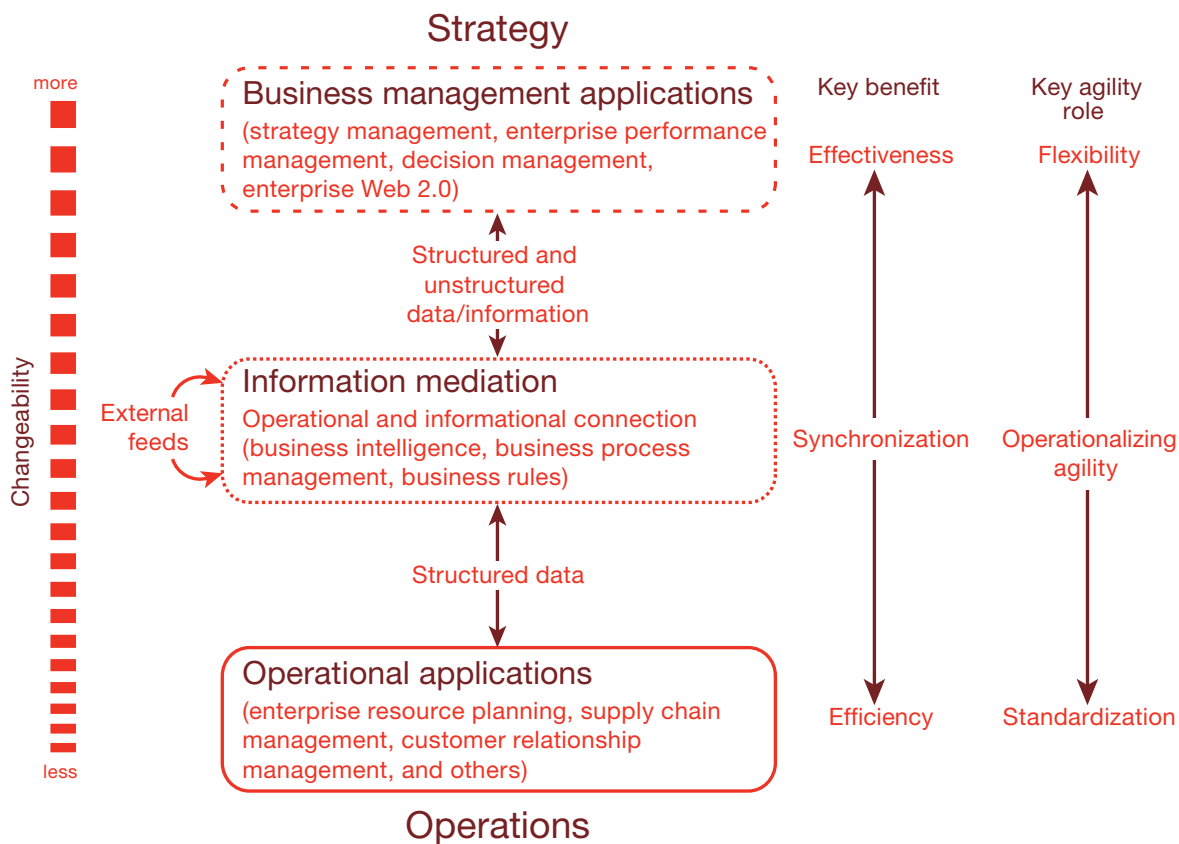


Figure 1: Three-layer agility-oriented view of the enterprise application environment

Agility-oriented view of enterprise applications

PwC describes agility as the deliberate combination of standardization and flexibility that prepares a company for change and allows it to proactively shift course with minimal disruption. Standardization and flexibility are polar opposites in many ways, and the applications for each have different requirements. From an agility perspective, enterprise application environments will evolve in a manner illustrated by Figure 1. Each of the three layers in the figure has a distinct role in creating agility, and each brings a distinct benefit to the enterprise.

The three-layer view shows applications in two groups: operational applications drive efficiency through standardized processes, and business management applications drive effectiveness by aligning with strategy. The interaction between them is enabled by an information mediation layer that provides the bidirectional synchronization necessary to operationalize the interactions. Bi-directionality is the key, because it allows strategy and operations to influence each other so they do not work at cross-purposes. Table 1 shows additional characteristics of these layers.

Agility is the deliberate combination of standardization and flexibility that prepares a company for change and allows it to proactively shift course with minimal disruption.

| Characteristics | Operational applications | Information mediation | Business management applications |
|--------------------------------------|---|--|---|
| Key agility role | Standardization of processes | Operationalizing agility | Flexibility in processes |
| Key benefit | Efficiency | Synchronization between operational and business management applications | Effectiveness |
| Process characteristic | Structured, predefined workflow | Orchestration of processes bridging strategy and operations | Unstructured, semi-structured, user-defined, ad hoc |
| Cost of changes | High | Medium | Low |
| Maturity | Very mature, stable, reliable, and mission critical | Established and emerging | Emerging and fragmented |
| Who makes changes? | Centralized; expertise needed to make changes | Centralized; IT and business expertise needed to make changes | Decentralized; end users will make changes also |
| Example applications or technologies | Enterprise resource planning, supply chain management, customer relationship management | Business intelligence, business process management, business rules, complex event processing, text analytics | Strategy management, performance management, scenario and business planning |

Table 1: The key characteristics of the three layers of the enterprise application environment

This view of the application environment provides a clear demarcation between the areas where enterprises should standardize and where they should maintain flexibility. Such a demarcation minimizes the need for frequent changes to operational applications, where changes are time consuming and expensive. Instead, changes are handled in the business management applications, which are designed to be easier and less expensive to change.

By conceiving of enterprise applications in these business management and operations layers, and by understanding the information mediation role, organizations can appropriately blend (and re-blend) standardization with flexibility to drive agility. As an example, consider how one company used its combined systems to achieve an agile response with its truck deliveries to the Gulf Coast during Hurricane Katrina, and later integrated what it learned into its

standard processes. (See the sidebar, “Operationalizing agility: Delivering products during Hurricane Katrina,” on page 34.)

By conceiving of enterprise applications in these business management and operations layers, and by understanding the information mediation role, organizations can appropriately blend (and re-blend) standardization with flexibility to drive agility.

From an agility perspective, the management of business ensures that operations reflect strategic intent and, if the strategy changes, that the operational environment reflects the change in a timely manner.

The following sections discuss the characteristics of each of the layers and the role each plays in creating a foundation for agility.

Operational applications

Operational applications automate the management of transactions or events within the company and among its trading partners. These are the systems that, if unplugged, can bring the enterprise to a halt: order management, receivables, payroll, general ledger, supply chain management, human resources management, and others.

These applications are typically monolithic, each one large and complex software with specific ways of doing things—from installation and configuration to integration and use—to which the enterprise must conform to obtain full benefit. Moreover, if the organization is to get the most from its investment, it needs to customize and integrate the applications to complement pre-existing applications—another complex undertaking frequently performed by consultants and maintained by IT staff. By design, these systems support standard processes without strong consideration of the possibility that the organization might need to change the processes.

During the past five years, improvements to these applications have made them more responsive to change. These improvements include:

- **More components**—In the past, monolithic packages depended on one central application to which plug-in applications added functionality. Today, these systems are composed of numerous

standalone modules that can run by themselves or in conjunction with others.

- **Loose coupling**—In the past, all the parts were tightly integrated, either through direct connections or through proprietary protocols. Today, the pieces are more often loosely coupled through third-party connectivity standards—such as Web services protocols and middleware standards such as Java 2 Platform, Enterprise Edition (J2EE)—for interaction and transfer of data. This loose coupling provides the foundation for making the service-oriented architecture (SOA) the natural and more flexible design for today's operational applications.

Together, these two trends bring to operational applications a level of flexibility not previously available. However, this flexibility is typically not enough to facilitate the overall agility desired. Given their absolute focus on efficiency and the high cost of making changes, operational applications should not require frequent changes to meet the demands of an ever-changing business environment.

Business management applications

Unlike operational applications, business management applications are closer to the influence of strategy and focus on the management of the business rather than the management of transactions. From an agility perspective, the management of business ensures that operations reflect strategic intent and, if the strategy changes, that the operational environment reflects the change in a timely manner.

Processes closer to strategy, many of which are decision- and policy-oriented, differ from operational processes in fundamental ways. They are ad hoc, unstructured, often constructed on the fly, often involve manual work, and rely extensively on collaboration. Processes closer to strategy typically lack the well-defined and well-sequenced workflows common to operational processes. An example illustrates these differences.

In a retail business, a response to a reduction in market share could spark collaboration among marketing, sales, and finance to analyze various alternatives and

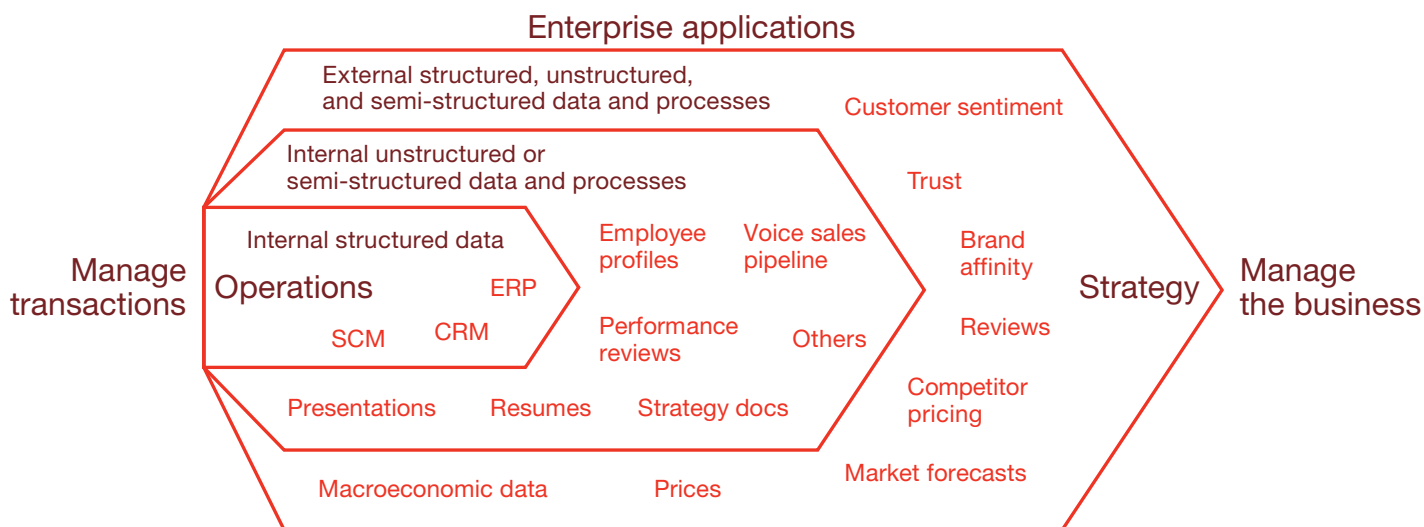


Figure 2: Increasing role of unstructured information as enterprise applications move beyond today's focus on operations toward strategy

their impact on revenues, profitability, and the strategic objective of market share. The result could be a new pricing scheme, or a shuffling of product offerings, or a change in customer service. And the result should be reflected quickly in point of sales, marketing, advertising, and other pertinent operational systems.

To improve overall performance, both the ad hoc process of developing a response by analyzing various alternatives and the synchronization with operational systems should be performed with agility. Such ad hoc processes need applications that require less structure and that allow modeling, scenario analysis, and other changes—all characteristics geared toward greater flexibility.

Processes closer to strategy handle structured data and unstructured information as shown in Figure 2. Structured data fits neatly in a relational database and is the predominant information used by operational systems. Most of today's business intelligence systems and decision support systems also use structured relational data because it easily lends itself to analysis and transactional operations. Unstructured information comes from many internal and external sources and is usually stored in file systems or content management

systems rather than relational databases. Strategy documents, regulatory filings, market research documents, Web sites, user reviews of products, and blogs are just some examples of unstructured information.

Over the years, techniques such as text analytics, text mining, and Semantic Web tools and methods¹ have made strides in offering capabilities for processing unstructured information. Techniques for classification, categorization, and tagging with a markup language are making it possible to use unstructured information in applications. Such techniques, although far from mature, are becoming integral to many business intelligence suites and analytical systems. For instance, most customer analytics solutions mine the transcripts of customer support interactions and customer feedback to discover key issues or insights that companies can use to improve products or develop new ones.

To address the different characteristics of information and processes closer to strategy, business

¹ For more on Semantic Web, see Wikipedia's entry at http://en.wikipedia.org/wiki/Semantic_Web.

management applications will include many capabilities that are not common in operational applications. Table 2 lists many of these capabilities, which will roughly support the following functions in the future:

- **Modeling and scenario analysis**—Anticipating changes and their impact on the business is essential to managing the business. Scenario analysis should help organizations analyze various options, and modeling should provide a system-level understanding of the potential impact of a change on strategic intent.²
- **Process and information discovery**—By searching across transactions, file systems, and document management systems, these applications should be able to discover undocumented or undefined processes and information. This information should be useful for either operationalizing future processes

or enforcing policies derived from strategy; more advanced applications could update policies dynamically. A combination of capabilities from pattern matching, semantics analysis, categorization, and classification could be used in process discovery. One vendor, InDorse Technologies, provides a solution that uses the process discovery technique to enforce security policies for regulatory filings to mitigate the risk of sensitive information leaving the enterprise.³

- **Feedback and learning**—Business management applications will be capable of continuously learning new procedures or policies based on training and on feedback about what is working and what is not. In advanced cases, they may also be capable of learning and making new business rules that are added to the business rules system and extend its functionality.

2 For more on modeling and how it relates to agility, please see “Modeling value and agility,” PricewaterhouseCoopers *Technology Forecast*, Fall 2008.

3 For details on InDorse, please see “Closing the strategy-operations gap: two examples” on page 44 in this issue of the *Technology Forecast*.

Business management application capability

Can discover the existence of undocumented processes, information (documents), and contexts that are implicit but not documented as part of standard business transactions

Uses pattern matching, semantics analysis, advanced statistical techniques, and other processes to automatically categorize information, processes, and transactions

Easily handles unstructured data and information, creating elements of an “unstructured data warehouse”

Explicitly analyzes unstructured information to create a more meaningful context for interpreting structured data

Supports modeling and scenario analyses

Demonstrates learning capability based on training processes and direct feedback

Can translate strategy or policy goals into the discovery, analysis, and management of related business processes

Can automatically create and externalize new business rules based on analysis and learning

Identifies and detects business activities not conforming to policy beyond what individual personnel are likely to find

Empowers enterprise managers to take action by providing direction and context

Table 2: Key capabilities of business management applications in the future

Business intelligence analytics and decision support applications are already in use today, and collaborative solutions such as wikis and other Web 2.0 tools are early examples of certain aspects of business management applications. But they need new capabilities to combine structured data and unstructured information to enhance the use of both.

Although structured data and unstructured information must be treated differently, it is how they are combined that defines their true value. “If we can get the unstructured data to overlay on top of structured data, that’s where the big win is. It’s not doing BI on unstructured information,” says Jonathan Becher, senior vice president of marketing for SAP Business Objects. Business intelligence analytics and decision support applications are already in use today, and collaborative solutions such as wikis and other Web 2.0 tools are early examples of certain aspects of business management applications. But they need new capabilities to combine structured data and unstructured information to enhance the use of both.

The successful use of emerging text-analysis techniques on mountains of data in some vertical industries provides early examples of how such techniques help. Electronic discovery solutions in the legal field, compliance in financial services, and fraud detection in the insurance industry all use text analysis to cluster, categorize, filter, and discover pertinent information from large data repositories to address specific business objectives. Vendors of text analytics products include Attensity, IBM (Cognos), Lexalytics, and SAP (with its acquisition of Inxight Software). PwC’s Ledger Analyzer is a business management application that analyzes detailed financial data to detect potential fraud or errors.⁴

4 For details on how the PwC Ledger Analyzer application helps manage business by detecting potential fraud risk, see “Closing the strategy-operations gap: two examples” in this issue of the *Technology Forecast*.

Strategy management and performance management software are two other examples of emerging business management solutions. They are available from IBM, Infor, Oracle, SAP, SAS, and others. One set of tools takes a top-down approach and the other set takes a bottom-up approach. Strategy management tools push information from strategy down into operations so those operations remain aligned with strategic objectives. Performance management tools pull data from operations, translate it into financial impact, and make it visible to management in decision-making dashboards. Together they create the two-way connection between strategy and operations. Although these tools facilitate some modeling and simulation of the impact of changes on financial performance, their initial focus is on reporting capabilities for decision support. They are also evolving in their ability to integrate unstructured information and to drive changes in the operational environment.

Information mediation layer

Applications produce and consume structured data and unstructured information. Data can be sourced from internal systems (data warehouses, file systems, document management systems) or external feeds (market research, competitive intelligence, and so forth). It could be generated in real time or archived in a data warehouse. Whatever its origin, source, or nature, data drives both operational and business management applications and requires important considerations from the viewpoint of agility.

Although operational and business management applications focus on standardization and flexibility, the need for agility requires the following:

- **An enduring and responsive connection between the two sets of enterprise applications**—“The operational apps and the business management apps aren’t in sync [today],” says Becher. “The changes in one must be reflected in the other appropriately. If they aren’t, then what you say you want to do and what you end up doing don’t match. That’s where the challenge really comes.” This operational connection cannot take form as a tight coupling with direct integration between the applications, because that would lead to several point-to-point connections, creating complexity and rigidity that would not have the necessary flexibility. The connection needs to be mediated.
- **A resource to manage semantics**—The lack of common data and information semantics used by the operational and business management systems can be a serious barrier to agility, because data needs to be rationalized before it can be shared or used for a different purpose. “Modular applications are just one requirement to achieve enterprise agility. The applications must be able to work together in a cohesive manner despite having different semantics,” explains Edward Abbo, senior vice president of application development at Oracle.

To address both requirements, there is a need for an information mediation layer that bridges operational and business management applications and that maintains a repository of structured data and unstructured information. (See Figure 1 on page 26.)

From the repository’s perspective, the role of information mediation is similar to data warehousing as used in business intelligence—with some differences. Information mediation brings together structured data and unstructured information, and so in essence creates an unstructured and structured data warehouse. To handle unstructured information, this layer will use text mining, text analytics, and emerging semantic

technologies to discover patterns and classify, categorize, and tag the information for use by business management applications as discussed earlier.

Too often, the semantics of data or information is tightly coupled with its use—defined for a specific purpose, such as to generate a particular report or support an analysis. This coupling compromises agility because it requires the same data to undergo changes through data mappings, extraction, or transformation to a metadata language before it can be used by a new application. In the future, semantics should be fully described to create the potential for maximum use in other contexts.

For the sake of agility, this layer must decouple the semantics of data or information from its immediate use to allow future uses that are unconstrained by how information is structured and stored. Too often, the semantics of data or information is tightly coupled with its use—defined for a specific purpose, such as to generate a particular report or support an analysis. This coupling compromises agility because it requires the same data to undergo changes

through data mappings, extraction, or transformation to a metadata language before it can be used by a new application. In the future, semantics should be fully described to create the potential for maximum use in other contexts.

Workday, a Software-as-a-Service (SaaS) vendor in human resources management, is an early example of decoupling in the data model. Workday has kept its data model separate from the applications that use it, so any new applications can use the same data without changes and without being constrained by other applications. “We’ve really decoupled the database’s role in giving any kind of data model to the application. The data model is held and encapsulated with the application logic,” explains Stan Swete, Workday’s chief technology officer.

This kind of decoupling is not unlike Internet Protocol (IP) networks, where the applications that use the data transported over the networks are completely decoupled from the data transport. As a result, the network can support new applications without any changes to the network. A complete decoupling like this may not be entirely possible in data and information semantics, but the greater the separation the information layer provides, the more flexibility it can enable.

Such an information layer is starting to emerge through the combination of technologies that have historically existed in silos. In the Summer 2008 issue of the *Technology Forecast*, we conceptualized this layer as a suite—an intelligent business performance platform (IBPP)—that blends business intelligence, business rules, and business process management (BPM) to link knowledge with the processes that need it.⁵

5 “Bringing order to chaos,” PricewaterhouseCoopers *Technology Forecast*, Summer 2008.

Business intelligence applications gather structured data and unstructured information from a range of sources and stage it for use by applications and processes. Business rules systems allow the automation of appropriate responses to changes and events. Business process management systems (BPMSs) can orchestrate predefined or on-the-fly discovered processes. BPMSs also capture the logic of the workflow associated with a business process. Rather than just capturing transaction data, they make available the process data that can be analyzed for a range of purposes, such as anticipating future changes. BPMSs allow users to rapidly modify business processes, providing flexibility in making changes to processes.

“We’ve really decoupled the database’s role in giving any kind of data model to the application. The data model is held and encapsulated with the application logic.”—Stan Swete of Workday

Conclusion

The better the processes and technology an organization has in place to accommodate change, the more disciplined and intelligent its response will be. By making the application environment responsive and flexible at moments of opportunity and stress, enterprises give themselves an advantage to profit during periods of rapid change.

Although operational applications will continue to provide the necessary standardization of processes, mission-critical availability, and efficiency, we see the rise of a new class of applications for managing the business that are closer to strategy, handle unstructured information, and support decision making. These business management applications—which will emerge from existing efforts around performance management, collaboration, and decision support applications—will complement transaction systems by bringing flexibility to enterprise operations. Many such applications will use text mining, statistical methods, pattern matching, machine learning, and other advanced analytics to discover processes and then leverage them to drive alignment with strategy.

Another key evolution will be the maturing of an information mediation layer that creates an enduring and responsive connection between the operational and business management applications, thereby completing the link between strategy and operations. This information mediation layer will enable greater agility by managing the semantics of information and decoupling information from the application that uses it to allow many intended and unintended uses of the same information.

Despite their reputation as difficult to change, enterprise applications will be the enablers of agility when they are separated into distinct layers that balance standardization and flexibility. The demands of business today do not permit, or even tolerate, a situation in which a company's response is delayed because programmers or IT staff cannot adequately bend the software to their needs.

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Operationalizing agility: delivering products during Hurricane Katrina

All trucking companies prepare for the failure of their trucks. They also have plans for situations in which delivery areas become inaccessible for one reason or another. Few companies have plans for once-in-a-century storms like Hurricane Katrina.

But consider this company that has a trucking division that transports its partially finished goods from its headquarters in the Pacific Northwest to its manufacturing partners around the country. Like everyone else, it did not know how serious Katrina would be until 48 hours before its landfall—too late to make many ship/don't ship decisions. The company couldn't control the weather, but it could ship products and use its enterprise applications to manage its trucks once they were on the road.

The company's transactional processes were supported by supply chain, inventory management, logistics, and other applications. It had a version of what PwC calls the information mediation layer—in this case, real-time data feeds from meteorological services, updates from transportation advisory systems, plus streaming GPS data from all its trucks. It also had complex event processing (CEP) software that could monitor thresholds of events to allow the company to determine which regions were safe to enter. Meteorological forecasts alone were not sufficient to decide which areas were accessible. The company needed to make sure that even if it could get through, its partners would be there to unload the trucks. Hence it accessed the integrated supply chain systems to see which manufacturers were working and which were not.

As it became clear that Katrina would make many roads in the Gulf Coast area impassable, the company began rerouting trucks to other partners. Using techniques such as demand shaping to analyze the pricing alternatives, the company could negotiate with partners to accept early delivery of inventory at a reduced price. To customers who were affected by the storm but were still accessible by truck, the company offered to buy back undamaged inventory (which was perishable) at a discount with the promise that it would replace it at a similar cost when the partner could reopen.

Because the company had in place an extensive analytics suite designed for easy adaptability and because it had installed real-time inventory systems that have remote supply chain access, it was able to calculate prices, determine discounts, and make deals in real time—thereby suffering no losses and only mildly reduced profits, and greatly improving customer loyalty.

The company analyzed this agile response to Katrina in a thorough post-mortem, and it has fully integrated a new business process into operations. The techniques used in Katrina are now a regular part of the company’s response to less disruptive events.

This example makes clear that certain disruptive changes can be handled with agility, even if their exact nature and timing cannot be accurately anticipated. How the product delivery company operationalized agility by using an arrangement that mimics the three-layer enterprise application environment PwC advocates is illustrated in Figure 3.

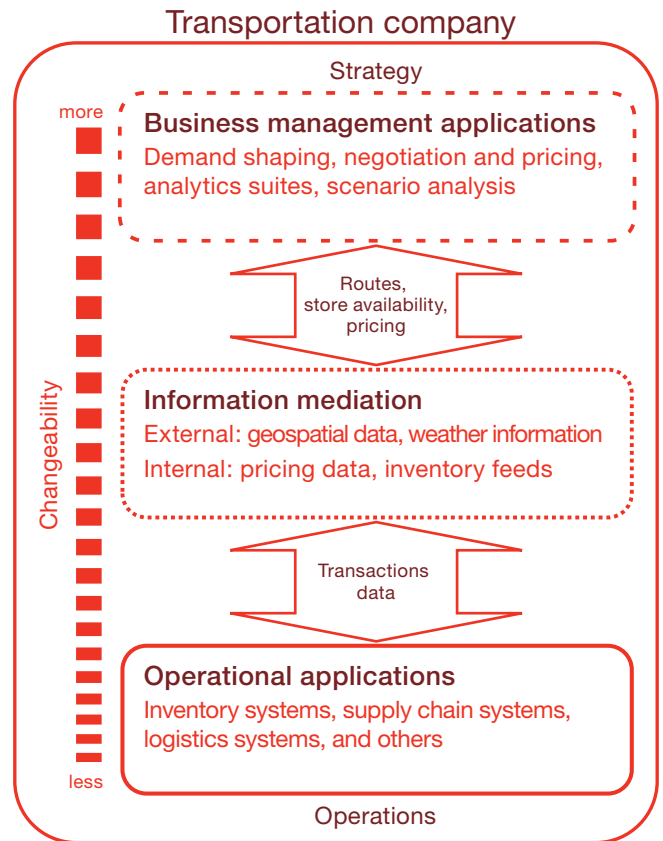


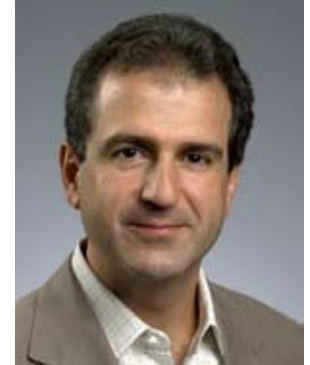
Figure 3: The agile enterprise application environment of the product delivery company

Abstracting above applications for agility

Edward Abbo of Oracle discusses how abstracting above applications provides agility for enterprises.

Interview conducted by Vinod Baya

Edward Abbo is senior vice president of application development at Oracle, responsible for the strategic direction and development of Oracle applications, including the Oracle E-Business Suite, PeopleSoft Enterprise, Siebel CRM, and JD Edwards application product families, as well as Oracle's Application Integration Architecture and SaaS.



Prior to joining Oracle in 2006, he was senior vice president of technology and chief technology officer for Siebel Systems, responsible for technology strategy in software design and development, as well as technology product marketing. He also held management roles in industry applications and sales consulting at Siebel Systems.

In this interview, Abbo discusses the evolution of networked enterprises as well as the abstractions and semantic bridges that allow enterprise applications to be responsive to business needs.

PwC: Enterprise applications now have many decades of history. What are some of the new areas of opportunity you see in the near and distant future?

EA: I think the opportunities, broadly, are in three areas. First, business models are evolving in a networked world where companies themselves no longer control end-to-end business processes. This provides an opportunity for IT to support processes that expand outside the company.

The second opportunity is leveraging information and transaction systems, allowing companies to make better-informed decisions. This opportunity involves the use of predictive engines and technologies.

The third opportunity is in the dramatic improvements in computing power, which enable capabilities such as Software as a Service [SaaS] to be used in conjunction

with software within an enterprise. Coupled with that is the enablement of specific applications for mobile devices such as the iPhone, and we're doing some fascinating things that take advantage of location services.

PwC: In the current business environment of accelerating changes, agility has become a corporate imperative. How do you define agility for your customers?

EA: Agility is the ability to quickly respond to changing business conditions. When a company wants to change its business model, whether it's reacting to customer demand or consumer or competitive trends, information technology has been one of the long-lead items that slow the company's ability to react. Oracle has put a lot of work into improving IT's ability to quickly adapt to changing business needs.

“Business models are evolving in a networked world where companies themselves no longer control end-to-end business processes.”

PwC: What are some of the things Oracle is doing to help its customers be more agile?

EA: In the past, information technology products have been built with some assumptions about the process running within the organization and data residency. However, now as processes have extended beyond enterprises, many of these assumptions are no longer true. So applications and associated architectures must evolve to be more flexible.

Oracle introduced the Application Integration Architecture [AIA] to enable organizations to be flexible by not making assumptions about which parts of the process Oracle applications execute and which parts of the process occur outside of Oracle applications. AIA gives companies the ability to quickly implement and change a business process that spans multiple applications.

PwC: Do you think SOA [service-oriented architecture] and its promises are adequate for all the flexibility that is needed? Are there other sources of flexibility for enterprise applications?

EA: SOA provides the right architecture to enable the adaptive enterprise. And to achieve the agility that SOA promises, applications not only need to be service enabled, but they need to be modular.

Oracle is delivering capabilities in a modular fashion so customers don't need the entire platform to take advantage of new functionality. Some examples of this

are demand planning, transportation management, or product lifecycle management. These modular applications allow customers to get valuable functionality without having to upgrade their existing ERP [enterprise resource planning] or CRM [customer relationship management] backbones.

Modular applications are just one requirement to achieve enterprise agility. The applications must be able to work together in a cohesive manner despite having different semantics. Oracle has solved this problem with the Application Integration Architecture. What AIA provides is an abstraction layer above the individual applications, which allows companies to quickly develop processes that go across disparate applications and, more importantly, to change processes very quickly.

Let me give you an analogy from the telephony world. Web services provide the dial tone, but once two people or two applications are connected, the challenge is that they may speak different languages. If someone in Germany is talking to someone in China, they may not understand each other because they're speaking German and Chinese. The semantic definitions we have come up with allow you to translate what one person is saying, so that the other can understand it.

Returning to applications, the abstraction layer allows companies to quickly define processes built on top of the underlying applications and to change those processes without tinkering with the individual applications that are below the abstraction.

PwC: So this abstraction layer is actually mediating between your operational applications—the ERP and other systems of record—and the modular edge applications you just talked about?

EA: That’s right. But it really extends to any application. This abstraction layer is built on open standards and allows you to integrate not only Oracle applications but also non-Oracle applications, such as legacy systems or third-party applications.

PwC: In our research, we have found that a key barrier to agility is the gap that exists between strategy and operations. While strategy stays flexible to respond to changes, operations are standardized for efficiency and harder to change. Does the abstraction layer as you have defined it play a role in bridging the gap between strategy and operations and, if so, how?

EA: Historically, you’re right, and that’s the issue I touched on earlier: a business would want to change its business model, but IT couldn’t react quickly enough. Oracle’s Application Integration Architecture includes process modeling so that a business can model its process and then enact it in the software. When a change needs to be made, the model is changed and that change is then replicated in the software.

PwC: Many enterprises are using performance management applications to track strategy. Can you provide some examples where input from performance management applications drives change in the operational environment?

EA: Performance is incredibly important in today’s economy. Wherever possible, companies need to improve results, and we’re building applications that help them do just that.

For example, we recently delivered two productivity applications called Sales Prospector and Deal Management. These applications make sales reps more

effective by proactively pitching products a customer is likely to purchase at the price that brings in the most revenue. Leveraging data mining and analytics, we can predict what one customer would buy at what price, based on purchases made by similar customers.

We use the transaction information that’s already captured in the application system, and the analytics provide the basis for driving changes in operational behavior.

PwC: For the most part, operational applications deal with structured data. How important is it for applications to handle semi-structured or unstructured data or information? And how good do you think it needs to get?

EA: I think it’s a very important area, and I would broaden it. Applications historically have done a very good job in terms of structured process—but what we’re doing now is focusing on unstructured interactions as well as unstructured data. For example, we’ve deployed a technology that we call Secure Enterprise Search—if you think of Google for searching the Internet, Oracle has the equivalent for the enterprise. Through a Google-like interface, you can search for a customer agreement and the system will search the transactional structured data and your unstructured data, irrespective of whether that’s an e-mail or in a document management system or in third-party systems. It will crawl the enterprise—securely—and provide you the data. Security is critical because you don’t want anyone within the enterprise to be able to access any information. That’s just one step we’ve already tackled.

“Applications historically have done a very good job in terms of structured process—but what we’re doing now is focusing on unstructured interactions as well as unstructured data.”

The other step is around unstructured interactions, and here we are borrowing a page from Internet innovations. We're using the concept of social networking to bring a group of people together in an ad hoc fashion rather than in a hierarchy or in a formal organization. A group could be working on designing a product across different organizations within a company but also actively including customers as well as suppliers.

This approach also brings the equivalent wisdom of the crowd to assessing information—structured and unstructured. Some of the products we've released include tools for salespeople that allow them to look at the best presentations for closing business. Another product helps identify the best talent to fill a particular position, whether that person has been recommended by people internally or is a referral that comes from outside of a network. But the point is that it's similar in the sense that we're bringing unstructured groups together to bubble their collective wisdom to the top. All of these concepts are very useful for the consumer-focused services on the Internet, and they now apply internally to the enterprise applications that we're delivering.

PwC: Software as a Service has emerged as a new delivery model for enterprise software. What role does this delivery model have from an agility perspective?

EA: Software as a Service provides agility because it gives enterprises the ability to take advantage of functionality very quickly. Having said that, we believe companies will continue to rely on a combination of Software as a Service and on-premises software for the more complex and tightly integrated business processes, so I really see this as a hybrid approach. And that is where Oracle has an advantage—through AIA we deliver supported integration between on-premises and on-demand software.

PwC: Often the semantics of information is tied to a particular use. Data models or schemas are defined for a particular report and transactions that feed the data model are captured. When

the same information is to be used in a new application, new data mapping or transformation is usually necessary. For the sake of agility, do you think it's important to separate the semantics of the information from its use, so that unintended uses are possible in the future?

EA: I think that's essentially what we are delivering with the Application Integration Architecture. The attributes we are exposing can be either transaction attributes or analytic attributes. So the end usage, whether it's a report or a Web service, doesn't need to worry about where the data is coming from or the access method.

We can do this today for two reasons. First, standards have evolved so that there is enough agreement to drive a quorum for horizontal definitions. Second, and what makes us uniquely able to do this, is our acquisition strategy. We have an unmatched breadth of applications that are not just ERP applications but also CRM and supply chain applications and industry applications, such as telco billing systems, utilities billing systems, activation and provisioning systems, banking deposits, mortgage loan systems, insurance policy administration systems, and on and on in each of these industries. And that means the object definitions we have are very pragmatic and can be considered de facto standards. So it's really the combination of standards evolving and our unique position with a plethora of applications that means we can define these objects, services, and standards and allow them to be consumed or plugged into other third-party and legacy applications.

The other thing we're doing is tackling the key processes by industry. I haven't talked about industries. But generically, for example, processes include order to cash, accelerating the new product introductions, and then customer service and customer resolution. We're defining those for the telecommunications, utilities, high-technology, and manufacturing industries.

We are being very, very specific, and there's enormous value to not just the processes but also the semantic layer that we are delivering in what we call a foundation pack. This foundation has the CIOs of many companies across these industries very excited about leveraging this abstraction layer to deliver agility in their companies. ■

Decoupling data semantics from data storage for agility

Stan Swete of Workday discusses how the company enables agility in organizational and business process changes.

Interview conducted by Vinod Baya

Stan Swete is the chief technology officer at Workday and is responsible for overall technology strategy, direction, and execution.

Swete spent 10 years with PeopleSoft in key leadership roles. Most recently he headed the products and technology organization, which included more than 4,000 employees.

He was also manager of tools development, general manager of the financial applications, and general manager of customer relationship management (CRM). Swete was responsible for the initial release of PeopleSoft's Internet architecture.

In this interview, Swete shares how Workday is building flexibility in the next generation of enterprise applications by decoupling applications from the data structures in the relational database. He also describes the origins of the business intelligence industry and the benefits of built-in business intelligence.



PwC: Can you tell us a little bit about Workday?

SS: Workday is a three-and-a-half-year-old startup. We're trying to build what we consider to be the next generation or an alternative to current ERP [enterprise resource planning] solutions. We think an alternative is needed because of some of the rigidity, complexity, and cost of ownership of current enterprise systems. We're taking a clean-slate approach in three different ways: creating a new business model that includes SaaS [Software as a Service]; leveraging new technology; and writing applications from the ground up to make new core enterprise applications available.

PwC: You advocate agility as a value proposition of your solution. Can you please define agility and how it relates to your customers?

SS: Agility is an ability to change when you have to. So the two high-level things that need changing—either because of growth or a strategy change—are your organization and your internal business processes.

Agility is the ability to do that just as quickly as your strategy changes or if growth changes your business.

PwC: How do your products allow your customers to be agile?

SS: Workday provides the enterprise core. We want to be an organization's main system of record for people, organizations, projects, financial results, etc.—that's what we mean when we say core. We put a lot of effort into making sure that the systems we deliver are not only feature rich but also are flexible. There are very good examples of that in human capital management, and it starts with people in organizations. We've done a lot of work to really give flexibility to how you can map your organizations. For example, we have a supervisory structure as well as a cost center structure. We also have more ad hoc organizations, and you can model your people in all these ways and translate between all these ways for rolling up both people and costs. There's a certain bit of flexibility just right there.

Second, we make it very easy to change those structures, and I think that's unique to Workday. If companies are constantly organizing and reorganizing, one aspect of enterprise systems that's too rigid is the inability to restructure an organization quickly in the system. Say you change from a line of business to functional areas; many companies seem to be constantly oscillating between those things. We'll make it easy to do that kind of a change and not have you waiting weeks for your systems to catch up to you. Organizational change is a key area where we've put in the flexibility.

We do the same thing with business processes. We deliver predefined business processes, but we also deliver a tool that allows customers—without coding—to configure changes to the business process so that they can make the process fit their organization. As the process changes over time, they can add steps into a process, take steps out, change routing rules, and change approval structures.

Both of these things—how you change organizations and how you change business processes—are done by configuring the service we deliver. You don't have to hire a programmer or call a Workday consultant to do that. It's just another business transaction to change the organization structure or the business process.

PwC: How is what you are doing at Workday different from what you developed before? What technical leaps are you making?

SS: Part of it is the technology, and part of it is how the product is written. I think we've put a lot more thought into how we're going to monitor organizations at the product level, but the technology is different, too. We're replacing what I'll just term client/server technology. To me, client/server technology is simplistically but accurately represented as millions of lines of code having a complex SQL conversation with a complex relational structure that generally has thousands of

tables in it. The applications that are built on that complexity gain a certain amount of rigidity in both business process and organization. It's difficult to split a supervisory organization in an enterprise software company. You have to handle all the restructuring that might entail at both the application logic layer and the database layer, and then typically you have a separate security structure that you need to update.

That is not agile. With Workday when you restructure, it's done without coding or database restructuring, and all the security aspects are tied into the change you make. It's not like you just push a button, but you can manage the process more quickly.

PwC: How do you deal with the link to the database now? Is it different?

SS: We take a very different approach to the use of a database. At the base of Workday is a relational database, but it's not used in the classically relational sense. It's an unchanging schema that is used just to persist the metadata definitions we have, the changes to them, and then the changes to the application data. No developer ever thinks of the structure of that database. They don't code to it, and when we make changes to the metadata structures, those changes are made at the logic layer above that.

The database really is there just to persist changes to the application data. We have divorced all the logic into an object model that is a part of our logic layer, and we're able to perform operations on that object model, such as restructuring and organization structure. When those changes are made to that model, a set of updates stream down to the database, but no database restructuring occurs.

That's very different from client/server. We've really decoupled the database's role in giving any kind of data model to the application. The data model is held and encapsulated with the application logic.

PwC: Does such a decoupling allow you to use the data that you store in multiple ways, giving more flexibility in what functionality you can add without disruption?

SS: Actually, what gives you the flexibility is the encapsulation of the data with the logic that manages it. I think a big part of the client/server problem is that you not only have these complex logic and database layers, but different applications are able to integrate directly to both. That just locks everything up. If you want to make a change that's fundamental to those things, you're blocked off from making the change.

Our developers think about applications as an object model. There's a class structure, and classes have relationships to other classes. The developer does not need to map to any other kind of a structure. It's persisted independently of how we actually turn transactions into SQL updates. That's all done in the tools.

So, when you change a relationship to point from one class to another class, you are changing a bit of metadata. That change is not linked to some corresponding, underlying table structure. When you make that change in the metadata layer, we're able to update the system without a data restructuring. We can do changes as business transactions rather than coding exercises and database restructurings, and that leads to massive improvements in agility for the customers and in speed of development for us.

PwC: How should your customers think of enterprise applications in enabling change?

SS: You want to make sure your applications enable you to pursue necessary changes and not get in your way. Today, applications get high marks for consistency

and reliability and low marks for allowing you to change when you have to. That's the problem we're working on. We're trying to make it so that the decision about whether you change is a business decision, not an issue of can you afford to change your applications. Right now the applications play too prevalent a role in saying we're not going to make that change because we couldn't afford to change the app. That needs to be eliminated.

PwC: What role does a Software-as-a-Service [SaaS] model play in agility? Are there benefits because of the different delivery model vis-à-vis on-premises software?

SS: I think SaaS on its own doesn't make you any more flexible than anyone else. It's all about what you deliver. SaaS gives you the benefit of the right people doing the right work. It is unusual to think about writing an application, selling it to someone, and then having them maintain it. That's one of the real logical things about SaaS. You let the people who write the application do all the upgrading and patching and everything else. The other benefit is better cost of ownership for both the customer and the SaaS vendor. The lower TCO for customers is discussed frequently. But there are savings on the vendor side as well. We spend a lot less time having to document, explain, and debug our install, patch, and upgrade processes for our customers. These kinds of things consume a lot of time and effort for vendors of on-premises solutions.

In addition to these primary benefits, I think SaaS can be an enabler of flexibility when it comes to integration, but there's a bit of a story to tell there. I think we're on a journey toward more interoperable applications, and the first step on that journey is embracing SOA [service-oriented architecture].

“I think a big part of the client/server problem is that you not only have these complex logic and database layers, but different applications are able to integrate directly to both. That just locks everything up. If you want to make a change that's fundamental to those things, you're blocked off from making the change.”

If you and I are application providers who both commit to SOA, integration between our applications will happen more easily, but that integration won't necessarily deliver more flexibility to customers. Now, if you and I are also both SaaS vendors, you start to get flexibility. We can work to support and, if necessary, refine the integration completely in the cloud and without the concern of the impact on the customer's environment. If one or both of us produces an on-premises solution, we lose control of the ability to manage the integration (and manage changes to it)—and the customer loses flexibility. The combination of SOA design and SaaS deployment should really raise the interoperability of future applications.

PwC: One of the value propositions you promote is the integration of business intelligence [BI] into your applications. What value does that create?

SS: It's yet another thing that we feel the previous generation of enterprise systems didn't get right. The data models for these systems were built to do a specific kind of reporting. In HR, it was regulatory reporting for the human capital management specialist who had to get out all these government-required reports. Financial systems were built to produce required financial reports. So you build a data model that allows you to produce those reports, and you gather transactions that feed the data model. There's nothing wrong with that, except that the kinds of reporting you can produce tend to be limited. These systems aren't able to produce a lot of basic business operations reporting—the things managers might want to know. I would claim that building ERPs for back-office reporting needs helped create the business intelligence industry. Basically, BI vendors said, "Let's try to extract the data and massage it in a way that makes sense to an operational manager."

As we look at building new applications, we think there's an opportunity to do a much better job of producing basic information out of systems in a way that not only accomplishes the regulatory reporting, but also helps the manager a little bit more. A constant design goal for our systems is to make sure that we're not constrained to a specific data model. For example, we have an HR system, but it also understands cost

centers and the cost center hierarchy. So you get your head count reporting and cost rollups how you want them and synced up.

We try to have a lot of information around that's relevant to people who aren't just back-office HR folks. Our philosophy is if you do a good job of generally collecting all the information that comes from the business events that happen, then you can be an HR system that does HR regulatory reporting, but you also can provide a richer set of reports to managers who care about people movement and things like that.

We think that should be built in. When it comes to BI, if the data for the report you're envisioning is managed primarily by the transaction system, then the transaction system ought to render it, and you should not need a third-party tool that reports on data that's generated solely by you. Third-party tools are really for aggregation and more sophisticated analysis or consolidation. You absolutely have to have them for that, but there's no reason transaction systems can't become more intelligent. Built-in business intelligence is a big differentiator that we talk about.

PwC: You have had a role in creating both the on-premises generation of solutions and the SaaS generation of solutions. What are some of the challenges that you had to overcome? Did you have to unlearn some old habits?

SS: There has been a constant effort of relearning or unlearning here. I mentioned that our technology is less reliant on relational databases. We have to continually emphasize to developers that all data access happens via Web services accessing our business logic and not via direct database access. We need to unlearn other things from our ex-ERP lives.

Another example is in the area of user interface design. As ex-ERP folks we have a good understanding of the underlying complexity of the applications we build. That's fine, but we're too inclined to demonstrate this understanding by dumping all that complexity out in front of users instead of buffering them from it. This is another bad habit that we have to fight constantly here. ■

Closing the strategy-operations gap: two examples

How emerging characteristics of business management applications enable agility in information lifecycle management and accounting fraud risk detection.



This issue of the *Technology Forecast* examines the future of enterprise applications and their role in creating a foundation for agility. We forecast a three-layer agility-oriented enterprise application environment that integrates operational and emerging business management applications via a rich information layer of structured and unstructured data. (See Figure 1.)

Here are two case studies that illustrate the three-layer environment. The first is a solution from InDorse Technologies that helps manage the problem of sensitive unstructured information being distributed inappropriately. The second describes software from the PricewaterhouseCoopers (PwC) Center for Advanced Research that helps ferret out fraud and error in general ledger data.

In each case study, we highlight the strategy-operations gap, the role of information mediation, and the business management application. We also describe the capabilities in these solutions that represent this new generation of business management applications.

Closing the strategy-operations gap: information lifecycle management in an era of extreme collaboration

Protecting sensitive information and complying with regulatory and security policies are of strategic importance to all enterprises. Information lifecycle management¹ (ILM) is designed to address these concerns. But standard ILM also illustrates the gap between strategy and operations, because it does not concentrate enough on the unstructured information that increasingly places enterprises at risk.

¹ The Storage Networking Industry Association (SNIA) defines information lifecycle management (ILM) as follows: *Information Lifecycle Management comprises the policies, processes, practices, and tools used to align the business value of information with the most appropriate and cost effective IT infrastructure from the time information is conceived through its final disposition. Information is aligned with business processes through management policies and service levels associated with applications, metadata, information, and data.*

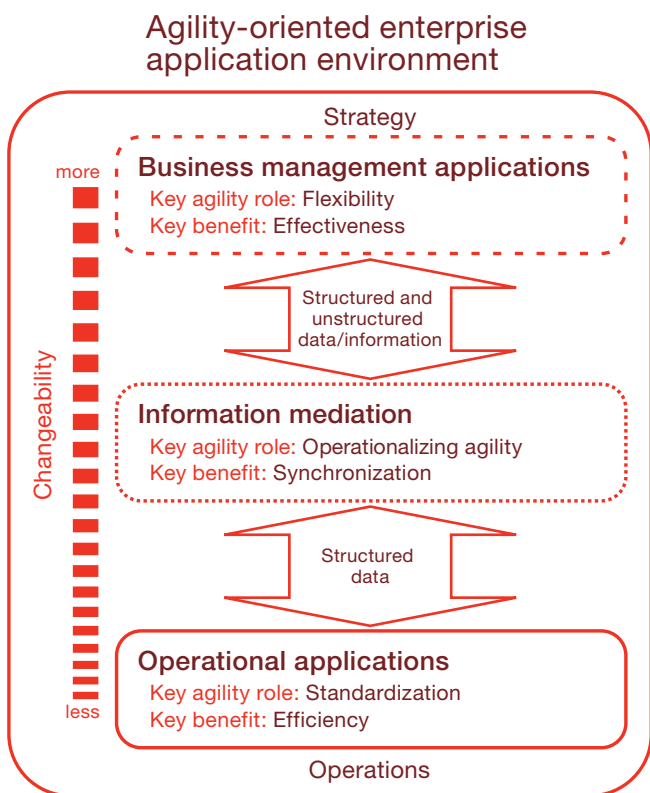


Figure 1: **Agility-oriented view of the enterprise application environment**

“Protecting your sensitive business data as captured in unstructured documents and files starts with knowing what files exist and are continually created and changed; automatically and continually categorizing them into groups; and associating access, usage, retention, and machine-assisted remediation policies to files in each group.” —Rob Marano of InDorse Technologies

Until now, ILM has targeted the structured data associated with managed business processes, operational systems, and data warehouses. This is partly due to the fact that these systems are located in the central data center, which is assumed to be the place where the most sensitive and at-risk data resides.

The assumption is only partly true. Because most documents, e-mails, presentations, and other unstructured information sit on laptops and desktops, they have received far less attention from ILM or other efforts to protect sensitive data and ensure compliance. Management and IT staff often expect that the knowledge workers who create these artifacts will treat them securely if they are given sufficient training. And if these workers do not, then management and IT staff often believe that any “mistake” will not be magnified because the information will not travel far before it comes to a “safe” stop on some colleague’s personal computer.

But the risk profile has only increased for sensitive information in unstructured files. The Internet has made files on laptops as vulnerable—or more so—as files on servers. And because companies feel pressure to innovate, they encourage extensive collaboration inside and outside the enterprise, which means unstructured information routinely passes through the firewall. To make matters worse, workers now have access to social networks that extend their personal links to hundreds of people or more. Each connection becomes an opportunity to knowingly or unknowingly share sensitive information.

Today’s ILM software offers reasonable protection for highly specific types of unstructured information. It can, for example, prevent unauthorized viewing and use of performance review data, or control information flows when 10-Ks and other US Securities and Exchange Commission financial filings are being created. But this capability only scratches the surface.

The problem is that many undocumented and unstructured processes are likely to create sensitive information. Work products from these activities are almost universally captured by office productivity tools and stored as electronic files. Many workers are likely to reject any measures to protect these files because those measures naturally disrupt their creative efforts. Staff will find workarounds or avoid any non-productive steps demanded by these systems.

In other words, there’s a gap between the strategic intent of controlling the distribution of sensitive and regulated information and the reality of how most individuals and companies operate.

What’s needed is a comprehensive system that builds on the capabilities of any installed ILM technologies rather than replaces them; that has minimal impact on how staff actually work; that recognizes the impact of collaboration within and beyond the enterprise; that classifies files according to risks and concerns; and that automatically helps the enterprise implement ILM policies and strategies.

What InDorse does differently

Software developed by InDorse Technologies, a startup company, is an example of a next-generation business management application because it treats the loosely structured, knowledge-driven workflows that define how companies operate as sources of data, not as things to manage directly. This data populates an information mediation layer that is analyzed, transformed, and managed with little or no impact on the activities while enhancing control of sensitive information. In other words, InDorse software closes the strategy-operations gap in ILM.

Rob Marano, InDorse founder and CEO, describes the functionality as follows: “Protecting your sensitive

business data as captured in unstructured documents and files starts with knowing what files exist and are continually created and changed; automatically and continually categorizing them into groups; and associating access, usage, retention, and machine-assisted remediation policies to files in each group.”

Although InDorse’s capabilities will continue to grow over time, the functions available already start to close the gap between strategy and operations for many companies. Marano describes the additional steps needed to close the gap further: “With an inventory and classification of files in place, one must begin tracking their usage inside and outside the IT administrative domain of the business; tagging them with active chains-of-custodies² as they are being used; and enforcing the policies with the native security model for each file type—all transparently to the end user community collaborating on these documents.”

InDorse focuses on the management of a targeted business strategy by reducing the distribution of sensitive information that could destroy business value. It also addresses a business problem for which the perfect solution is not possible, and might never be. As long as businesses interact with customers, partners, and the broader community, there will be some level of sensitive information loss. As with many management problems, however, any significant improvement is valuable.

Several early adopters provide examples of the business management issue. One is a sizeable bank that maintains thousands of servers for enterprise collaboration. A side effect is the large number of unstructured data files that end up on the servers—files of unknown content that have unknown sensitivity. A quick manual review of some servers found many files that contained references to sensitive data, and the files were broadly available due to their placement on the servers, increasing the risk to the business.

“By deploying InDorse, the bank’s IT audit team now can maintain compliance with business policies to keep sensitive data off their corporate collaboration and file servers without changing user behaviors,” Marano says.

InDorse is not just another “operational system,” because it supports a business management issue that is constantly changing as the nature of what makes a document sensitive changes. It isn’t a “classify and forget” scenario. InDorse enables the management of policy dimensions that are meaningful today, such as information sensitivity, risk, and value, and it can apply new dimensions as they evolve.

InDorse represents many of the characteristics of a new generation of business management applications. Figure 2 shows how it fits in the three-layer agility-oriented application environment, and Table 1 highlights how many of its capabilities are consistent with PwC’s definition of a next-generation enterprise application.

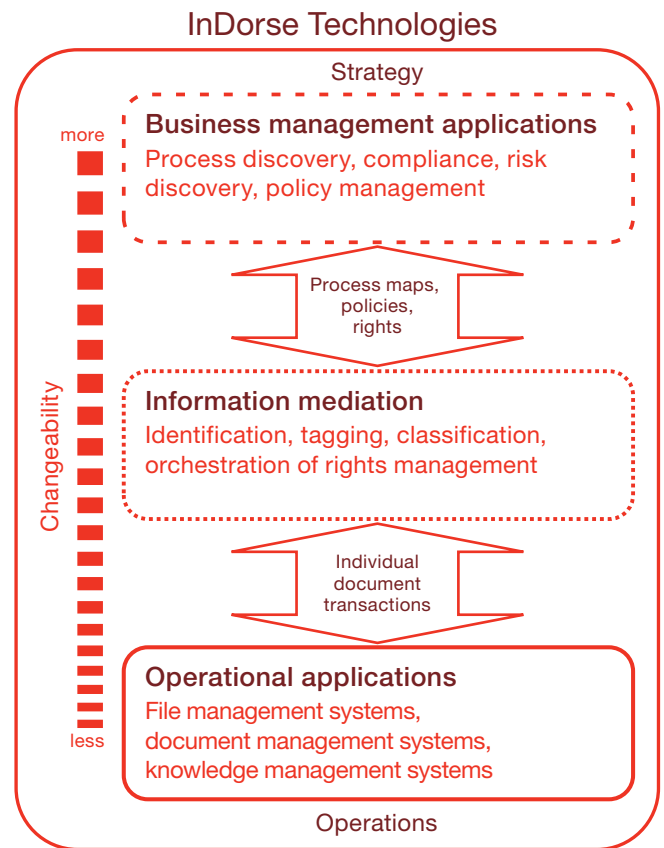


Figure 2: How InDorse fits in the agility-oriented enterprise application environment

2 Chains-of-custody refers to capturing and providing an audit trail of all activities that affect the lifecycle of information (such as files, code, and intellectual property).

Business management application capability

InDorse's solution

| | |
|--|---|
| Can discover the existence of undocumented processes, information (documents), and contexts that are implicit but not documented as part of standard business transactions | Performs an exhaustive inventory of unstructured data artifacts and maintains in real time the inventory as well as the relationship between files and which files stem from other files (file pedigree); details the step-by-step migration of documents that parallels opaque but important business processes; discovers how files progress through a workflow and assigns respective policies |
| Uses pattern matching, semantics analysis, advanced statistical techniques, and other processes to automatically categorize information, processes, and transactions | Uses text mining, natural language processing (N-gram technique), and advanced statistical means to identify and classify unstructured data artifacts for value and sensitivity |
| Easily handles unstructured data and information, creating elements of an “unstructured data warehouse” | Builds a metadata structure (taxonomy) defined by document age, usage levels, creators, and many policy details that define otherwise totally unstructured data artifacts; allows users to add their own metadata, thus enabling a folksonomy ³ |
| Explicitly analyzes unstructured information to create a more meaningful context for interpreting structured data | Uses natural language processing and usage analysis to derive the context of information used in the business, especially those contexts that are hidden; moreover, by connecting to structured data sources, InDorse is designed to associate structured sources of unstructured data |
| Supports modeling and scenario analyses | Allows document discovery, categorization, and classification coupled with usage and remediation history to be input into decision support systems for reporting and what-if scenario analyses |
| Demonstrates learning capability based on training processes and direct feedback | Uses training data sets of documents of known content to establish patterns that are used to classify new artifacts; responds to human reviews of classification failures and successes (computer-assisted remediation using fewer staff) |
| Can translate strategy or policy goals into the discovery, analysis, and management of related business processes | Uses tags associated with classified artifacts to implement policies regarding the use of those artifacts and to create audit trails of where and how artifacts have traveled through and beyond the enterprise |
| Can automatically create and externalize new business rules based on analysis and learning | Uses data about the movement of and changes to documents to detect latent process flows of business activities that can be formalized and better aligned with policy |
| Identifies and detects business activities not conforming to policy beyond what individual personnel are likely to find | Automatically classifies unstructured data artifacts at the time they are saved in a file system in real time |
| Empowers enterprise managers to take action by providing direction and context | Detects when sensitive documents are about to leave the enterprise boundary and signals owners and users of sensitive documents to take appropriate action |

Table 1: InDorse capabilities that match the characteristics of next-generation enterprise applications

³ Folksonomies are an emerging way of empowering entire user populations to casually label information artifacts with no central authority.

Enhancing agility and closing the strategy-operations gap

By supporting the business management function of preventing the loss of sensitive information, InDorse's solutions enable corporate agility. The creation and use of sensitive information is largely not affected because InDorse tags and classifies the information, and manages and monitors policy enforcement. Information mediation also enables the analysis of the chain of metadata across multiple instances of a document as it moves through a series of collaborating authors. As a result, business managers can access the data they need to discover unstructured workflows and create new policies.

InDorse closes the gap between strategy and operations by managing the massive collection of unstructured information in documents, e-mails, and other files. Despite the fact that most companies have the strategic intent to control the distribution of sensitive information, their unstructured files have not been part of ILM strategies. The rise of extreme collaboration is threatening to put more sensitive information in vulnerable places, widening the gap between strategy and operations. Adapting ILM to an approach similar to that demonstrated by InDorse can close the gap.

Closing the strategy-operations gap: creating agility in accounting fraud risk detection

To maintain public trust, publicly held companies view the accurate and timely reporting of financial information through published statements as a strategic task as well as a regulatory mandate. But the difference between the intent of publishing statements and the possibility of fraud and errors occurring highlights a gap between strategy and operations.

Here's why the gap exists. Financial applications in an enterprise resource planning (ERP) system can help prevent errors and fraud by using controls and customizations written to detect errors that are known to occur. However, sometimes controls can be ineffective or overridden. Also, the methods and nature of fraud continually change. Over time, financial applications can become disconnected from the strategic intent of detecting fraud.

This is not just a hypothetical problem. During the last decade, the financial statements of several companies intentionally or unintentionally misrepresented the balance sheets by billions of dollars. In response, regulatory bodies mandated that public auditors, such as PricewaterhouseCoopers, perform analytics on detailed financial data to discover such misstatements. This often means analyzing millions of client records.

Most companies use software to record general ledger and subledger transactions. Increasingly, the software comes from one of a few vendors, including Oracle and SAP. These operational applications hum along, efficiently processing a large number of financial transactions, and these digital records increase the opportunity to use software to detect fraud. Because of the highly public litigation against Enron, WorldCom, and others, there's also a growing list of the known approaches used to perpetrate fraud. In theory, then, the combination of standardized accounting software and a defined set of tests should make fraud detection easier.

In fact, the situation is more complicated. The data found in these systems can vary widely, in part because of the customizations buyers implement in the software, and in part because of changes over time in a company's business and revenue models. Some of the other reasons accounting data can vary widely include:

- Unique chart of accounts structures
- Different levels of detail specified in individual transactions
- Unique ledger and subledger account structures

“We worked with auditors and investigators to understand how their requirements differed, even though the basic structure of general ledger data being analyzed might be the same across the two types of engagements.”

—David Steier of PwC Center for Advanced Research

Additionally, while the list of known approaches to fraud grows, perpetrators constantly find new methods to commit fraud. Operational systems that prevent some levels of fraud from occurring are unlikely to be up to date in preventing all potential fraud. Where does this leave the strategic intent of publishing only accurate financials?

Here was a challenge and an opportunity: to find a solution that would enable agility in detecting fraud; specifically, to design software that would learn from the known patterns to detect fraud in new sets of data, and that would overcome the lack of data consistency across clients and over time.

The PwC Ledger Analyzer approach

At the PwC Center for Advanced Research, Director David Steier led the effort to develop effective analytics to address these problems. PwC conducts investigations where fraud is suspected, and the firm also conducts audits where the likelihood of fraud or error is much lower. In both cases, however, the potential to use effective software is huge. “We worked with auditors and investigators to understand how their requirements differed, even though the basic structure of general ledger data being analyzed might be the same across the two types of engagements,” Steier says.

The result is software called PwC Ledger Analyzer, which addresses two main challenges:

- **Detection, discovery, and learning**—A system that handles all the diversity in general ledger data and in fraud schemes. The Ledger Analyzer team used a combination of three classes of techniques: (1) statistical classification of historical data to distinguish general patterns associated with higher risk, (2) anomaly detection methods to recognize unusual account and transaction behavior, and (3) rules to recognize specific patterns or “signatures” associated with particular fraud schemes. The team then developed scoring mechanisms that combined the results of all three techniques to prioritize findings for follow-up investigation. The system can be expanded with new patterns as new schemes become known, and the accuracy of the system can increase over time as it learns the range of legitimate business patterns.
- **Guide, not decide**—Presenting results in a way that empowers users to exercise judgment. Auditors and investigators are unlikely to decide solely on the basis of software whether fraud or errors have been committed. Ledger Analyzer guides them to suspicious patterns. The application identifies the accounts and transactions that contain the suspicious debits and credits, and it explains the reasons they were flagged. The reports contain sufficient information to allow users without training in statistics to follow up.

Ledger Analyzer creates an intermediate form of the original accounting data to mediate across heterogeneous accounting structures. This is the equivalent of information mediation in the three-layer framework illustrated in Figure 1 on page 45. To apply the statistical models against new sets of general ledger data, the non-material differences in how companies represent accounting data must be rationalized. The ability to detect unusual transactions is more accurate and scalable when the underlying data is presented to the statistical process in a consistent structure. PwC

established a canonical general ledger relational data model based on the work done by XBRL.ORG, the consortium that develops the open standard extensible business reporting language. Using a commercial extract, transform, and load tool, tables and fields describing millions of individual transactions are efficiently rationalized into this standard structure.

Although Ledger Analyzer is a work in progress, it has already been used in dozens of engagements, detecting fraud where it was and was not suspected. “In one investigation, the system found transactions in a multimillion dollar inventory fraud, even though the perpetrator, an ex-auditor, tried an amazing number of tricks to try to ensure those transactions wouldn’t be identified,” Steier says. One internal audit used “unbatching” techniques to analyze transactions that had tens of thousands of lines of detail, finding hidden reversals the client would not have found.

How Ledger Analyzer fits in the three-layer agility-oriented application environment is shown in Figure 3. The operational applications are the financial applications from the ERP system. The mediation layer aggregates operational data in a canonical general ledger format and fraud feature sets, and the auditor and investigator support functionality represents the business management application, which handles changes by detecting fraud and guiding managers.

Although Ledger Analyzer is a work in progress, it has already been used in dozens of engagements, detecting fraud where it was and was not suspected.

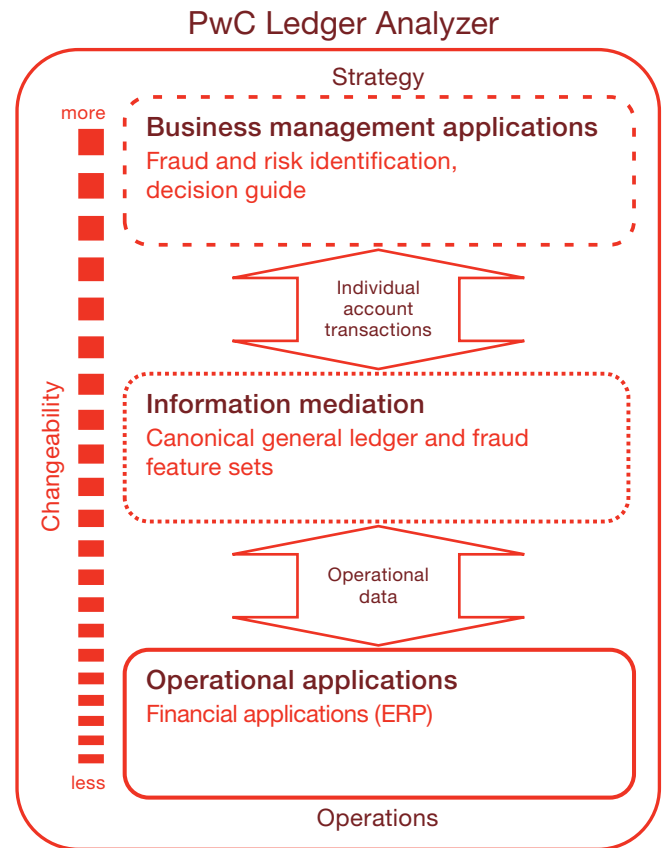


Figure 3: How PwC Ledger Analyzer fits in the agility-oriented enterprise application environment

Ledger Analyzer has many traits of the new class of business management applications. It focuses on the management of business by targeting errors and potentially fraudulent activity that can destroy business value. It also focuses on a problem where significant improvement is useful, but a perfect solution or certainty is not possible because detecting errors and fraudulent activity is unlikely to be 100 percent accurate.

Table 2 describes the characteristics PwC anticipates in business management applications and the features within Ledger Analyzer that are consistent with these characteristics.

| Business management application capability | PwC Ledger Analyzer |
|--|---|
| Can discover the existence of undocumented processes, information (documents), and contexts that are implicit but not documented as part of standard business transactions | |
| Uses pattern matching, semantics analysis, advanced statistical techniques, and other processes to automatically categorize information, processes, and transactions | Uses classification, anomaly detection, and a signature-based technique to identify suspicious general ledger transactions and accounts |
| Easily handles unstructured data and information, creating elements of an “unstructured data warehouse” | |
| Explicitly analyzes unstructured information to create a more meaningful context for interpreting structured data | Examines account and transaction description text, which is a form of unstructured data, to help “unbatch” transactions and identify suspicious combinations of accounts |
| Supports modeling and scenario analyses | |
| Demonstrates learning capability based on training processes and direct feedback | Calibrates the classification based on known historical frauds and learns not to flag legitimate business transactions over time, as its range of experience broadens |
| Can translate strategy or policy goals into the discovery, analysis, and management of related business processes | |
| Can automatically create and externalize new business rules based on analysis and learning | Enables fraud investigators to refine their understanding of business rules; prior to using Ledger Analyzer, investigators testing folklore about fraud indicators had a limited ability to challenge them |
| Identifies and detects business activities not conforming to policy beyond what individual personnel are likely to find | Looks at groups of transactions that together define a violation of policy even though no single transaction appears to do so; in addition, individuals cannot adequately review millions of transactions using purely manual methods |
| Empowers enterprise managers to take action by providing direction and context | Directs auditors to problematic business transactions and provides a description of what error or potential fraud may be associated with the transactions |

Table 2: PwC Ledger Analyzer capabilities that match the characteristics of next-generation enterprise applications

In short, Ledger Analyzer is a new type of enterprise application that incorporates many of the capabilities needed to close the gap between strategy and operations. It pulls data from the operational layer, generates new derivative data, and flags suspicious patterns of ledger activity not consistent with existing controls, enterprise policy, or accounting standards. These new forms of data reside in the information mediation layer, where they can be accessed by business managers and auditors. Ledger Analyzer also helps define new types of fraud that eventually can be tested for in the operational systems during their next major upgrade. Finally, Ledger Analyzer provides direction and context for users who seek to analyze a suspicious pattern of data.

Ledger Analyzer is an example of an application that enhances agility without forcing extensive, undesired changes in the underlying operational systems. Ledger Analyzer transforms and analyzes the original transaction data in a separate, extensible system. The operational financial systems can remain unchanged.

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Subtext

| | |
|----------------------------------|---|
| Business agility | A deliberate combination of standardization and flexibility that prepares a company for change and allows it to proactively shift course with minimal disruption. |
| Operationalizing agility | Creating a process that makes an enduring and responsive connection between strategy and operations so changes in one are reflected in the other. |
| Operational applications | Transactional applications such as enterprise resource planning (ERP), supply chain management (SCM), customer relationship management (CRM), and others that focus on efficiency by standardization of transactional processes. |
| Business management applications | An emerging class of applications that are closer to the influence of strategy and that focus on effectiveness of operations. By incorporating the capabilities to take advantage of unstructured or semi-structured information and processes, these will enable management of business. |
| Information mediation | A resource to connect operational and business management applications by enabling two key roles. One is to manage information semantics so applications can share and integrate information in a plug-and-play manner. The other is to operationalize the connection between strategy and operations to keep the respective applications in sync—changes in one are coordinated with changes in the other. |

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