



Achieving Dynamic Capabilities with Cloud Computing

Barry C. West, *Georgia State University*

Douglas A. Battleon, *Georgia State University*

Jongwoo Kim, *University of Massachusetts Boston*

Balasubramaniam Ramesh, *Georgia State University*

Dynamic capabilities let organization integrate, build, and reconfigure competences to address business challenges posed by rapidly changing environments and achieve a competitive advantage. Organizations can realize these competences using cloud computing technologies.

In today's turbulent business environments, organizations increasingly use IT to become more agile and adapt to changes. Cloud computing allows a pool of configurable computing resources to be shared through ubiquitous and on-demand networks.^{1,2} Organizations can rapidly provide and release these resources with minimal management effort or interaction with service providers. Cloud computing also has the potential to enable organizations to transform IT-enabled business processes. Senior IT executives therefore now view cloud computing as a top priority.

Cloud computing has become a disruptive technology in both private and government organizations.^{3,4} The pay-as-you-go pricing model,

infinitely expandable capacity, easy access to IT services, and minimal investments needed for IT infrastructure are some of the benefits claimed by users of cloud computing.

Although many organizations use cloud computing to reduce IT costs and improve their functional competencies, only a few use cloud computing to pursue dynamic capabilities. Dynamic capabilities refer to a firm's ability to integrate, build, and reconfigure organizational competences to address business challenges posed by rapidly changing environments, thereby achieving a competitive advantage. We interviewed senior IT executives in a variety of public and private organizations to determine how these organizations are incorporating cloud computing

Organization Types and Roles of Interviewees

We conducted 33 interviews with 26 senior-level executives from both public (four) and private (10) organizations.

Public organizations were in the areas of agriculture, technology and services, energy, real estate, and acquisition of products and services.

The 10 private organizations were in the following areas: IT hardware and software, technology consulting, manufacturing, IT infrastructure provider,

software development, hospitality, sales and distribution, retail, and financial services.

Interviewees included chief information officers (2), an associate CIO (1), a chief information services officer (1), chief technology officers (4), directors (4), managers (5), vice presidents (3), an associate VP (1), engineers (2), a chief scientist (1), an analyst (1), and a cloud computing expert (1).

into their IT strategies. Based on our analysis of the data, we present recommendations on the use of cloud computing to achieve dynamic capabilities.

Dynamic Capabilities

Dynamic capabilities are an organization's abilities to effectively reconfigure internal and external competences to match the changing business environment.⁵ These competences denote managerial and organizational processes or routines through which organizations develop new and transformative forms of competitive advantage.⁶ Changes in the external and internal environments often require changes in competences for organizations to thrive. For example, customer requirements, new technologies, and internal crises require organizations to build and exercise dynamic capabilities.

Dynamic capabilities denote the ability to reconfigure and change, whereas operational capabilities describe the ability to deal with day-to-day operations.⁷ Operational capabilities aim to align processes and resources to produce and sell the same product or service, on the same scale, and to the same customer population. Dynamic capabilities, on the other hand, aim to change the product or service, the production process, the scale, and the markets served.⁷

Dynamic capabilities include four dimensions:⁸

- *Sensing the environment*: the ability to identify, interpret, and pursue the requirements for changing the enterprise's operational capabilities by understanding market needs and identifying opportunities.
- *Learning*: acquiring, assimilating, and developing new knowledge and expertise needed to revamp operational capabilities with new knowledge and skills.

- *Integrating knowledge*: embedding new knowledge into new operational capabilities by creating a shared understanding and collective sense-making.
- *Coordinating activities*: orchestrating and deploying discrete reconfigured tasks, resources, and activities embedded in the new operational capabilities.

Cloud computing can play a crucial role in enhancing dynamic capabilities.⁹ The organizations in our study used cloud computing as an enabler of agility to quickly cope with environmental changes. They reported not only operational benefits (for example, cutting operating costs in half), but also mission-critical benefits (such as the acquisition of new skills, increased readiness for emergencies, and continual upgrades). By integrating cloud computing with key processes, organizational knowledge, and relationships with stakeholders, they were able to nurture innovation. Cloud computing enabled them to rapidly adapt to changing requirements by exploiting emerging and untapped market niches, collaborating with partners in a way competitors cannot easily duplicate, and changing information-based value propositions.

Case Study

For our exploratory case study, we conducted 33 interviews with 26 individuals drawn from 14 organizations (see the sidebar for details). We carefully selected organizations that adopted and used cloud computing innovatively. These organizations face dynamic business environments and use cloud computing as part of their IT strategy for surviving and thriving in such environments. We contacted key professionals (such as chief technology officers) in the organizations and sought their help in identifying participants.

The interviewees were senior executives who possess significant experience (an average of 21 years) and are responsible for making crucial decisions associated with cloud computing.

We collected qualitative data by conducting semi-structured interviews focusing on the organizations' past and ongoing cloud computing projects. Each interview took approximately one hour. We conducted another round of interviews when clarifications were needed. We conducted data collection and analysis iteratively, and used NVivo, a qualitative data analysis tool, to code interview transcripts. We coded the interview data to iteratively refine the concepts drawn from our literature review of IT-enabled business transformation and cloud computing. Two researchers separately analyzed data and then reached consensus on the findings.

Cloud Computing Capabilities

Our analysis identified the following cloud computing capabilities that help organizations achieve dynamic capabilities.

Sensing and Learning

Organizations respond to challenges by helping individuals and organizational units collect, process, and analyze appropriate information to recognize opportunities for new products and services. Cloud computing lets organizations translate environmental signals quickly into meaning and subsequent action.

For example, a sales director at a field service organization believed that the company's cloud computing service, which tracked customers and their buying behavior, enabled it to better understand customer needs in real time. Instead of relying on in-house implementation, which was deemed expensive and slow, the organization integrated data from two cloud-based systems to develop this capability quickly and inexpensively. Similarly, a manufacturing organization credited cloud-based advanced analytics services for its ability to collect and analyze customer and purchase information that, in turn, enabled the company to better understand its customers' buying patterns and preferences. Similarly, the CIO of a public organization used cloud computing services to improve brand image by tracking customer opinions and addressing complaints.

In each of these cases, the organization's ability to sense the environment and learn about

customer needs was dramatically enhanced by the integration and use of services that were readily available on the cloud rather than through expensive and time-consuming IT investments.

Integration

The ability to collect and integrate knowledge that might be obtained from multiple systems using cloud-based tools helped a retail organization optimize its inventory holdings. Although the lack of integration of data and organizational knowledge that is spread across fragmented systems has been a concern with conventional IT solutions, the availability of cloud-based tools for accessing data from multiple sources helped a manufacturing organization optimize its production processes. Thus, cloud computing enables the integration of knowledge (say, about customer and production processes) to optimize the response to changing market conditions.

Coordination and Reconfiguration

Cloud computing enables organizations to dynamically commit both IT and non-IT resources. Specifically, cloud computing lets organizations scale their IT infrastructure up or down with ease.² In particular, this capability is important to organizations dealing with seasonal businesses. Cloud computing also gives organizations on-demand access to resources that are available with rapid real-time provisioning. Further, they can assess the cost of the services more accurately instead of using unreliable demand estimates.

Cloud computing allows organizations to dynamically commit even non-IT resources. A large public organization provisioned IT resources for anytime, anywhere access for 4,000 employees even though its physical infrastructure was designed to accommodate only 2,000. Similarly, a private infrastructure provider was able to dynamically reclaim IT resources that were not currently being used and provisioned them in real-time to those that need them.

Some organizations in our study used the cloud infrastructure to reconfigure their operational capabilities, thereby rapidly creating or modifying their products and services. A CIO of a public organization noted that whereas it used to take several weeks for his organization to provision IT infrastructure with appropriate security certifications, a cloud infrastructure provider

was able to comply with the same requirements in just a few hours because it could scale and re-use across a large number of clients with similar needs. Modular design capability supported by cloud computing lets organizations interact with external stakeholders (suppliers, intermediaries, and so on) by redesigning and integrating their business processes with those used by their external stakeholders. Well-defined service models and abstracted applications that are exposable and cloud-ready enable organizations to develop and deploy IT services, as well as modify products and services based on internal and external feedback.

In addition, by following common standards, cloud computing enables organizations to increase interoperability of their information systems and processes. The development of customized solutions to match market changes is made possible with a modular architecture used by cloud services.

Risks Associated with Cloud Computing

Our study also identified several risks related to the use of cloud computing. Although the list is not exhaustive, a careful review of these issues would help organizations develop appropriate risk-management strategies.

Security

Information security is often a major concern for cloud computing adopters. To manage this risk, organizations use private and hybrid cloud services for mission-critical functions and public cloud services for other functions. Organizations must also develop detailed service-level agreements that specify their security requirements. The adoption of certifications such as the Federal Risk and Authorization Management Program (FedRAMP) can help implement a standardized approach for assessing and monitoring the security of cloud products and services. We also observe that for organizations that do not have sophisticated capabilities for managing information security, cloud computing providers might offer higher levels of security than is possible with in-house computing.

Misalignment of IT Roles

The role of IT staff changes significantly when an organization adopts cloud computing. If the

IT department is unprepared for its new role in a cloud computing environment, it might resist the move. IT departments act as service brokers rather than service providers. Therefore, even business units might resist the migration of applications and infrastructure to the cloud because of the attendant changes in the nature of their relationship with their IT staffs. Organizations must therefore carefully evaluate the risk of resistance by both business units and IT staff and create appropriate strategies—such as educating both groups about cloud computing’s potential to offer dynamic capabilities—before embarking on major cloud initiatives.

Network Dependency

Interruption of cloud computing service due to the unreliability of networks can significantly impact critical organizational processes. Therefore, organizations often create cloud services that are redundant and replicated. Several of the organizations we looked at decided to develop and use private cloud computing for their mission-critical functions on top of their own IT networks to reduce network dependency.

Integration Challenges

Integrating and coordinating cloud computing services with existing IT infrastructure might require significant resources from organizations. Finding quality cloud computing services as well as integrating and coordinating them are crucial for the successful use of cloud computing. Many focal organizations adopted cloud computing incrementally and developed technical and managerial competencies over time. For example, some organizations invested considerable effort in assessing challenges related to integration with existing infrastructure and applications before rolling out cloud services.

Recommendations

Based on the data collected from the senior executives in our study, we present recommendations on how organizations can achieve dynamic capabilities with cloud computing.

Focus on Strategic Use

With the mature use of cloud computing, organizations can strategically realign IT resources with their business goals. If an organization’s

strategy focuses on exploration of new markets for its existing products and services or the development of new products and services, cloud computing might enhance its ability to achieve these goals quickly. Experimentation, which is often required in developing novel solutions, might be better facilitated using services that are available on the cloud platform rather than through custom development. Often, novel re-configurations of existing technologies and processes, rather than radical innovations, provide competitive advantage. As organizations gain competence and improve their understanding of the links between cloud computing and performance, they can adapt existing routines and recognize the need for more fundamental change.

Organizations with sufficient experience and knowledge of cloud computing for their internal business process changes can explore a more strategic use of cloud computing. External business process changes involve the redesign of business networks with stakeholders. The organizations in our study explored ways to restructure their business networks by leveraging the competencies of their business partners. For example, with a cloud platform, organizations can share information about their business processes with their clients transparently, which can lead them to redefine their relationships.

Enable Dynamic Capabilities

Many organizations still perceive cloud computing as an enhancer of operational capabilities and focus on cost reduction and short-term performance. Our study suggests that the use of cloud computing to enable dynamic capabilities will provide more strategic benefits. Organizations can use cloud computing to redesign business processes and networks and to redefine business scope, helping them to effectively respond to changes in the business environment. Toward this goal, organizations should carefully evaluate the challenges and threats, both internal (for example, lack of IT capabilities or resources) and external (for example, competitive pressures) and identify potential solutions that might be more readily deployed on the cloud platform.

For example, a careful evaluation of the available cloud computing services that could improve business processes to make it more agile led one of the studied organizations to move its sales and

order processing functionalities to the cloud. This move allowed the organization to respond rapidly to changes in customer demands. Similarly, another organization was able to provide real-time information on its orders to suppliers, helping to dramatically reduce inventory costs for the parts it needed, but more importantly, reducing the lead time needed to deliver customized solutions to its customers, and thus improving its competitive position in the industry.

Nurture Improvisation Capabilities

Cloud computing offers the opportunity to enhance not only dynamic capabilities, but also improvisational capabilities. Improvisational capabilities refer to the ability to repetitively engage in spontaneous activities effectively. One organization was able to enhance its ability to sense and interpret the environment with sophisticated cloud-based business intelligence services. These services enhanced its ability to respond to unexpected challenges posed by sudden changes in market demand for its products.

Build a Cloud-Based IT Platform

Both cloud computing providers and their clients should develop strategies to use cloud computing as an important component of their IT platform. A cloud-based IT platform with a modular design enables organizations to efficiently and effectively manage the complexity of their systems and enhances sharing and reuse of services. With such a platform, both cloud computing clients and providers can better serve their customers by increasing product variety by mixing and matching services quickly. When a market for components exists, organizations can easily swap services to provide better or cheaper products and services by replacing or enhancing existing ones.

Integrate Incrementally

Organizations should integrate cloud computing with existing IT infrastructure incrementally over time rather than radically. An initial step is to identify appropriate cloud computing services. For example, using cloud computing providers that have obtained certifications such as FedRAMP can reduce the effort and time involved in evaluating their security. Cloud computing provides modularity at the architecture level, which can facilitate incremental integration

and coordination of processes and applications. Each layer of cloud computing is loosely coupled, thereby supporting separate evolution of these resources. Many organizations in our study used an incremental integration strategy. Organizations can experiment with a few selected cloud applications and compare them with noncloud applications using criteria such as total cost of ownership, satisfaction, and performance.

Enhance Transition Readiness

Although organizations spend considerable time and money in selecting, negotiating, and contracting with cloud computing service providers, they tend to overlook the need to prepare for and manage switching costs once the contracts take effect. As cloud computing continues to gather momentum and mature, changing service providers at the end of a contract, or even earlier, has become a reality for many. Our study identified actions an organization can take before, during, and at the end of a cloud computing arrangement to prepare for transitioning cloud computing services. These actions can help client organizations enhance their dynamic capabilities by leveraging the cloud computing market.

Before signing any cloud computing contract, organizations should verify that appropriate resources are being provided by reputable cloud computing vendors, and they should clearly articulate the roles and responsibilities of all resources involved in the transition. They should identify the specific resources or knowledge required to ensure smooth transition if the need to switch cloud computing services arises. Walk-through exercises that simulate various transition scenarios may help clarify requirements. If possible, organizations should contractually specify cloud computing providers' obligations (for example, commitment to service-level agreements during transition) for transitioning to new cloud computing services.

During the operational phase of a cloud computing contract, organizations should continuously review and safeguard against new sources of potential resource stickiness. For example, they should check whether knowledge asymmetry might develop in favor of cloud computing providers. Organizations should proactively reduce operational complexity by simplifying and standardizing internal operations connected with cloud computing services. For example, the use of multiple cloud computing

services from different providers could add significant complexity to interface management and thus make the transition more difficult.

During the transition phase to new cloud computing services, organizations should tactfully manage the relationship with former, current, and new providers of cloud computing services. In addition, organizations should ensure that there are adequate resources for facilitating the transition and coping with unexpected outcomes.

Develop a Balanced Security Approach

Although the need to rapidly respond to environmental challenges might lead organizations to seek cloud-based solutions that can be readily deployed or reconfigured, these organizations must ensure that such implementations do not compromise their core processes and data. For example, many organizations in our study expressed concern about the level of security provided by cloud computing solutions that were otherwise a perfect match for their needs.

Organizations should take a broad view of security management and seek balance between prevention and response paradigms.¹⁰ Although the prevention paradigm might dominate in commercial organizations, the response paradigm measures for managing unpredictable threats (such as advanced persistent threat attacks) play an important role in protecting information and data. For example, organizations using cloud computing in a stable business environment might face security threats that are mostly predictable and measurable, so they can focus on preventative measures (for example, implementing intrusion-detection systems¹¹) to protect their cloud computing services.

Organizations in turbulent environments, where unpredictable security threats are frequent, should refrain from transitioning their mission-critical business processes and focus on responsive measures (such as disaster-recovery planning and incident response) against security risks. Providers can focus on preventing security threats to their cloud-based services, whereas clients can focus on responding quickly, should a security breach occur.

Acquire Skills Needed

Because the move to cloud computing can significantly alter how an organization implements IT

services, it's essential to develop and nurture the skills and expertise that are necessary for evaluating and implementing cloud computing. The organizations we studied educate both users and IT staff on the nature and impact of cloud computing. User training focused on the need to understand how users might adopt and configure cloud computing services to support or redesign their business processes and the attendant benefits such as scalability, access to best practices, and rapid deployment.

Cloud computing might move some of the IT services currently provided by the IT organization to a self-service model. Both the IT staff and the users might resist such a change. Because IT staff might be unwilling to accept such a disruptive change and delegate control to users, organizations must educate them on cloud computing's potential to provide novel capabilities that will benefit the organization's competitive position. Thus, this education should not only deal with technical aspects of managing a cloud implementation (such as planning, requirement gathering, testing, and deployment) but also the managerial issues associated with the move to cloud computing.

Our study suggests that organizations can use cloud computing to develop dynamic capabilities to cope with rapidly changing business environments. Although most organizations use cloud computing primarily to improve the efficiency of their business processes, our study suggests that cloud computing can enhance an organization's ability to integrate, build, and reconfigure organizational competences and achieve competitive advantage. ■

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Barry C. West is a chief information officer of a federal government agency. His research interests include cloud computing, innovation, and enterprise architecture. Contact him at barry_west@verizon.net.

Douglas A. Battleon is the director of programs of computer information systems at Georgia State University. His research interests include de-escalation of complex IT projects, IT project management, and leadership. Contact him at dbattleon@gsu.edu.

Jongwoo Kim is an assistant professor of management sciences and information systems (MSIS) at the University of Massachusetts Boston. His research interests include IT in interorganizational networks, information systems security, and conceptual modeling. Contact him at jonathan.kim@umb.edu.

Balasubramaniam Ramesh is Board of Advisors Professor and chair of the Department of Computer Information Systems at Georgia State University. His research interests include requirements engineering and traceability, agile software development, decision support systems and knowledge management. Contact him at bramesh@gsu.edu.

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