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In March 2010, Michigan's Department of Information Technology consolidated with the state's Department of Management and Budget. The new Department of Technology, Management & Budget (DTMB) is building a full array of service and functional relationships across governments and the private sector. Seeking to fully leverage the confluence of technology and management, Michigan is strategically aligning resources and targeting cloud-enabled opportunities for action.

The Michigan story for cloud computing is one of evolution, maturation and economic necessity. Now in its eighth consecutive year of budget reductions, this hard-hit Midwestern state is adopting cloud-computing practices to transform service-delivery capabilities. Other elements driving this momentum range from managing shifts in client and staff expectations to maximizing investments in infrastructure.

The Michigan approach, as detailed below, supports, drives and enables federal, regional and local collaboration as well as private-sector partnerships.

The Michigan Approach – MiCloud

Michigan's cloud-computing program, dubbed MiCloud, provides governance and direction for cloud-computing efforts. The MiCloud initiative is charged with proving, piloting and sourcing the state's government cloud offerings. With a focus on transforming government operations, Michigan is moving toward leveraging the cloud to provide clients with rapid, secure and lower-cost services.

Recognizing that not all functions are cloud appropriate today, MiCloud is a key component of Michigan's big-picture sourcing strategy. Through MiCloud, Michigan is using a unified and tiered approach to manage both primary and secondary business support functions. Targeted functions are based on business criticality, security requirements and legal constraints. These include:

- Government cloud: Primary business support functions that are critical to government operations or impose unique security requirements and legal constraints.
- External and commercial clouds: Secondary business support functions that are not critical and do not impose unique security requirements or legal constraints.

Annual Alignment with Cloud-computing Opportunities

Each year, the MiCloud function review process aligns ICT functions with business needs in light of new cloud-computing opportunities and offerings. Key elements of the process include:

- **Commodity alignment with business needs:** Complexity imposes risk on the business. As increasingly simple commodity options emerge, they are reviewed for fit-to-business needs.
- **Cost alignment with current business value:** As part of the review process, Michigan targets functions with cumbersome ordering processes and long fulfillment times for cloud transformation opportunities.
- **Delivery-method alignment with current options and needs:** Since clients value more granular delivery options, Michigan reviews opportunities to break up complex tiers into simpler options that may be managed and delivered by separate means.

Once options and costs are aligned with business needs and value, the MiCloud delivery-method decision tree is used to determine if a cloud option should be pursued and, if so, the appropriate sourcing method to use. As depicted in Figure 1, sourcing methods include an internal government cloud (on-premises), external government cloud (off-premises, cross-boundary partners), external commercial cloud (off-premises vendors) and hybrid cloud (any combination) along with traditional noncloud sourcing options.

MiCloud

Vision to Action

From top to bottom, Michigan is re-examining technology infrastructure delivery with a focus on delivering best value for clients. Key areas of current action and 2010-2014 strategic plan goals follow:

- **Virtual Data Storage:** Michigan has made strategic investments in storage virtualization technologies and is actively piloting MiCloud storage for users and storage for servers as internal government cloud functions. These functions are delivered by DTMB and have a planned production date of October 2010. The consumption expectation is more than 250 terabytes in the first year of operation.

  The projected cost for MiCloud storage is 90 percent lower than today's lowest-cost storage tier. At the same time, MiCloud provides self-service and automated delivery within 10 minutes of submitting an online request. MiCloud storage may be used like any other network storage. Features include approval workflow, an online wizard that creates audit records as users manage permissions, an off-site copy option for business continuity purposes, usage-metered billing and storage pools in separate data centers.

- **Virtual Server Hosting**: The State of Michigan has made critical strategic investments in server virtualization technologies. To make the most of these investments, the state is in the proof-of-concept phase for the MiCloud hosting-for-development function in the internal government cloud. The function will be delivered by DTMB with a planned production date of April 2011. Michigan expects to deliver more than 80 servers in the first year. The function automates the delivery of virtual servers within 30 minutes of submitting an online request. Michigan also will explore a hybrid cloud to deliver a more complex application platform as a service.

- **Process Automation:** The state is in the proof-of-concept phase for the MiCloud process orchestrator function in the internal government cloud. This function enables business users, regardless of ICT skill level, to create and test simple process definitions. The function will be delivered by DTMB and has a planned production date of April 2011. Michigan expects to automate hundreds of processes in the first year of operation. Business users will be able to publish processes and related forms to the service catalog and, over time, analyze related metrics. The process definitions and metrics serve as the foundation for process transformation. The business analysts determine whether this basic level of automation is sufficient or if a more sophisticated automation effort is warranted. The next phase of development will enhance the integration capabilities of the function.

The cloud-computing paradigm is a startling shift in the thought process behind ICT sourcing methods. In Michigan, this shift is being used to free up scarce capital, staff resources and ICT assets such as development servers for critical investments. As described above, MiCloud follows a defined adoption path **–** prove the option will close gaps in tiered offerings, secure the delivery mechanism, enable Web-based service catalog access, transform the delivery in production and extend success to cross-boundary partners. In this way, Michigan is navigating the cloud-computing roadmap to secure tangible benefits for citizens and businesses.

Background

Today, the State of Michigan is actively creating business value by implementing cloud-computing functions. Like most sectors, government once saw itself as a unique business domain demanding unique ICT functions and custom solutions. Now, government business processes are converging with those of industry. These processes, such as staff recruiting and the ICT functions that support them, are becoming standardized commodities.

As with any commodity (wheat, for example), competition to deliver commodity ICT functions is based on cost. Small providers cannot compete on cost against large providers with massive economies of scale. (Just as small wheat producers are swallowed by large commercial farming operations.) Cloud computing involves a set of principles and practices that are optimized to deliver low-cost commodity ICT functions to multiple client organizations on a very large scale.

MiCloud

Michigan must review commodity ICT functions such as messaging for possible delivery by commercial cloud-function providers. These providers often operate on a global scale and deliver extremely low-cost functions. In contrast, Michigan internal staff members have competitive advantage when delivering specialized government ICT functions, such as regulatory compliance monitoring systems. For delivering these functions, best value is derived by precise alignment between the ICT functions and the unique government business processes in Michigan.

Yet most ICT functions do not conform to this simplistic view. For instance, specialized government ICT functions can be created by combining and configuring standardized commodity ICT functions in unique ways. Some commodity ICT functions are critical to government operations. These functions are not suitable to transfer to an external cloud provider. Michigan would represent only a small fraction of the client base, and the external cloud provider may not see Michigan as a priority. Some functions have unique security requirements or legal constraints. The cost and complexity of making a commodity ICT function provider compliant would negate the benefits of using the commodity ICT function.

In recognition of the opportunities and challenges presented by the advent of cloud computing, Michigan has made a strategic investment in the MiCloud (pronounced “my cloud”) program.

MiCloud Program

The MiCloud program provides governance and direction for cloud-computing efforts in Michigan. Delivered cloud functions are branded MiCloud functions. The MiCloud program captures the benefits of cloud computing for client agencies. Michigan has already made critical strategic investments in enabling technologies. We now apply cloud-computing practices to extract the maximum value from those prior investments. We accomplish function transformation, optimization and automation without major additional capital outlay.

For commodity ICT functions that are critical to government operations, MiCloud delivers optimized internal government cloud functions. Although these internal government cloud functions do not have the global scale of commercial cloud functions, they do deliver competitive value.

Internal MiCloud functions are not exposed to the Internet. This means business processes using internal MiCloud functions are not exposed to many of the threats they would face using a commercial cloud function. A reduced-threat profile enables us to deliver a simpler, less-costly function. Internal MiCloud functions are presented over the Michigan intranet, so they feature significantly faster data throughput than an Internet-based commercial cloud function.

MiCloud functions transform the way government services are delivered. They will serve cross-boundary entities such as local governments, universities and medical facilities. There is no technical barrier to serving commercial businesses as well; however, this is not currently a targeted outcome. For now, all MiCloud functions are limited to serving Michigan government agencies.

MiCloud Vision to Action

Michigan’s strategy is to truly transform how we deliver ICT functions by leveraging cloud-computing practices and providing clients with:

- rapid service request fulfillment.
- secure functions.
- satisfying user experience.
- much lower costs.

We manage primary and secondary business support functions using a strategic, tiered approach.

Business criticality, security requirements and legal constraints drive sourcing decisions. Primary business support functions are critical to government operations or they impose unique security requirements or unique legal constraints. Secondary business support functions are not critical to government operations, and they do not impose unique security requirements or unique legal constraints.

Sourcing is the process of identifying the delivery method for a defined function. Sourcing methods include:

- Internal government cloud (delivered by on-premises Michigan internal provider)
- External government cloud (delivered by one or more off-premises cross-boundary government partners)
- External commercial cloud (delivered by one or more off-premises vendor partners)
- Hybrid cloud (any combination of the above)
- Internal hosting (traditional ICT function delivery by Michigan for Michigan)
- External hosting (traditional ICT function delivery by one or more vendors or cross-boundary partners for Michigan)
- Multihosting (any combination of internal and external hosting)

Cloud computing is not a panacea. MiCloud is one element of Michigan's overall function sourcing strategy. A cloud-computing approach may be suitable for only one function option in a multitiered function. It will not be suitable for some functions. Within a tiered function, there may be some cloud options and some noncloud options. Over time, a dynamic business process will need a mechanism to migrate from a commodity cloud option to a custom noncloud option and vice versa as requirements change. Our initial cloud functions satisfy client demands for commodity options within our broader, tiered function offerings.

External and commercial clouds are not viable options for every function. Michigan will continue to house primary functions securely in its internal government cloud. Examples include health, tax and criminal justice records. Secondary functions are possible targets for external or commercial clouds. The scope and variety of potential secondary functions are vast. Secondary functions provide exciting opportunities to transform the delivery of noncritical functions. Examples include human resources information, e-mail and messaging.

Why is Michigan adopting cloud-computing delivery models for internal functions?

Changing approaches to client business: At one time, government was a unique business domain. Each agency required a portfolio of unique processes and custom-enabling functions. Today, there is an increasing recognition among clients that standard business processes and commodity functions are readily adaptable to the business of government. Our cloud-computing model is optimized to deliver standardized function options to many distinct Michigan clients.

Changing staff needs and expectations: To deliver quality functions, we must attract and retain top talent. The emerging workforce demands challenging, varied and rewarding work. Staff members derive satisfaction from their ability to focus on complex tasks that create quality outcomes for the business. Implementing a cloud-computing function challenges and develops our staff. We have demonstrated that a successful cloud function automates routine tasks, freeing staff to pursue varied, high-value opportunities.

Imperative to maximize efficiency: Government is under fierce pressure to reduce staff, capital and operating budgets. At the same time, constituent demands for new service options and online services is steadily increasing. Michigan has demonstrated that the cloud-computing approach delivers new self-service options at a much lower cost. Michigan achieves industry competitive results with minimal up-front investments.

Positive impacts on noncloud functions: An overlooked benefit of pursuing a cloud-computing approach is the effect it will have on our noncloud functions. Fundamental to the cloud-computing approach is the ability to free capital, staff resources and ICT assets for investments elsewhere.

For example, if we deliver development servers using an automated cloud function, we free our server support staff to focus and optimize their noncloud function for test and production servers. We reduce cycle times for standing up test and production servers, because development server requests are removed from the work queue. Our capital is not tied up in physical development infrastructure; virtual development servers are de-allocated when not in use. This also saves

MiCloud

power, HVAC, UPS capacity, rack space, floor space, switch ports, SAN ports, monitoring capacity, O/S licenses, application licenses and database licenses, among others.

The unsustainable spiral of complexity: No organization has enough resources to analyze, engineer, secure and integrate custom solutions for every business-enabling function indefinitely. Each custom function introduced into the ICT environment increases the level of complexity—and risk—for all other functions. The potential for unintended interactions increases exponentially. Automated cloud functions must deliver standardized, commodity options wherever practical as a matter of long-term sustainability.

Investment risk management: When establishing a new ICT function, a major up-front investment is often needed to achieve the economies of scale necessary to make it cost effective. Assumptions are made about expected demand. The business case frequently projects recouping the initial investment over a period of years. What if the demand doesn't materialize? Much more cost must be spread over far fewer adopters. The function would never deliver the projected value.

By initially leveraging a cloud function, especially for the proof-of-concept and pilot phases, we can mitigate this risk. If the function is adopted at the predicted rate, we can make the capital investment with confidence. If not, we may choose to eliminate the function without swallowing major sunk costs.

The challenge of rogue cloud sourcing: Cloud services are extremely easy to adopt and use. A sophisticated user can stand up a fully automated business process without the ICT organization being involved or perhaps even being aware. Cloud services are often so inexpensive that, if purchased, they would not trigger a procurement review. Some are so inexpensive that staff may actually pay out-of-pocket just for the personal convenience.

Cloud services are automated and extremely elastic, but the resources to provide oversight, governance and security are not. Reducing the manual steps necessary to acquire services means fewer eyes on service use. Automation saves money, but it also creates the potential for misuse or abuse to go undetected longer. Services that formerly consumed internal network bandwidth only now add load to perimeter security assets and ISP connection costs.

In response, Michigan provides a limited number of feature-for-cost competitive government cloud functions as secure alternatives to the vast and growing numbers of commercial cloud services. Then we are able to block similar cloud services to prevent rogue cloud-sourcing. We are able to provide effective governance over this limited subset of cloud-computing options.

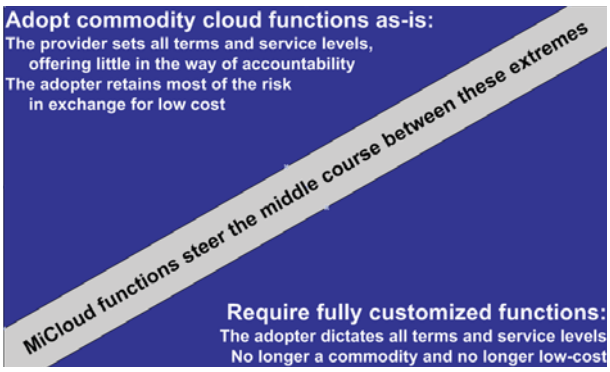
MiCloud Functions

Adopting a commercial commodity cloud function as is, is an act of trust. The cloud function provider sets the standards, terms, conditions and service levels. Such providers naturally offer little in the way of accountability for themselves. The adopter retains most of the risk in exchange for extremely low cost. The opposite extreme would be for the adopter to dictate all standards, terms, conditions and service levels. This is possible, but the resulting function is fully customized for the adopter. It is no longer a commodity, and it is no longer low cost.

MiCloud functions steer the middle course between these extremes. We seek the right balance by setting some basic parameters for evaluating external cloud-computing opportunities:

- Business criticality
- Unique security requirements
- Unique legal constraints, such as privacy laws

In cases where an external cloud function is not appropriate, MiCloud internal government cloud functions close the gap. This gives us the best of both worlds in terms of reduced costs, accountability and agility.



MiCloud

MiCloud functions follow a defined adoption path:

1. Prove	Demonstrate successful function options that close gaps in our offerings as proof of concept and then as a pilot. Explore policy changes, template contracts, service level agreements, terms and conditions.
2. Secure	Evaluate results to ensure the MiCloud function is fit for the business purpose and secure. Release updated policies. Provide tools and training. Block external providers lacking required controls.
3. Enable	Publish a self-service catalog. Educate clients about cloud and noncloud options and the benefits of each.
4. Transform	Deliver tiered functions with options ranging from commodity, self-service through dedicated, fully customized.
5. Extend	Once a MiCloud function is successfully launched, explores cross-boundary opportunities: - Share policy examples, requirements and RFP templates - Enable other units of governments to purchase using our contracts (MiDeal) - Provide a solution pattern and reference model (the blue prints/details of our successful function) - Deliver functions directly to other units of governments (future)

MiCloud

How does Michigan identify cloud-computing opportunities that make sense?

Fundamentally, cloud computing is an integrated part of Michigan's function delivery strategy. The MiCloud Function Review Process, shown to the right, guides an annual review of each ICT function category for proper business alignment in light of new cloud-computing opportunities.

Function option alignment with current business needs: Increasingly, extremely simple commodity options will satisfy many consumers. Extremely complex custom options often exceed the true needs of most consumers. Complexity imposes risk on the business.

Function option cost alignment with current business value: As part of the review process, Michigan identifies function options with costs that exceed the business value delivered for many consumers. We recognize that these function options are not viable, even if the function meets client requirements. Michigan works to target functions with cumbersome ordering processes and long fulfillment times for cloud transformation as well.

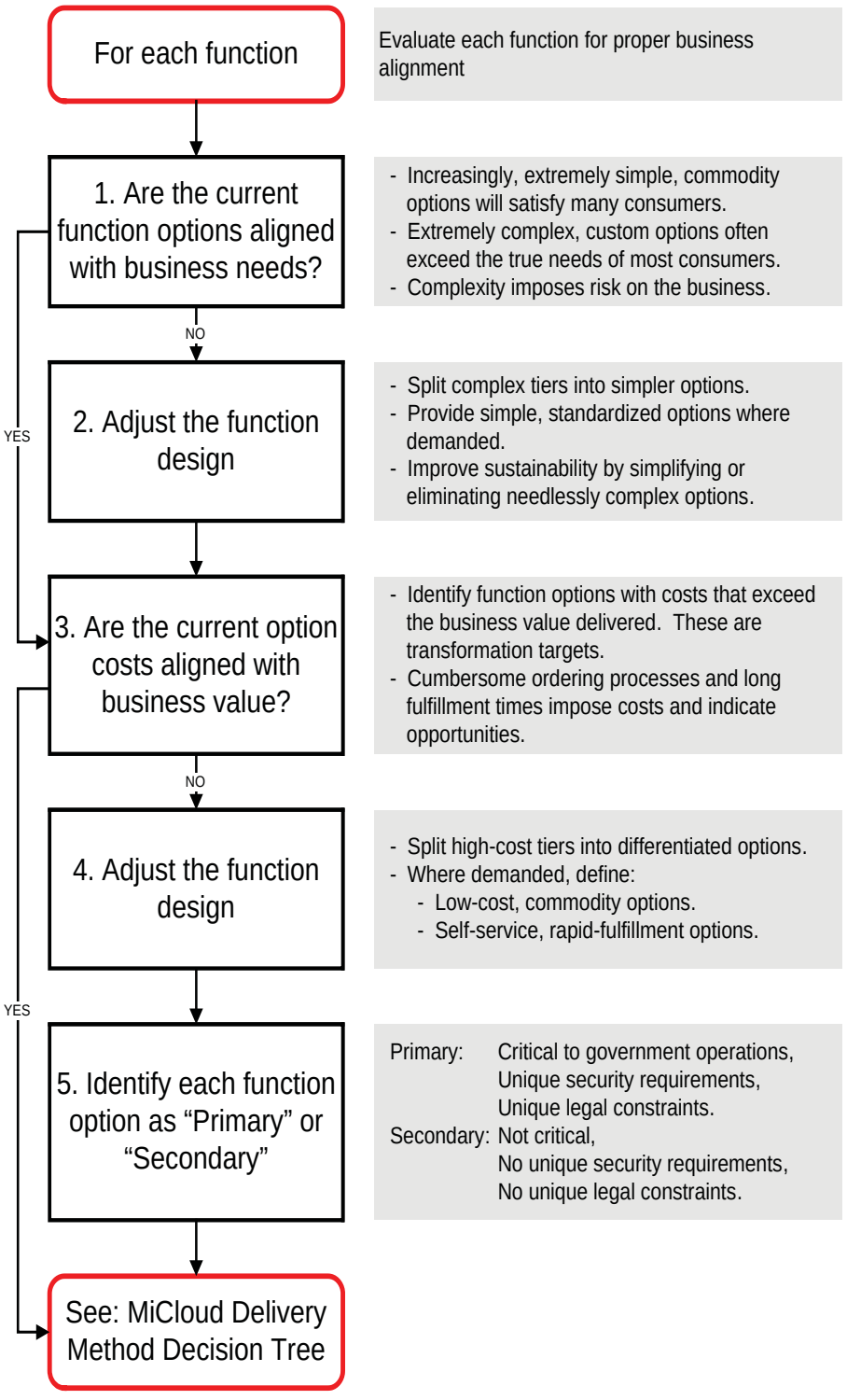
Transforming our function delivery methods: Michigan breaks up complex function tiers into simpler function options that may each be managed and delivered by separate means. We work to improve consumer satisfaction by providing new function options that are:

- low cost
- usage metered
- standardized
- commodity
- self-service
- rapid fulfillment

Michigan recognizes the need to improve its overall function sustainability by simplifying or eliminating needlessly complex function options. Unlike traditional ICT solutions, cloud functions must get simpler and more standardized over time.

A Michigan agency can require special, noncommodity functionality in an ICT function option. Michigan has a custom function development offering to accommodate that. The result would be a new, custom, noncloud function option. The resulting one-off complexity is not incorporated into the cloud function. The resulting premium one-off cost is born by the requesting client, not spread across all commodity cloud function clients.

MiCloud Function Review Process



MiCloud

How does Michigan decide where to pursue cloud sourcing?

Once the function options and costs are aligned with business need and value, the MiCloud Delivery Method Decision Tree is used to determine if a cloud option should be pursued, and if so, the type of cloud function.

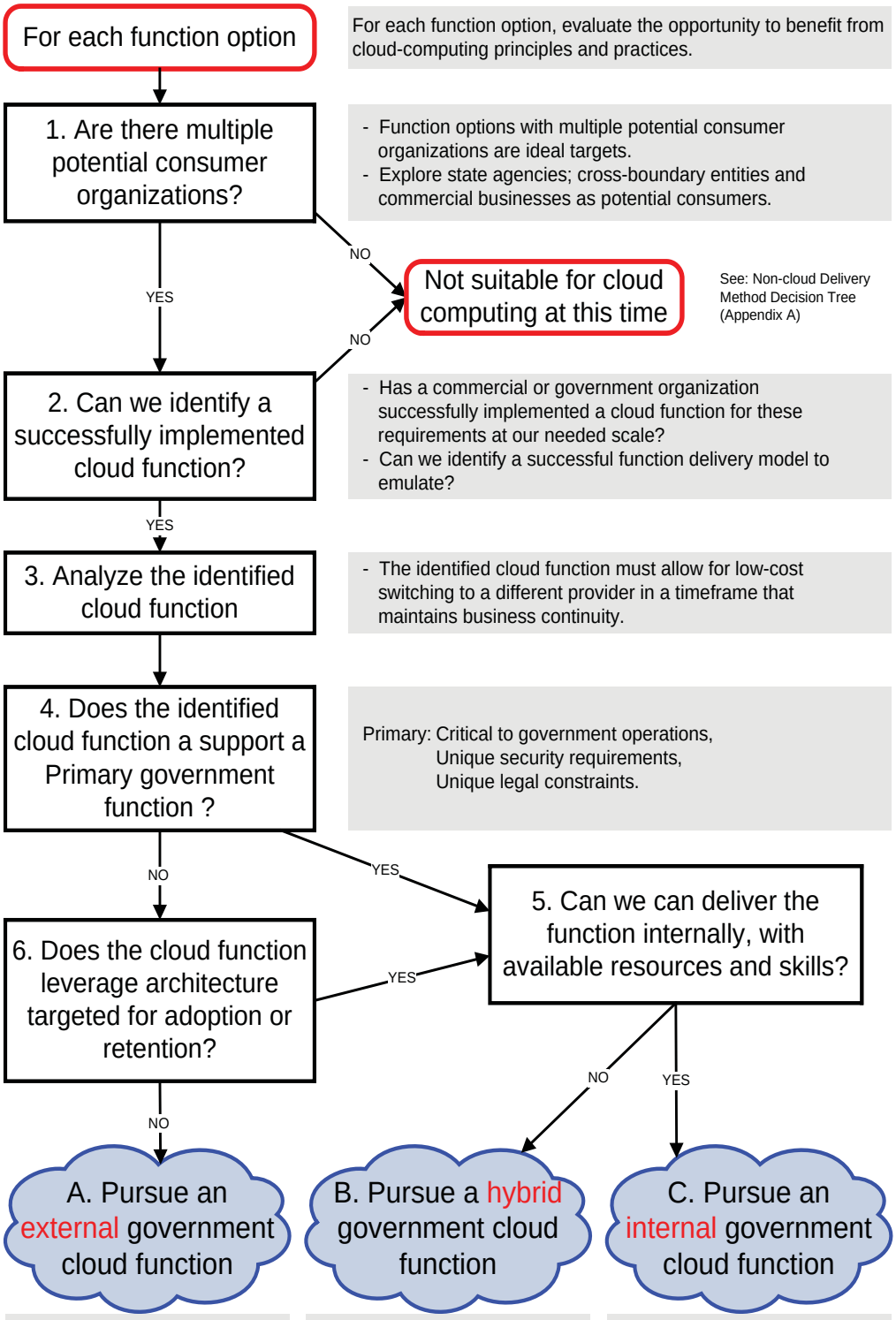
Whenever practical, DTMB pilots internal government cloud-computing functions first. The label internal government cloud-computing function makes it clear the function is hosted and provided by Michigan government itself. This is in contrast to an external government cloud-computing function, which would be provided by a cross-boundary government partner. An external commercial cloud-computing function would be provided by a commercial vendor. When an ICT function is delivered by a combination of these, it is called a hybrid cloud-computing function.

Exploring opportunities to transform existing ICT functions into internal government cloud-computing functions allows State of Michigan staff to evaluate the maturity and interoperability of various cloud technologies and practices. Piloting internal government cloud-computing functions allows State of Michigan staff to gain competence before engaging with a commercial vendor. Thus, our agency business clients realize immediate benefits at low risk.

The MiCloud program identifies reference functions. These are successfully implemented commodity ICT functions that meet equivalent requirements at the scale of current Michigan ICT functions. MiCloud challenges Michigan's current function providers to match the value-for-cost performance of these reference functions. Where successful, there is no need to incur the risk and complexity of engaging with commercial cloud providers.

For example, the MiCloud Storage for Servers function is an internal government cloud function delivered by DTMB. The function is cost and feature competitive with commercial cloud storage providers such as Amazon S3. The low-cost cloud option is integrated with noncloud options in a comprehensive, tiered storage offering. The MiCloud Storage for Servers function performs at Intranet speeds, much faster than any Internet-based commercial function. The function does not rely on an Internet-based provider. Government data does not leave our secure intranet. Because the benefits of an external cloud function have been achieved, even exceeded, there is no business imperative to engage a commercial cloud provider.

MiCloud Delivery Method Decision Tree



MiCloud

In which areas is MiCloud delivering internal government cloud functions now?

Summary Table:

Offering	Type	Production Date
MiCloud Storage for users	Virtual Data Storage-IaaS	October 2010
MiCloud Storage for Servers	Virtual Data Storage-IaaS	October 2010
MiCloud Process Orchestrator	Process Automation	April 2011
MiCloud Hosting for Development	Virtual Data Storage-IaaS to APaas	October 2010

Virtual Data Storage: Michigan is actively piloting MiCloud Storage for Users and MiCloud Storage for Servers as internal government cloud functions. These functions are delivered by the Michigan DTMB. Production for these functions is planned for October 2010. We expect to consume more than 250TB in the first year of operation. This is an example of the Infrastructure as a Service (IaaS) model.

In recent years, Michigan has made critical strategic investments in storage virtualization technologies. We now use cloud-computing practices to extract the maximum value from those prior investments. This low-cost option represents a service alternative that is only appropriate for data that do not require 24x7 availability or real-time block-level replication.

MiCloud Storage for Users: The cost for this function is 83 percent lower than our lowest-cost storage tier today. At the same time, the function delivers self-service and automated provisioning within 10 minutes of submitting an online request. The provisioned storage may be used like any other network file share. Features include:

- Network Attached Storage (NAS) network file shares
- Slightly reduced performance from current lowest-tier function
- Reduced service levels from current lowest-tier function
- Fully automated provisioning
- Limited access to authorized agency users
- An online wizard that manages permissions and creates audit records
- No backups but an off-site copy that may be requested for continuity
- Metered usage with charges computed as the daily GB rate x the maximum GB usage for that day

The key benefits are self-service and low cost

Normally, the provisioning service and storage pools are available 24x7. If an incident were to occur, however, the storage team would not respond until the next business day between 8:00 a.m. and 5:00 p.m. In that sense, the storage is supported Monday through Friday during standard business hours.

The MiCloud storage pools are not backed up. Data may be replicated to a second data center for continuity, but this doubles the cost to the agency.

A Case in Point – MiCloud Storage for Users:

Chuck is forming an ad-hoc cross-functional team to plan for major budget reductions. Step 1 is definitely not, “Spend a bunch of money.” Chuck’s agency participates in the low-cost MiCloud Storage for Users function.

Chuck requests a virtual storage area from the online service catalog. The network file shares are provisioned within 10 minutes by an automated process. Chuck immediately provides access to his cross-functional team members, using the online access wizard. Chuck’s team begins to collect the necessary data and formulate plans. The MiCloud Storage for Users file shares allow for simple collaboration. Chuck knows he can request a SharePoint team room, but he feels the cost is not justified for this purpose.

Membership in Chuck's team is very dynamic. Over time, multiple members transition on and off the team. Chuck can change access permissions immediately, so new team members can quickly gain access and come up to speed. Chuck also designates several read-only members to review his team's progress. All access changes are logged and preserved for audit purposes.

Once the final package is delivered, Chuck de-allocates the bulk of the storage. He is paying for the amount of storage he actually consumes. His agency needs every dollar to make the plan a success.

MiCloud Storage for Servers: The cost for this function is 83 percent lower than our lowest-cost storage tier today. At the same time, the function delivers self-service and automated provisioning within 10 minutes of submitting an online request. The provisioned storage may be used like any other network file share.

- These are Network Attached Storage network file shares.
- Their performance is slightly reduced from our current lowest-tier function.
- Service levels are reduced from our current lowest-tier function.
- Provisioning is fully automated.
- Access is limited to authorized DTMB users.
- Requestors manage permissions with an online wizard that creates audit records.
- Usage is metered. Charges are computed as the daily GB rate x the maximum GB usage for that day.
- There are no back-ups or automatic replication across data centers.
- The key benefits are self-service and low cost.

Normally, the provisioning service and storage pools are available 24x7. If an incident were to occur, however, the storage team would not respond until the next business day between 8:00 a.m. and 5:00 p.m. In that sense, the storage is supported weekdays from 8-5.

The MiCloud storage pools are not backed up. To achieve redundant copies in physically distinct data centers, requestors create two storage pools, which are guaranteed to be in separate data centers, and write to both locations. This doubles the cost to the agency.

A Case in Point – MiCloud Storage for Servers:

Sandra is awakened in the middle of the night by an urgent text message. A critical Michigan application has experienced a server failure. The server's cluster partner is still operational, but performance is degraded.

Sandra knows how to fix this issue, but the procedure is complex and risky. She has used temporary virtual storage from the MiCloud Storage for Servers function successfully in the past. Sandra requests a virtual storage pool from the online service catalog. The storage is provisioned within 10 minutes by an automated process. Now Sandra is able to make copies of critical data and system files before she starts her recovery procedure. If she wishes, she can direct the data to two physically distinct data centers.

Fortunately, the procedure succeeds on the first attempt, and the cluster is restored. Sandra closes the incident, but she does not de-allocate the MiCloud storage yet. She knows the MiCloud virtual storage pool has retained valuable clues that will identify the cause of the server failure. Sandra and her team can perform a root cause analysis in the morning, without having to disrupt the running business application.

Storing this data for only one day is so inexpensive that it is within Sandra's authority to make this decision, based on team guidelines established by her manager and their client. The MiCloud Storage for Servers function empowers Sandra to respond effectively and deliver quality outcomes for the business.

Virtual Server Hosting – IaaS to APaaS: Michigan is in the proof-of-concept phase for the MiCloud Hosting for Development function as an internal government cloud function. The function is delivered by the DTMB. The planned production date for this function is October

MiCloud

2011. We expect to deliver more than 80 development server instances in the first year of operation. Today, this is an example of the IaaS model. We will explore a hybrid cloud function approach to deliver the more complex Application Platform as a Service (APaaS) model.

In recent years, Michigan has made critical strategic investments in server virtualization technologies. We now apply cloud-computing practices to extract the maximum value from those prior investments.

A Case in Point – MiCloud Hosting for Development:

Dan is wearing two hats. He owns management responsibility for the operation of a high-visibility public-facing State of Michigan business process. The successful operation of this process relies on Generation 3 of the enabling software. Generation 3 is currently running in the production environment. Dan is also the executive sponsor for the high-profile multimillion-dollar project to transform the business process through innovation, including a highly customized Generation 4 version of the software, currently under construction in the development and test/QA environments. Dan's project team is six months into a 12-month development effort. The project timeline is extremely aggressive.

The current situation:

Development	**Test / QA**	**Production**
Gen4	Gen4	Gen3

Late Friday night, Dan gets the fateful call. One key assumption about the Generation 3 solution currently in production was flawed. It is clear to Dan's analysts that production will fail in three weeks unless several software remediations can be made quickly. Dan knows from experience that flushing all the project changes from the development and test/QA environments so the production support team can make the necessary application changes will cause much more than a three-week project delay. Dan can hear the project dependency train wreck in the distance.

The train-wreck scenario – The Generation 4 project team is flushed from Development and Test/QA:

Development	**Test / QA**	**Production**
Gen3	Gen3	Gen3

Dan's production support team proposes using the MiCloud Hosting for Development function to immediately allocate a second set of development servers. They will only need to pay for three weeks of access. Once the remediations are ready for testing, they will coordinate with the project team, promote the Generation 3 development changes to test/QA, do their validation, then let the project team promote their Generation 4 version back to test/QA. The production support team will then store the server images in case they are needed again and de-allocate the new servers. Dan clearly sees the advantages and approves the minor expenditure.

Development	**Test / QA**	**Production**
Gen4	Gen4	Gen3
Development 2		
Gen3		

The Generation 4 project team continues while the production support team works in the Development 2 environment. When ready, the production support team coordinates with the Generation 4 project team and promotes Development 2 to Test/QA to allow the client to validate the production fixes. The Generation 4 project team continues to work in the Development environment:

Development	Test/QA	Production
Gen4	Gen3 (fixed)	Gen3
Development 2		
Gen3 (fixed)		

Once validation is successful, the production support team promotes Test/QA to Production:

Development	Test/QA	Production
Gen4	Gen3 (fixed)	Gen3 (fixed)
Development 2		
Gen3 (fixed)		

The Generation 4 project team then promotes the Development environment to Test/QA and Development 2 is de-allocated. This restores the original state:

Development	Test/QA	Production
Gen4	Gen4	Gen3 (fixed)
~~**Development 2**~~		
~~Gen3 (fixed)~~		

Driving home, Dan thinks about his budget. He has funds allocated to host his development environment multiple years past the end of his Generation 4 project. Can't Dan's team do the same thing at the end of the Generation 4 development project – archive the server images and release the resources? Dan realizes the savings would far exceed the cost of the temporary development environment he just approved. Dan now understands his physical development servers represent a capital asset that could be reinvested elsewhere. The funds that would have paid to host his development environment for a rainy day can now fund further innovation efforts. The MiCloud Hosting for Development function makes this possible.

Process Automation – SaaS: Michigan is in the proof-of-concept phase for the MiCloud Process Orchestrator function as an internal government cloud function. The function is delivered by the Michigan DTMB. The planned production date for this function is April 2011. We expect to automate hundreds of processes in the first year of operation. This is an example of the SaaS model.

In recent years, Michigan has made critical strategic investments in process improvement initiatives. We now apply cloud-computing automation and metrics capabilities to extract the maximum value from those prior investments. Process automation is universally recognized as a necessary organizational competence to enable organizational transformation.

The MiCloud Process Orchestrator function enables agency business users to create simple models of as-is and to-be processes. Without ICT skills, business users build and test process models through simulation, then implement the basic business processes. Within the MiCloud Process Orchestrator function, agency business users publish processes and related forms to the service catalog.

After operating within the MiCloud Process Orchestrator environment for a time, agency business users analyze metrics. The process models and metrics serve as the foundation for process transformation. The business analysts determine if the process is operating as intended and pursue continuous improvement. They determine if this basic level of automation is sufficient or if a more sophisticated business process automation effort is warranted.

MiCloud

The Process Orchestrator lifecycle:

- Describe
- Simulate
- Pilot
- Operate
- Measure
- Optimize

As with other successful SaaS functions, the MiCloud Process Orchestrator function is most suited to automating business processes requiring little integration to other ICT systems. The next phase of development will enhance the integration capabilities of the function.

A Case in Point – MiCloud Process Orchestrator

Tina has heard all the complaints. Anecdotal horror stories about her team' paper-based processes abound. Tina is a change agent and is ready to begin transforming the operations of her team. To accomplish the transformation, Tina knows she needs metrics. Will her proposed transformations improve service? Without objective measures, she will still be battling the anecdotal perceptions of the past.

Tina recognizes that her clients do not understand her manual processes, which are extremely difficult to measure. Some basic level of Web-based ordering and process automation would allow Tina to begin to generate statistically significant numbers of measures. This would also provide some convenience and transparency to her clients. But how can she justify an investment in tools and development to automate a process that she knows needs to be over-hauled?

At a departmental leadership conference, Tina learns about the MiCloud Process Orchestrator function. She is excited to learn that the function was designed for self-service use by non-ICT staff. Tina accesses the function and enters details about the process that will be her first transformation target. She gets representative stakeholders into a computer training classroom, and together they use the MiCloud Process Orchestrator function to simulate the operation of the process. All agree that the simulation automates the existing process accurately. Both her clients and her own team members appreciate the ability to track and display the status of any request throughout its lifecycle.

Her clients are so impressed they ask Tina to publish the simulation to the service catalog in order to automate the production service. Tina points out that, although simulation is free, there is a charge for automating production. The client agrees to pay a few cents for each production transaction for six months. They are just as eager as Tina to see objective metrics.

Because there is no major up-front investment, Tina's clients can support funding the cost for as-is process automation. Client managers are able to evaluate the value delivered first-hand, before agreeing to pay ongoing charges. Tina designs, models and simulates her to-be process while the as-is continues to operate. The MiCloud Process Orchestrator function makes this possible.

What does Michigan see as barriers to implementing a true SaaS model?

SaaS is inherently problematic. Placing the focus on software is misguided. The focus should be on enabling business processes. Do we imagine that clients will purchase document management or customer relationship management SaaS offerings from alternatives presented in a service catalog? How many business processes spider out from a typical document management or customer relationship management service? How many legacy integrations? How will the client alone analyze the impacts of such a decision?

Software services are not interchangeable. Figuring the cost difference of selecting one SaaS offering over another requires an intimate knowledge of both SaaS offerings and the many other systems that may need to interface to the SaaS offering. An offered option may be far more costly, or actually precluded, based on the necessary integrations.

Our clients will not thank us for presenting options in the service catalog, only to discover later they can't really leverage them. To be successful, the SaaS service to be purchased from the service catalog must be a business process enablement consulting engagement, not software.

Despite claims to the contrary, Michigan views most touted SaaS implementations as application outsourcing. This is not to assert that application outsourcing is inherently good or bad. Michigan has many outsourced applications. It's just not cloud computing. A cloud function is a commodity. True commodities are interchangeable, regardless of the provider. (Wheat from Provider A is the same as wheat from Provider B.)

Achieving this interchangeability has been easier for IaaS providers. Strong standards for interchangeable components are part of the infrastructure culture. Competition in the infrastructure space has been based on commodity cost for many years.

To a lesser degree, this is also true for APaaS. Standard application platform models do allow for relatively painless switching between two providers delivering the same product stack. If Provider A delivers my Linux-Apache-MySQL-PHP (LAMP) application platform today, I can switch to Provider B's LAMP application platform fairly easily tomorrow.

Achieving this in the SaaS space is much more problematic. Unlike the infrastructure industry, the software industry has long followed a differentiation strategy. This is the opposite of a commodity strategy. Software vendors pride themselves on delivering standards-plus ICT functions. The sales pitch goes, "This software is not just standard! It's even better than standard!" This is nonsense, of course, and means the software is not standard at all.

An Application Services Provider (ASP) offering falls short of true cloud computing. Fundamental to the ASP model is sharing a single application implementation across multiple client organizations. This is the multitenant hosting model. With this model, client dependency problems arise quickly.

For example: Let's say that an ASP is hosting Arbitrary software, for clients X, Y and Z. Because of an internal project, Client X must upgrade to the next version of Arbitrary or the project will fail. Because of integrations with legacy functions, Client Y must not upgrade to the next version of Arbitrary or the business process will fail.

Someone is going to lose here:

If the ASP does not upgrade, Client X must incur cost to change providers.

If the ASP does upgrade, Client Y must incur cost to change providers or rewrite its legacy integrations.

If the ASP decides to host both versions of Arbitrary, efficiency is lost and additional costs must be passed on to clients. This is bad news for Client Z, who had no preference either way.

Replay this scenario in your head with 30 clients. How about 300 clients? You can see that, at some scale, this approach must break down.

How is Michigan overcoming the barriers to SaaS?

Services Oriented Architecture (SOA): DTMB has proposed implementing a SOA Enterprise Services Bus (ESB) environment to lower the cost of integrating and re-integrating changing SaaS offerings. Unfortunately, the first introduction of SaaS into a business process area will be the most costly for highly integrated environments. In conjunction with the initial SaaS implementation, many of the custom integrations to the service must be altered. Where practical, Michigan directs such re-integration efforts to leverage the ESB. After the initial investment in ESB integrations, any of the internal or external software services supporting the business process can be swapped out at significantly reduced re-integration costs in the future.

Encapsulation: IaaS and APaaS overcome the client dependency problem through encapsulation. The service provider delivers an abstraction layer that allows each client to function within his or her own virtual bubble. Each client may then control their own upgrade schedule, at least to some degree.

A software function provider can follow this strategy. Each client could be allocated separate virtual machines (VMs) for software presentation, application and database. That will work fine, but it is an application platform. This is an example of APaaS, not SaaS.

MiCloud

Encapsulation is the approach Michigan follows for many internal applications today. The need to reduce the cost of software licenses, support and infrastructure drove the creation of large, multitenant software hosting implementations. Negotiating virtual machine-friendly licensing rates is critical to deliver encapsulated software platform functions successfully. Delivering encapsulated software platform functions is, in turn, critical to eliminating client dependencies and reducing business complexity.

Reserve the right to re-source: Michigan is pursuing changes within ASP contracts. We must stipulate certain preparations and reserve certain rights to enable a future function re-sourcing. Along with application data, all software configuration data must be secured either at the State of Michigan or with a third party, such as a DR provider. The annual DR exercise then becomes a rehearsal for a potential future re-sourcing. What if our ASP is purchased by a foreign entity? What if security requirements or legal constraints change and an in-sourcing is required? The ability to exchange one provider for another while minimizing cost and impact to the business is critical.

How does cloud computing fit into Michigan's data center strategy?

Although our data center strategy does not revolve around bricks and mortar, we must recognize that Michigan will need of a minimum of two physical geographically separated data centers. That is not to say that these data centers must be dedicated for State of Michigan use exclusively.

Cloud computing is an integral element of our data center strategy. Cloud computing models have a major impact on how we manage ICT function delivery. Cloud computing provides new function sourcing options beyond the four walls of the traditional data center.

For ICT functions that support the critical, primary functions of government, Michigan demands a high level of delivery control. Unique security requirements and legal constraints also result in demands for a high level of control. To satisfy these demands, the State of Michigan will need to secure a high level of control in at least two physically distinct data centers to deliver critical government support functions.

This has important implications as we pursue public-private partnerships for creating the Great Lakes Information and Technology Center. Potential cross-boundary partners and commercial partners must understand and formally agree to the Michigan need for control over ICT functions that enable critical government operations. Further, Michigan contributions and responsibilities must be confined to governmental activities. Failure to do so could leave the State of Michigan open to claims of improper commercial competition or lead potential litigants to attempt to pierce Michigan's governmental immunity protection.

By identifying the secondary government functions that do not require this high level of control, we define the domain of ICT functions that can be more flexibly sourced to capture the cost savings and other benefits of exciting alternatives such as external cloud-computing services.

How does Michigan's cloud-computing approach compare to the U.S. federal strategy?

Federal broker strategy - Apps.gov: The U.S. General Services Agency (GSA) has created Apps.gov as a marketplace. Apps.gov allows government agencies to purchase cloud-computing functions from approved vendors. Federal agencies benefit from assurances that the vendor's terms and conditions have been vetted by GSA and that a contract and rate schedule have been negotiated in advance. This is a broker strategy for cloud computing.

GSA's value add: The broker strategy puts much of the onus for function adoption on the agency. Any re-sourcing must be initiated and managed by the agency as well. The Apps.gov cloud offerings are not presented as options within a broader tiered-function offering. Mitigating the business impact of switching providers appears to be the responsibility of the agency, rather than the GSA.

Michigan's provider strategy: In contrast, Michigan follows a provider strategy. DTMB owns the responsibility for delivering business enabling functions. Like the federal strategy, if a contract with a commercial cloud provider is needed, DTMB negotiates it. But as a provider, DTMB adds value throughout the business process lifecycle.

Michigan's value add: DTMB's low-cost cloud function options are integrated with noncloud options in a comprehensive tiered-function offering. Our solutions are designed to enable cross-tier migration and provider switching. MiCloud functions are designed to mitigate re-sourcing impacts to the business and avoid vendor lock-in. We function as the one-stop shop for the broad spectrum of function options, from commodity cloud functions to fully customized dedicated solutions. It is DTMB's role to ensure portability and secure service migration options on behalf of the client.

Federal internal government cloud strategies: Several U.S. agencies are pursuing internal government clouds, in contrast to the Apps.gov approach. The federal internal government cloud approach is similar to Michigan's strategy.

What are the expected cloud-computing benefits for Michigan?

- Green ICT: minimize footprint, efficiency
- Remediate legal, policy compliance
- Optimize provisioning over time
- Transform function delivery capabilities
- Energize staff
- Enable government transparency, social computing
- Optimize function delivery
- Redeploy highly skilled staff to our highest-value tasks
- Provide automation support for routine provisioning
- Reduce complexity and cost of ICT functions
- Improve user satisfaction
- Offer standard functions catalog and self-service
- Facilitate cross-boundary opportunities, storefront
- Offer repeatable solution patterns
- Encourage public-private partnerships
- Drive economic development

Conclusion

Michigan is pursuing a culture change, not just within our ICT organization but throughout our agency clients, cross-boundary partners and commercial partners as well. For decades, ICT function providers have collected detailed requirements from clients and delivered high-cost customized ICT functions that failed to satisfy the client's true needs. The success of extremely simple, no-frills cloud-computing solutions should be no surprise. The truism, "It's only a requirement until the client sees the price tag," anticipates this evolution.

The cloud-computing paradigm says, "The client can have something simple, proven and cheap immediately, or they can have something complex, unproven and expensive in six months." This is a startling shift in the way we think about ICT functions.

If the client is educated about the simple, proven and cheap options and still demands a custom solution, he or she must truly have unique needs. With many needless requests for custom solutions removed from the work stream, DTMB can focus on delivering high-value results for the remaining few. DTMB has developed the skills and competencies to assemble unique solutions by combining standard, interoperable cloud-computing functions.

MiCloud

Like so many overly hyped trends of the past, the best principles and practices of cloud-computing will be assimilated into the standard ICT business model. Over time, the rest will fall by the wayside. Michigan is working to capture the real benefits of cloud computing for our clients, while ignoring the hype. The old paradigm is already dead. In Michigan, cloud computing is delivering business value today.

Michigan's guidance for structured agreements with cloud vendors

There are no unique legal issues or constraints for cloud computing that are not present in other third-party hosting agreements. A template contract for both third-party hosting and cloud-sourcing contracts helps shape negotiations and ensure best practices are included from the outset. Key elements include:

Ownership

- Guarantee that Michigan will continue to own and control all access to Michigan business data, configuration data and business processes
- Guarantee that the provider will surrender and purge all Michigan data on demand
- Stipulate that the provider will replicate all Michigan data to a State of Michigan-designated data repository within a state-designated interval of time. This supports annual DR testing and serves as a hedge in case the vendor is seized or sold and refuses to cooperate with Michigan's efforts to re-source. In a sense, our annual DR exercise is a rapid re-sourcing rehearsal.

Security

- Compliance with Michigan identity and access management
- Auditable records of all data access events
- Certification by a third-party auditor that security controls are appropriate for the type of Michigan business process enabled. (We don't really want to review the technical details of their security architecture ourselves because we have access. We would not want another client organization that has access to review the security details and learn vulnerabilities that might allow them to breach our data. The third-party auditor must have read-only access while conducting the audit.)

Legal issues

- Guarantee that the provider complies with all applicable federal and state legal requirements for the type of Michigan business process enabled
- Stipulate that the provider is accountable for breach notification and mandated follow-up costs but that Michigan is responsible for any actual notifications
- Guarantee that all provider contracts, including telecom providers, are enforced under U.S. law. There is a strong preference for substituting Michigan law here. Michigan is much better equipped to contest legal issues in Michigan courts.
- Define protocols and procedures to be followed if the provider receives a Freedom of Information Act request, e-discovery request or court order related to Michigan data. Michigan owns the data; therefore, only Michigan can release it.

Location for hosting

- As prescribed by law for the type of Michigan business process enabled

SLAs

- Set required availability and performance metric thresholds with penalties
- Set incident response metrics: Support availability, initial response time and method, update time and method, MTTR with penalties