DOR Infrastructure Modernization IV&V
Initial Independent Assessment

July 21, 2017

Prepared for: Arizona DOR

GARTNER CONSULTING

Project Number: 330044169

Executive Summary

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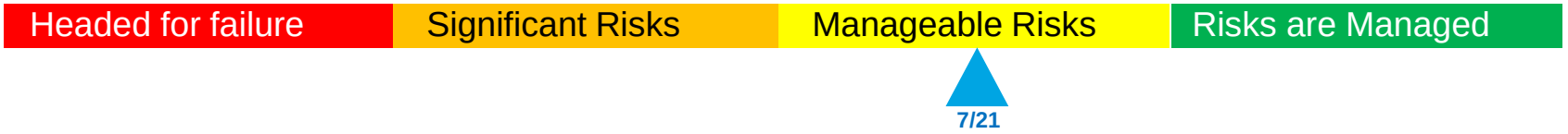
Executive Summary Observations and Recommendations



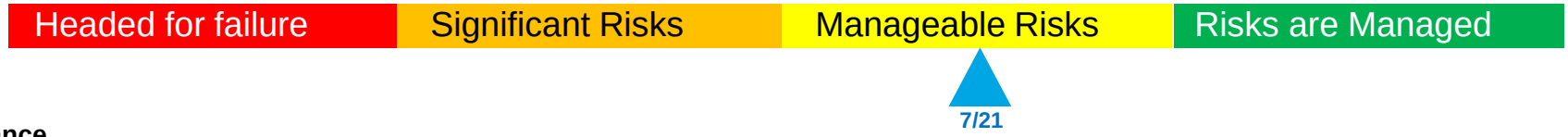
Observation:

- Gartner has determined that the overall project risks are manageable and that DOR is in a good position to complete the project successfully and within budget if Gartner recommendations are adopted. Although key recommendations are listed below, additional recommendations can be found in corresponding work stream sections.

Key Recommendations:

- Establish a project schedule that **focus on migration of non-production application environments before production systems.**
- Given the prolonged blackout period during the tax season (from mid January to end of June), **Gartner estimates that August, 2018 will be a reasonable completion date** for the project without imposing unnecessary risks.
- **Ensure that back-out plans are incorporated into application move plans**. This means leveraging data replication for migrating data rather than moving physical equipment.
- **Ensure that application dependencies are fully identified.** This will most likely require use of an application discovery and dependency mapping (ADDM) tool to discover all applications, servers, and their communication patterns. Discovery can then be completed through interviews with application owners. **Gartner recommends leveraging a vendor with experience in this area to assist.**
- **Ensure that operation teams are trained** on the use of new technology being deployed at the IO data center as well as during the migration **before** any **production systems are migrated**.

Project Governance, Organization, Scope, and Objectives Dashboard.



Governance, Organization, Scope, Objectives	Base 7/21	Rv#2	Rv#3	Rv#4	Comments
Executive Sponsorship	G				ADOR Director, Deputy Director, and CIO have identified that the Data Center Modernization is high priority due to the risks of Monroe St. data center ageing infrastructure and the closure of ADOA Adams St. facility, in December 2018.
Steering Committee	G				CIO's Leadership Team convenes as the Steering Committee for the project. Leaders of key work streams are participants and collectively bring recommendations to the CIO for review and approval.
Vendor Accountability	Y				No change since Phase 0. World Wide Technology (WWT) remains the integrator and will manage the Dell/EMC, Cisco, and VMWare sub-contractors. **SOW for WWT is work in progress and does not include application dependency mapping which will be done by DOR**. Application mapping may require additional support, tools, or resources.
Program Management	Y				DOR senior project manager has been identified and supported by a part time WWT project coordinator. Current team has little experience in migrating data centers. **Gartner recommends planning for access to subject matter expertise through WWT if needed.**
Roles and Responsibilities Matrix	Y				Some DOR IT team members are also new to the organization, but are quickly adjusting to their roles. WWT SOW that defines the vendor roles and responsibilities remains to be finalized.
Work Stream Ownership	Y				Work stream owners are identified. Coordination and **communication** among the work streams is good, but has **room for improvement**.
Organizational Alignment with project Objectives	G				The main objective is clearly defined and project charter was created. **(Note: Gartner believes that DOR executives understand that this project will not result in a fully functioning disaster recovery plan for DOR, although data will be protected in a secondary data bunker).**
Vendor Management	G				DOR is on-boarding vendor resources quickly and without unnecessary delays. WWT SOW is in the process of being completed and approved. Project team has established a weekly vendor call to coordinate efforts among vendors and ensure effective use of vendor resources.

Project Management Summary Dashboard

Program Management	Base 7/21	Rv#2	Rv#3	Rv#4	Comments
Project Integration Mgmt.	Y				**There are many dependent and concurrent activities that are not documented in the project plan** (i.e. virtualization of application servers, application dependency mapping, training, etc.).
Scope Management	G				Project charter defines the scope to migrate Adams St. and Monroe St. data centers to the IO data center while replacing aging hardware, improving virtualization, and updating end-of-life OS and infrastructure software. Changes to core business applications or migration to cloud are out of scope.
Schedule Management	Y				**A reasonable end date for project will be August 2018.** Project plan is still at a milestone level and details are being added. Additionally, it does not contain the inter-project dependencies like the required P2V or dependency mapping of applications. Some schedule risks exist.
Cost Management	Y				A project budget log was not provided but is necessary in monitoring all project costs to avoid budget overruns. **Vendor SOW's need to be finalized to better understand the costs**.
Quality Management	Y				**DOR staff needs to train** and become familiar with operation of vBlock and other new infrastructure technologies being deployed. **Quality management activities must integrate into the project plan.**
Human Resource Mgmt.	Y				Due to limited and highly utilized resources, there is a risk that resources will have limited time or be diverted to other project work putting this project at risk. **Project plan should avoid unnecessarily tight due dates to avoid pressure on staff and allow for adequate training and risk management.**
Communications Mgmt.	Y				Communication planning has not yet been completed as the project is still in the initial planning stage. **A communications plan should be in place before the end of August.**
Risk Management	Y				Risk log has been provided, however; **governance related to socializing and mitigating risk needs to be in place before the end of August.**
Procurement Mgmt.	Y				Once a project expense register is established the project costs will be able to be monitored to ensure procurement is timely and within the project budget.
Stakeholder Management	Y				**By end of August, DOR should identify all internal and external stakeholders** that will be impacted by the project and whether they should be informed, consulted, or be a decision maker when appropriate.

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Project Work Stream Summary Dashboard (Infrastructure)

Headed for failure | Significant Risks | Manageable Risks | Risks are Managed

7/21

Project Work Streams	Base 7/21	Rv#2	Rv#3	RV#4	Comments
Network (DC LAN)	G				**DC LAN equipment (Cisco 5596 and Palo Alto Routers/Firewalls, F5) have been installed at IO**, but not fully configured and tested. **Should investigate options for migrating VLANs such as extending the existing VLANs at Monroe/Adams through layer 2 extension**. This could make migration simpler.
Network (Telecommunications)	G				WAN and telecommunication connectivity will be provided through cross connect from DOR space to the new DOA AZNET space at IO and then to Cap Mall over ADOA leased fiber. Two 10GB connections are being negotiated with AZNET. Additional temporary circuits for migration purposes can be ordered at no cost. **WAN Infrastructure can be turned on by end of July**.
Midrange Systems (Systems & Storage)	Y				There are currently 2 Sun Solaris servers at Monroe Data Center running the Executive Dashboard application. **Intention is to retire Solaris servers before migration.** DOR also leverages the DOA mainframe and **should ensure connectivity to the DOA mainframe from the IO data center**.
Open Systems (Systems & Storage)	Y				**New foundational components are already installed at IO**. All open systems will be migrated from HP platform running VMWare 5.5 to new vBlock platform on VMWare 6.0. Current EMC VMAX 2 storage (5 in Monroe, 2 in Adams) will be replaced by 1 VMAX 3 all flash storage at IO. **Gartner recommends a method of server and storage migration that does not require physical move of server or storage assets and allows for a back-out plan (i.e. vMotion or SRDF).**
DC Facilities (Capacity, Readiness, Decommission)	G				**DOR data center space at IO with 180 kW of reserved power capacity is ready and operational.** Phase 0 equipment is already installed in this space and powered up.
DC Operations	Y				New hardware and software platforms (vBlock, VMWare 6.0, VMAX 3, etc.) will require additional training for the operations teams. **Gartner recommends that all training be completed before any production workload is migrated to IO.**
Disaster Recovery Planning	O				DOR currently does not have a DR plan. **DOR will establish a data bunker at the IO Scottsdale data center after migration to IO Phoenix is completed**. While this will protect the data, **it cannot be considered a DR plan.** A full DR plan will require additional funding.

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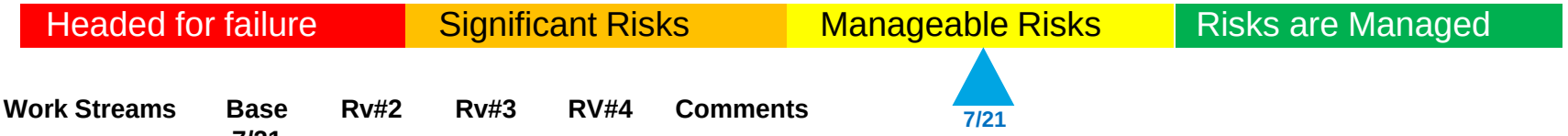
Project Work Stream Summary Dashboard (Applications)



Project Work Streams	Base 7/21	Rv#2	Rv#3	RV#4	Comments
Group 1 Applications – Core TAX Applications	Y				Core TAX applications such as Tax Accounting System (TAS) consist of 4 distinct environments, Production, Test, Development, and Quality Assurance (QUAT). Most **production systems are located at the Adams data center** while **nearly all Test/Development/QUAT systems are located at the Monroe data center.** Several production and non production systems run on physical servers, which will be migrated to virtual prior to migration to the IO data center. **Gartner recommends that DOR create a complete dependency mapping of all production and non production systems to other applications, servers, storage devices, and network appliances prior to migration. Gartner also recommends that non-production environments be migrated before production environments. Extension of VLANs from Monroe/Adams data centers to IO data center (if possible) can help reduce the risk if any dependencies are missed.**
Group 2 Applications – Business Critical Applications	Y				Production environments for this group of applications can be found in both Monroe and Adams data centers. **Gartner recommendations for Group 1 also apply to this group of applications.**
Group 3 Application – Other applications	Y				This group of applications consist of productivity, monitoring, and other tools. An outage to this group of applications does not have a significant impact on daily services provided by DOR. Some applications may not have all 4 environments that are found in groups 1 and 2. **This group of applications can be migrated early once it is established that it is safe to do so.**

Summary of Activities and Findings

Key Activities in This Period

Key activities in this period

7/11/2017 – 7/13/2017 Site Visit

- Provide an initial project assessment to support DOR in preparation for the upcoming ITAC meeting on July 26.
- Gartner was on site for 3 days (7/11 – 7/13)
    - Reviewed project documents and facilitated 17 discussions with key stakeholders
    - Visited the Adams, Monroe, and Phoenix IO datacenters to obtain a baseline understanding of the current state
    - Attended the Thursday ADOR vendor status meeting

Weekly Status Calls with:

- 7/13 - Weekly vendors call - ADOR Technology Infrastructure Modernization Phase 1
- 7/19 - Status update call – Status call with the Project Manager to confirm DCM planning and the status of documentation that was requested
- 7/20 – Weekly vendor call - ADOR Technology Infrastructure Modernization Phase 1

Weekly Executive Calls with:

- 7/13 - Met with Sandip Dholakia to discuss the preliminary findings, risks, and recommendations
- 7/20 - Met with Sandip Dhloakia and his leadership team to provide an update on the preparations for the ITAC meeting on July 26, progress of the initial assessment and on DCM planning

Gartner has conducted a review of the Data Center Migration

Areas Reviewed to Date

Program	Project Governance and Organization
	Scope and Objectives
	Project Management (Plan & Scope)
	Skills, Resources, Schedule
Stake-holders	Stakeholder Communication Plan Stakeholder feedback
Work Streams	Network (DC LAN)
	Network (WAN)
	Midrange and Mainframe Systems (Systems, Storage)
	Open Systems (Servers, Storage)
	Applications and Databases
	DC Facilities
	Operations
	Disaster Recovery Planning

All work stream were reviewed for this report

Key Interviews

Sandip Dholakia	**Chief Information Officer**
Tom Ferruccio	**Deputy Chief Information Officer**
Johnathon Edwards	**Chief Security Officer**
Michael Piatt	**Systems/Network Senior Manager**
George Simanson	**Quality Assurance Senior Manager**
Tom MacConnell	**Chief Financial Officer**
Beth Neeley	**Applications Development Senior Manager**
Ismail Fernandez	**System/Network Senior Manager**
Bodie Graves	**Senior Project Manager**
Mike Trunzo	**Systems/Network Engineer**
Chad Smith	**Systems/Network Engineer**
Suzan Tasvibi-Tanha	**ADOA Chief Networking Officer & Assistant Director**
Pam Dreyer	**ADOA Program Manager – Network Services Enterprise**
Allen Gazza	**ADOA Data Center Manager**
Reem Prendiville	**ADOA Engagement Manager**
Keish Crandall	**World Wide Technology Project Manager**
Shaukat Lodhia	**World Wide Technology Engineer & Project Manager**
Chad Rohner	**CenturyLink Account Executive**

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Major Documents Reviewed

Major Documents Reviewed

7/21/2017 Report

- ADOR Org Chart (Agency and IT)
- ADOR WAN Architecture Diagrams (Including connectivity to Monroe, Adams, and IO (Phoenix and Scottsdale))
- ADOR IO data center LAN network design diagrams
- Project Charter
- Project Roles and responsibilities matrix (RACI)
- Preliminary Data Center Migration project plan
- Project risk register template (Issues Log)
- Change management policy and procedure
- Current State Server, Network, Storage architecture
- Updated current asset inventories (Servers, Storage, Network, Applications) for each data center
- Updated IO data center floor plan and rack elevations
- Updated rack elevations for Adams and Monroe data centers
- List of ADOR projects in flight
- PIJ, ITAC, and JLBC related documentation and presentations

Major Documents Requested But Not Yet Received

Major Documents Requested But Not Yet Received

7/21/2017 Report

- List of project stakeholders and Stakeholder communication plan (if developed)
- Vendor SOWs and Contracts (WW Technologies, CenturyLink, IO (Phoenix and Scottsdale), Cyxtera, others)
- Desired Target State Architecture Artifacts (Virtualization plans, storage consolidation plans, tech refresh, etc.)
- Master server list
- Resource analysis
- Electronic data capture document
- Application list (listing category 1, 2, 3)
- Physical to virtual application server list
- Current application RTO, RPO and DR plans
- BOM (Bill of Materials) for recently ordered equipment for IO (Servers, network, and Storage)
- Current IT power consumption of Monroe and Adams data centers
- Baseline project budget (Breakdown of project budget)
- To date expenditures against the budget
- Official blackout times

Key Findings: Specific Topics

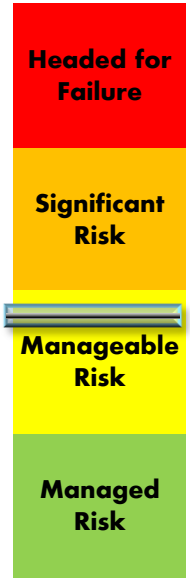
The follow section provides general observations for each area

Program	Project Governance and Organization
	Scope and Objectives
	Project Management (Plan & Scope)
	Skills, Resources, Schedule
Stakeholders	Stakeholder Communication Plan Stakeholder feedback
Work Streams	Network (DC LAN)
	Network (WAN)
	Midrange Systems and Mainframe (Systems, Storage)
	Open Systems (Servers, Storage)
	Applications and Databases
	DC Facilities
	Operations
	Disaster Recovery Planning

Key Findings: Program
Project Governance and Organization

Best Practices

- Establish data center migration PMO.
- Form migration steering committee with at least weekly meetings to review and approve activities.
- Steering committee should define guiding principles for the project.
- Document and communicate the governance and decision making process.
- Define the roles and responsibilities (RACI).
- Conform to change management processes.
- Define approach to manage needs of competing projects.
- Define a stakeholder communication plan.



Key Interviews and Observations

- Executive leadership team (steering committee) has been established and have committed to the priority of the data center migration project.
- Project Manager and a part-time Project Coordinator have been assigned.
- Weekly and daily status meeting have been planned.
- Change management policy exists.
- RACI chart has been developed, but may require additional work.

Recommendations

- Steering committee should define the guiding principles. For example risk avoidance vs. speed, project deadlines that are aligned with compelling business reasons, etc.
- Leverage WWT to obtain additional PM support that has data center migration experience to assist with the planning.

Key Findings: Program Scope and Objectives

Best Practices

- Scope should be documented, understood, and approved.
- Business case, schedule, budget, and resources must be aligned with the scope.
- Ensure scope is aligned with organizational objectives or expectations.
- Validate and approve scope by stakeholders.
- Ensure that all assumptions are clear and understood.
- Change request process described, including management of changes related to technology.
- Process owners identified per scope domain areas.

Key Interviews and Observations

- Project charter defines the scope to migrate Adams and Monroe data centers replacing the ageing hardware and updating infrastructure.
- Project scope excludes upgrades or changes to the core tax and business applications.
- Project scopes excludes creation of fully functional disaster recovery capability, although a data bunker for data protection will be provided.
- Scope of work vendor activities and statements are work are being negotiated (work in progress).
- The requested $11.1M budget appears to be aligned with the communicated scope (further review will be needed once all statements of work are finalized).

Recommendations

- Outline the complete scope with all concurrent or dependent work streams and vendor statements or work before the end of August.

Key Findings: Program
Project Management (Plan & Scope)

Best Practices

- Ensure experienced Project Management teams is in place.
- Ensure project plans and schedules are defined and maintained in an up-to-date status.
- Project/Program manger should rely on the steering committee for key decisions as well as establishing the guiding principles.
- Regular project review processes are in place and being used to manage the project on a daily basis.
- Project feedback mechanism to recognize and log action issues/risks is in place and being used to manage the project on a daily basis.

Key Interviews and Observations

- Project manager has been identified; however does not have direct data center migration experience. WWT is committed to provide a project coordinator for support.
- A high level project plan has been prepared; however; detailed activities and inter-dependencies will need to be included.
- Process to review the project plan on a regular basis has not yet been established.

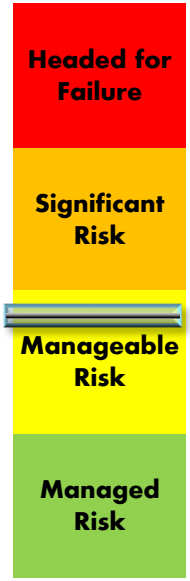
Recommendations

- PM should work with the CIO and leadership team to agree on the guiding principles which can then drive the project activities, methods of migration, and schedule.
- A detailed project plan needs to be developed and socialized by the end of August.
- Maintain a risk log and decision log for all issues and decisions.
- Document, socialize, and begin executing the process related to project plan and risk management.

Key Findings: Program Skills, Resources, and Schedule

Best Practices

- Schedule is documented, approved and proactively reviewed and managed by project leadership.
- Milestones are clearly defined.
- Tasks are defined to reasonable activity details and durations are realistic (time-boxed, includes resources and dependencies).
- Milestones and the critical path is well-defined and aligned with guiding principles.
- Planned project staffing levels have been adequate to meet project requirements.
- Project member roles and responsibilities are clearly defined, documented and are stable.
- Project team is receiving commitment from management in the form of additional resources and support when necessary.
- Project team is receiving commitment from management in terms of active engagement and resolution of staffing issues.



Key Interviews and Observations

- Preliminary project resources have been identified but are currently over-utilized and probability is high that they would need to focus on other non project related priorities.
- Primary project knowledge and experience reside on a single resource and adds risk to the project in the event the person is not involved in the project for an extended period of time.
- The team in general is highly skilled in their specific areas.
- Original timeline was focused on having the production data center moved first by the end of 2017, there are not business or financial reasons for this schedule and recommending to migrate the development, test, and QUAT first.
- A project RACI was provided, suggest reviewing with the management team to ensure all members buy-in to the roles. Include all items identified in the detailed project plan.

Recommendations

- Migrate the development, test, and QUAT first and the production data center right after the blackout window (6/2018).
- WWT should be leveraged to obtain the specific data center migration planning expertise if needed.

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Key Findings: Stakeholder
Stakeholder Communications Plan and Stakeholder Feedback

Best Practices

- All stakeholders and their roles identified.
- Communication strategy and plan documented and approved.
- Ownership & accountability established.
- Aligns with governance and stakeholder communication channels.
- Meets executive, project team, advisory team, business stakeholders and public needs.
- Document repository established, medium and frequency of communication identified.

Key Interviews and Observations

- The project is in the initial stage of the project and the communications plan has not yet been developed.
- Discussions were completed with stakeholders from the DOR project team, vendors, and ADOA.
- Business stakeholders were not included in the interviews as this initial assessment report.

Recommendations

- Prepare, socialize, and begin to execute a comprehensive communications plan. The communication plan needs to address communication to all stakeholders that include the project team, project management, executive leadership team, end user community, and potentially the public.
- Discussions with key user stakeholders need to be considered in quality and readiness assessments.

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Key Findings: Work Streams
Network (DC LAN)

Best Practices

- Plan for new network equipment, appliances such as routers, switches, firewalls, and load balancers.
- Avoid major architecture changes during the migration. Make those changes either before or after.
- When data centers are within 5 ms latency, extending existing VLANs to the new location will provide the simplest method of migration and the least complexity.
- Avoid having to change IP addresses if possible. Many applications may have hard coded IP addresses which will have to be addressed.
- Commission and test the network configuration thoroughly before moving any production workload.

Key Interviews and Observations

- As part of Phase 0, DOR has purchased the seed network equipment for the IO data center. This equipment is currently installed at IO data center (Cisco switches, Paulo Alto Firewalls, F5 load balancers)
- DOR is not planning any major architecture changes to the core data center network topology.

Recommendations

- Gartner recommends to extend existing VLANs from Monroe and Adams data centers to the IO data center. This will minimize the risk if some application dependencies are missed and will make it easier to use vMotion, SRM, or other tools to migrate from existing data centers to IO.

Key Findings: Work Streams
Network (WAN)

Best Practices

- WAN connectivity should provide diverse routes, adequate speed, and lowest latency possible.
- When necessary obtain temporary WAN connections to accommodate data replication during the DC migration.
- When possible leverage diverse carriers.
- Plan for WAN connections early on as they may require long lead times.

Key Interviews and Observations

- WAN connection between the IO data center and Adams and Monroe data centers will be provided by DOA and AZNET. Two 10GB connections will be provisioned for DOR. There are no direct charges for these connections.
- DOA leased fiber from IO to Cap Mall are already in place and connected to the DOA space at the IO data center.
- Redundant cross connects from DOA space at IO (DC1) will be provided to the DOR space at IO (DC7). Connection will pass through the IO meet rooms in DC1 and DC7. These connections will be in place and operational by end of July.
- DOR can request DOA to provide additional temporary connections for data replication (no charge).

Recommendations

- The currently planned two 10GB connections will most likely be adequate to support all storage replication between data centers. DOR can plan for additional temporary connections for data replication if required without charge (was confirmed by Suzan Tasvibi-Tanha during the interview).

Key Findings: Work Streams
Midrange and Mainframe System (Systems, Storage)

Best Practices

- Assess options for migration off of proprietary midrange systems and mainframe, and when possible do so prior to migration.
- Otherwise, consolidate systems leveraging LPAR and virtualization options.
- Replacement of systems should be driven by remaining residual life of the hardware assets, but ideally use seed equipment in the new data center when possible to manage risk.

Key Interviews and Observations

- DOR mainframe applications run on two LPARS on the DOA mainframe. DOA plans to outsource all mainframe services starting in September 2017. Therefore, other than ensuring connectivity to the DOA mainframe services, migration of the mainframe is not in the scope of this data center modernization project.
- DOR currently operates two Sun Solaris servers at the Monroe data center in support of the Executive Dashboard application. DOR plans to migrate the Executive Dashboard to new platform prior to migration to IO.

Recommendations

- Ensure that funding to migrate the Executive Dashboard from Sun Solaris systems to new platform has been planned for and approved and integrate related activities into the overall data center migration project plan.
- Coordinate with DOA regarding any special activities related to outsourcing of the mainframe operations and assess impact on data center connectivity and application dependency requirements.
- Assume that the DOA mainframe outsourcing project will consume some project resources, and plan for it.

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Key Findings: Work Streams
Open Systems (Servers, Storage)

Best Practices

- Virtualize all workloads that can be virtualized.
- With today's technology nearly all open system migrations are accomplished using data replication. Physical assets are moved only after data is moved first, and only when there is reasonable residual life left in them.
- Refresh hardware assets when possible to take advantage of higher storage and compute densities and reduce power consumption.
- Ensure that virtualization platforms at the source and target data centers are the same version.
- Always have a back-out plan.

Key Interviews and Observations

- Existing environment consists of nearly 400 virtual and physical servers at Adams and Monroe data centers running on HP X86 servers and EMC VMAX 2 storage devices. Adams data center is all production, while Monroe data center has production and non-production systems.
- Nearly 90% of environment is virtualized with few physical servers remaining. All physical servers will be virtualized prior to migration to IO.
- Virtualization platform is VMWare 5.5, which will be upgraded to VMWare 6.0 prior to migration.
- Phase 0 afforded DOR funds to purchase vBlock racks with 4 Cisco UCS Chassis, 20 compute blades (can support up to 80), and one EMC VMAX 3 all flash storage device with 50 TB of usable storage (can support up to 1PB). This equipment is installed at the IO data center, but not in use.
- Existing DOR VMAX 2 storage (5 at Monroe and 2 at Adams) support nearly 600 TB of usable capacity. This entire capacity will be moved to the single VMAX 3 once additional flash storage is added.
- DOR will purchase additional storage and UCS blades with funds from Phase 1 to meet capacity needs.

Recommendations

- Gartner recommends that data migration from existing VMAX 2 systems to VMAX 3 at IO be accomplished using data replication without moving any of the existing equipment to IO (SRDF or vMotion are options). This will leave the existing environment intact during the migration as a back-out option should issues be encountered at the IO data center.
- Gartner also recommends that migration of servers be accomplished via VMWare vMotion, Metro vMotion, or SRM.

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Key Findings: Work Streams
Applications and Databases

Best Practices

- Fully understand the application inventory, their function, support structure, and owners.
- Complete application dependency mapping that identifies dependency of applications to each other, databases, servers, storage devices, and network appliances.
- Leverage an application discovery and dependency mapping tool to discover network traffic between servers and applications. Very often institutional knowledge may lack the full picture.
- Complement the output of discovery tools with application owner interviews to complete any missing information and obtain final confirmation.
- Group applications into affinity groups. These are applications that must move together based on dependencies.
- Move non-production environments first to uncover the unexpected.
- Ensure that test plans are in place for each application to confirm successful move.

Key Interviews and Observations

- DOR has three groups of applications, Core tax applications, business critical application, and other applications that are mostly productivity, support, and monitoring tools.
- Core tax and business critical applications such as Tax Accounting System (TAS) consist of 4 distinct environments, Production, Test, Development, and Quality Assurance (QUAT). Most production systems are located at the Adams data center while nearly all Test/Development/QUAT systems are located at the Monroe data center.
- Several production and non production systems run on physical servers, which will be migrated to virtual prior to migration to the IO data center.
- Dependencies may exists between open system applications and mainframe applications. DOA's outsourcing of mainframe this year could consume DOR application resources for planning, validation, and testing.
- On-line tax applications such as TPT can tolerate reasonable maintenance windows.

Recommendations

- All best practices listed above, including use of application discovery and dependency mapping tool. **Leverage vendors for support.**
- **Migrate non-production environments before production environments.**
- Leverage vMotion, SRM, and EMC SRDF for data replication and migration of servers. **Avoid server IP or name changes.** Extension of VLANs from Monroe/Adams data centers to IO data center (if possible) can help reduce the risk if any dependencies are missed.

Key Findings: Work Streams
Data Center Facilities

Best Practices

- Establish multi-site strategy to manage risk and provide differentiated class of service.
- Location of data centers must avoid the same disaster strike zone. Additional considerations must include power cost, personnel availability, network cost, real estate cost, and climate (which impacts energy efficiency).
- Avoid data center ownership to improve flexibility and reduce investment risk.
- Data centers should be located in dedicated data center facilities in order to improve security, reduce environmental risks, and minimize impact of office real estate strategies on IT operations.
- Leverage a Tier III data center capable of providing concurrent maintainability.

Key Interviews and Observations

- DOR operates two data centers. It currently leverages the Arizona DOA Adams data center as a colocation tenant. This facility will be shutdown by DOA in December, 2018. DOR has 7 racks at this location.
- Second DC is in the main DOR office at Monroe street. This facility is aging and is a Tier I data center (lowest resiliency). For example it lacks backup generator power and is supported by only one electrical distribution path.
- DOR plans to migrate to the IO Phoenix data center as the primary site and IO Scottsdale data center for data replication (data bunker). IO is a commercial data center colocation operator. Its data centers are Tier III.
- DOR will leverage the DOA state contract for IO DCs.
- DOR space at IO consists of one modular unit located in the DC7 building capable of supporting up to 180 KW of power. This space is ready and operational with some DOR equipment already installed. DOA has also moved to IO Phoenix, but are located in a caged space in DC1 building. DOA will provide WAN connectivity for DOR from their space.
- Gartner visited all 3 locations.

Recommendations

- DOR space at IO is more than adequate to accommodate the planned migration. Gartner only recommends that best practices for cable management be followed as additional equipment is installed.
- Gartner also recommends that airflow barriers between the hot and cold aisles at the IO facility be installed to optimize cooling of the equipment. This will require installation of blanking panels in racks.

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Key Findings: Work Streams
Operations

Best Practices

- Data centers should be operated as lights-out facilities. Staff presence should be required only for the purpose of installing and replacing equipment.
- At colocation data centers ensure that the contract provides for “remote-hands” also called “smart-hands”. These are vendor resources that can perform simple on-site tasks such as powering equipment on and off, connecting and disconnecting cables, and more on short notice.
- Train and if required certify operations staff on any new platforms and systems that might be replacing old ones.
- Fully review and understand colocation provider’s methods and procedures for access and security, particularly by third party vendors.
- Ensure that remote monitoring and management tools are in place.
- Leverage an out of band network for systems management.
- Install DCIM and or interface with colocation provider’s DCIM system if one is available.

Key Interviews and Observations

- Cyxtera, which has acquired CenturyLink’s interest in nearly 57 data centers will be the party providing most operational support of the IO data center, including remote-hands.
- DOR uses Solarwinds IT management tool.
- DOR staff have not been trained on the use of new physical assets such as vBlock, VMWare 6.0, EMC VMAX 3 or use of data replication tools such as SRDF. Some training credits exists which can be used for this purpose.
- DOR currently uses a 4G connection for out of band management until a wide area connectivity to the DOR module at IO is established.

Recommendations

- Train staff on the use of data migration tools when necessary, or leverage certified vendor staff.
- **Ensure that staff are fully trained and experienced with the use of new equipment prior to migration of any production systems**.
- Explore use of DCIM tool for monitoring of the infrastructure. Cyxtera or IO may have a tool in place to accomplish this.

Key Findings: Work Streams
Disaster Recovery (DR)

Best Practices

- Establish multi-site strategy to manage risk.
- DR with pre-established recovery time and recovery point objectives (RTO and RPO) will gradually evolve into Continuity of Operations where downtimes are eliminate or reduced to minutes or seconds by leveraging multiple active data centers.
- Leverage virtualization technologies such as virtual data centers and virtual clusters to load balance and recover between locations.
- When multiple data centers are not readily available, leverage a data bunker for off-site data storage.
- Physical tape libraries are quickly becoming replaced by virtual tape libraries (VTL).

Key Interviews and Observations

- Currently DOR does not have a fully functional disaster recovery plan.
- While the DOR infrastructure modernization project will establish a data bunker at the IO Scottsdale location, **it is not intended to enable a fully functional DR environment. This will plan will only protect the integrity of the data, not services.**
- Data from the primary IO Phoenix data center will be replicated to the IO Scottsdale facility by leveraging Netbackup and Object Storage. However the current plans and budget does not include purchase of additional compute capacity for full DR capability.

Recommendations

- Proceed with implementation of the data bunker at Scottsdale.
- Continue to pursue a business case for funding the DR capability.

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Appendix: Historical Information

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Major Documents Reviewed

Major Documents Reviewed (Historical)

7/21/2017 Report

- ADOR Org Chart (Agency and IT)
- ADOR WAN Architecture Diagrams (Including connectivity to Monroe, Adams, and IO (Phoenix and Scottsdale))
- ADOR IO data center LAN network design diagrams
- Project Charter
- Project Roles and responsibilities matrix (RACI)
- Preliminary Data Center Migration project plan
- Project risk register template (Issues Log)
- Change management policy and procedure
- Current State Server, Network, Storage architecture
- Updated current asset inventories (Servers, Storage, Network, Applications) for each data center
- Updated IO data center floor plan and rack elevations
- Updated rack elevations for Adams and Monroe data centers
- List of ADOR projects in flight
- PIJ, ITAC, and JLBC related documentation and presentations

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