SAP Saber
Carving SAP into Separate Landscapes for Company Split
Rick Jones and Van Vi
Introductions

Rick Jones
Marathon Petroleum Corporation
SAP Architect
rajones@marathonpetroleum.com

Van Vi
SAP America, Inc.
SAP Certified Professional
Platinum Consultant
van.vi@sap.com
Learning Points

- How to quickly provision infrastructure to support an SAP rapid and agile deployment
- How to carve an existing SAP system into two separate independent systems
- Delivering SAP high availability at reasonable costs with low complexity
- SAP Virtualization at Marathon Petroleum – Lessons Learned
Agenda

- Introductions
  - About Marathon Petroleum Corporation
  - SABER Project Overview
- SAP Hosting Decisions
  - OS and Database Platforms
  - Virtual Infrastructure
- SAP Migration
  - Planning, Clone and Delete, OS/DB Migration
  - Migration Take Away
- SAP Recommendations for Virtualization
  - High Availability Options
  - Distributed Architecture, Installation Methods
- MPC Virtual Environment
  - SAP Systems
  - Virtualization at Marathon Petroleum
  - Lessons Learned
SABER Project Introduction

- On January 13, 2011, Marathon Oil’s board of directors announced they had approved plans for moving forward with the spin-off of the Downstream business.

- Marathon Oil Corporation – Houston, TX (MRO - Upstream):
  - Operates as an international energy company with operations in the United States, Canada, Africa, the Middle East, and Europe.
  - Operations includes Exploration and production, Oil Sands Mining, and Integrated Gas.

- Marathon Petroleum Corporation Findlay, OH (MPC – Downstream):
  - Total separation from Marathon Oil
  - Shared systems and data centers required new deployments
  - Day One – New Company Begins July 2011 (less than six months)
  - Day Two – New Company operating with new SAP systems Jan 2012
Marathon Petroleum Corporation (MPC)

- 125 years in business
- 5th largest U.S. refiner
  - Largest in Midwest
- 2011 Revenues: $78.8 billion
- 2011 Net income: $2.4 billion
- Employees: > 24,000
- Headquartered in Findlay, Ohio
- Approximately 1,375 Speedway convenience stores
- More than 5,000 Marathon Brand retail outlets
- Extensive terminal and pipeline network
MPC - Focused and Integrated Network

- Pipelines
- Terminals
- Refineries

Real Experience. Real Advantage.
MPC - Extensive Retail Network

- **Speedway**
  - Fourth largest company-owned/operated c-store chain in the U.S.
  - ~1,375 convenience stores
  - ~2 million customers/day
  - Located in seven states

- **Marathon brand**
  - Independent entrepreneurs
  - More than 5,000 branded retail outlets
  - Located in 18 states

*Industry-Leading Retail Operation*
SABER Project Introduction

Marathon Petroleum Corporation (MPC) Overall Information Services Goals

- Fill Organizational Structure
- Provision New Data Center
- Split Shared Services (HR, Payroll, Treasury, ServiceDesk, Contracts)
- Split Shared Systems (LAN architecture, mainframe, eMail, SAP, etc)
- Continue to Run Core Business and Operate Line of Business Operations

SAP Split Project Timeline

Day 1: Q3 2011
  - Consolidation Reporting
  - Solution Manager

Day 2: Q1 2012
  - HR
  - Payroll
  - Treasury

Day 3: Post Day 2 to ~2013
  - Adding additional functionality
  - Adding additional SAP Product (e.g. SRM, CRM, MDM, Data Services, BW Java....)
Foundation for MPC SAP Systems

Marathon Shared SAP System Prior to Split
• ECC (HR, Payroll, Treasury), Portal (Employee Self-Services), GRC PC
• Approximately 12 years old
• ECC System (approximately 4.7 TB)
• AIX based running in hosted data center
• Oracle database

Hosting Decisions for New MPC SAP System
• Expedient solution required to meet 2011 split target dates
• Support for migration of above systems in 2011
• Design for future SAP applications over next few years

• What Operating System? AIX or Windows
• Which database platform? Oracle or SQL Server
• Will we go with Physical vs. Virtual infrastructure?

• How will disaster recovery be handled?
• Can we improve RPO and RTO for the new MPC SAP?
• System reliability and performance
• While not at the top of the list, in the back of our minds - On-going Support costs
Foundation for MPC SAP Systems

Risks of Change
• Existing SAP system has been rock solid for several years
• If we were ever going to switch horses, now was an opportunity
• Will new system be stable and perform well?
• Can OS/DB migration be completed reliably?

Why Change? Reward
• Rapid deployment and flexibility
• Lower support and licensing costs
• Shared computing, storage, and networking infrastructure
• Synergy with non-SAP infrastructure
• In-house experience with Microsoft OS and DB

Our Selections
• Operating System: Windows 2008 R2
• Database Platform: SQL Server 2008 R2
• Infrastructure: Virtualized on VMWare ESX 5.x
• Storage: EMC Symmetrix VMAX with FAST
Supporting the Decisions

- Customer Interviews
- Vendor Interviews
- Conference Attendance
- White Papers
- In-house experience with VMWare
- In-house experience with Windows and SQL Server
## Why Windows?

### Summary Point For Decision Making:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Windows</th>
<th>UNIX</th>
<th>LINUX</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPC Experience with OS</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Existing Partnership with Supplier</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>VMware Support</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Licensing Cost</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Infrastructure Cost</td>
<td>Low</td>
<td>Medium/High</td>
<td>Low</td>
</tr>
<tr>
<td>MPC Datacenter Consistency</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Simplified HA</td>
<td>Yes</td>
<td>No</td>
<td>Medium</td>
</tr>
</tbody>
</table>
Why SQL Server?

Summary Point For Decision Making:

<table>
<thead>
<tr>
<th>Feature</th>
<th>SQL</th>
<th>Oracle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licensing Cost for multi-core processor</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Infrastructure Cost</td>
<td>Same</td>
<td>Same</td>
</tr>
<tr>
<td>MPC experience with DB</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Windows native clustering</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Virtualization Support</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Windows/AD Integration</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Horizontal Scale-Out</td>
<td>No</td>
<td>High</td>
</tr>
<tr>
<td>Established Tier 1 History</td>
<td>Moderate</td>
<td>Long</td>
</tr>
</tbody>
</table>

(OSS note 1173954)
More than 30,000 SAP installations are on SQL Server and more than 65,000 are on Windows Server.

Over 400 SAP customers have a productive SQL server DB size of over 1TB.

Several Microsoft SQL Server and SAP customers have SAP ERP productive DB sizes of over 1TB.

Microsoft SQL Server and SAP customers are running SAP ERP with over 3,000 concurrent users.

Why Virtual?

MPC Drivers for Virtualization:

- Shorter Deployment Cycle (High Priority):
  - Faster provisioning of new servers
  - Existing older x86 servers for immediate start for SAP installations
- Provide flexibility in relocating SAP to different data center
- x86 Server Hardware independency – Decoupling software from Hardware
- Faster procurement time for commodity hardware
- Datacenter/Infrastructure consistency – Virtualization on VMware.
- Simplification for HA and DR
- VMWare DRS, SRM, and Storage Virtualization
- SAP and Microsoft Supported
Was it Good Decision?

- Early Watch metrics look good – ECC using < 20% computing
- VMWare usage patterns are trending well
- Clients not complaining about performance issues
- SLA’s are improved
- System uptime has been very good (99.5% or higher)
  - No unplanned outages since going live
  - Planned outages of ~1-2 hours per month for patching
- Gained agility in provisioning new landscapes to support 2012 projects and enhancements
## Migration Project – Business and Landscape Requirements

<table>
<thead>
<tr>
<th>Business Requirements</th>
<th>Landscape Solution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Day 1 Go Live – Q3’2011</strong></td>
<td>• BPC</td>
</tr>
<tr>
<td>• Enable financial consolidation close as a separate company</td>
<td>• BW</td>
</tr>
<tr>
<td>• Solution Manager</td>
<td>• Solution Manager</td>
</tr>
<tr>
<td><strong>Day 2 Go Live – Q1’2012</strong></td>
<td>• PI</td>
</tr>
<tr>
<td>• Establish independent MPC SAP environment:</td>
<td>• ECC</td>
</tr>
<tr>
<td>• HR Payroll (~25,000 employees)</td>
<td>• Pecaso</td>
</tr>
<tr>
<td>• HR Employee and Management Self Service (ESS/MSS)</td>
<td>• EP</td>
</tr>
<tr>
<td>• Treasury and FI</td>
<td>• GRC AC/PC</td>
</tr>
<tr>
<td><strong>Post Day 2</strong></td>
<td>• BI/BOBJ</td>
</tr>
<tr>
<td>• Enable Common Enterprise processes and retire burning platforms:</td>
<td>• Other – TDMS, HPQC, ARIS</td>
</tr>
<tr>
<td>• ATLAS – Finance and Procurement</td>
<td></td>
</tr>
<tr>
<td>• Frontier – Plant Maintenance</td>
<td></td>
</tr>
<tr>
<td>• Aurora – Master Data Conversion and Governance</td>
<td></td>
</tr>
<tr>
<td><strong>Day 2 Landscape plus:</strong></td>
<td></td>
</tr>
<tr>
<td>• MDM</td>
<td></td>
</tr>
<tr>
<td>• CRM</td>
<td></td>
</tr>
<tr>
<td>• Sourcing</td>
<td></td>
</tr>
<tr>
<td>• SRM</td>
<td></td>
</tr>
</tbody>
</table>
Migration Project Constraints

- Identify options to split Downstream / Upstream SAP system into a standalone Downstream with current functionality
- Business downtime allowed is 5 business days
- Reduce DB size
- Data center relocation (Network bandwidth)
- HW, OS, and DB platform change
- System performance must meet or beat existing
- Improve RTO, RPO, and availability
- Use existing out dated HW initially and migrate to new virtualization HW
## Services Provided to Marathon Petroleum Company

### System Landscape Optimization Service (SLO)
- **Company Code Delete** - Remove company code dependent data from Upstream
  - Customizing
  - Master data
  - Transaction data

### OS DB Migration Service
- AIX to Windows
- Oracle to SQL Server

### Technical Consultants and Max Attention Service
- **Basis Resources**
  - Data center relocation (Kentucky → Ohio)
  - New landscape design (LPAR → VMware)
  - Post migration tasks and reconnection
- **Functional Resources**
  - SME to assist with company code delete validation
  - Recreate BW reporting requirements
- **AGS Max Attention (IT Planning, Volume Test Optimizing, and Go Live Support)**
Create a target system by performing a system copy (clone). Apply DB logs to bring copy as up to date as possible.
**ECC Migration Process – Step 2**

1. Create a target system by performing a system copy (clone). Apply system logs to bring copy as up to date as possible.

2. Perform a client (configuration only for future reference) copy to generate the pre-delete (read-only) Client **Not done in Cutover**
ECC Migration Process – Step 3

1. Create a target system by performing a system copy (clone). Apply system logs to bring copy as up to date as possible.

2. Perform a client (configuration only for future reference) copy to generate the pre-delete (read-only) Client **Not done in Cutover**.

3. Perform standard SLO Delete by Company Code (All Upstream Companies); Delete validation.
Create a target system by performing a system copy (clone). Apply system logs to bring copy as up to date as possible.

Perform a client (configuration only for future reference) copy to generate the pre-delete (read-only) Client **Not done in Cutover**

Perform standard SLO Delete by Company Code (All Upstream Companies); Delete validation

Perform an OS/DB Migration step to move system to Windows/SQL Environment **Network and/or Dump and Drive**
ECC Migration Process – Step 5

1. Create a target system by performing a system copy (clone). Apply system logs to bring copy as up to date as possible.

2. Perform a client (configuration only for future reference) copy to generate the pre-delete (read-only) Client. **Not done in Cutover**

3. Perform standard SLO Delete by Company Code (All Upstream Companies); Delete validation

4. Perform an OS/DB Migration step to move system to Windows/SQL Environment. **Network and/or Dump and Drive**

5. Post migration activities and Reconnections (Redirect interfaces to new system; Install and connect BSI; Integrate ECC, EP, and Pecaso)
**ECC Migration Process – Step 6**

1. Create a target system by performing a system copy (clone). Apply system logs to bring copy as up to date as possible.

2. Perform a client (configuration only for future reference) copy to generate the pre-delete (read-only) Client **Not done in Cutover**

3. Perform standard SLO Delete by Company Code (All Upstream Companies); Delete validation

4. Perform an OS/DB Migration step to move system to Windows/SQL Environment **Network and/or Dump and Drive**

5. Post migration activities; Reconnections; Validation (Redirect interfaces to new system; Install and connect BSI; Integrate ECC, EP, and Pecaso)

6. Catch up on parallel activity / transactions
Keys to Seamless Migration

- Perform Adequate Cycle Testing Based on Environment – Cycle 1 for baseline and subsequent cycles for continuous time reductions and tuning (3 Test Cycles, Mock, and Cutover)
- Hold Post Cycle Meetings – Better, Faster, and Cheaper
- Prioritize Key Resources – Secure non project key resource and prioritize workload
- Leverage Virtualization – Reallocations of CPU and Memory, VM backup and restore
- Migration Using Network? – Network versus Automobile (KY to OH)
- Robust Test Plan – Test everything critical to business operation
- Load and Performance Test – Validate sizing and enable tuning opportunities
- Focus On The Objective – Minimum scope and do not piggy back
**Keys Migration Highlights**

- **Deletion Process** – Went from 4+ days to 20 hours (>75% Reduction)
- **OS DB migration**
  - Cycle 1 – ~ 70 hours using Non Production Data Center (Parallel Export/Import)
  - Cycle 2 – ~ 120 hours using Production Data Center (Parallel Export/Import)
  - Cycle 3:
    - ~ 27 hours using Dump and Drive (8 export, 4 dump, 3 drive, 4 upload, 8 import)
    - ~ 64 hours using Network (8 export, 48 FTP, 8 import)
  - Mock/Cutover – ~ 27 hours using Dump and Drive (8 export, 4 dump, 3 drive, 4 upload, 8 import)
- **DB size** – before migration was 4.7TB and after migration is 1.2TB.
- **Go Live and Post Go Live issues**
  - 3 printer issues, 3 security issues, 0 business interruption issues
- **Validation of sizing** – Volume Test Optimization (VTO) testing with Production HR and TR loads
High Availability Options with Physical/Windows

SAP Single Point of Failures:
- SAP DB
- SAP stand-alone Enqueue/Message Server
- SAP CI with incorporated Enqueue/Message Server (Pre NW04s)

Examples of some HA MSCS/VCS Configuration

Challenges of Physical High Availability Solutions:
- Additional cost in terms of hardware
- Additional cost in terms of Clustering software and support
- Adds additional complexity to environment
- Then multiple by number of systems in Production and another set in QA.

DB – Database
CI – Central Instance
MSCS – Microsoft Cluster Server
VCS – Veritas Cluster Server
High Availability Options with VMware / Windows

SAP Single Point of Failures:
- SAP DB
- SAP stand-alone Enqueue/Message Server
- SAP CI with incorporated Enqueue/Message Server (Pre NW04s)

Possible High Availability Solutions:

<table>
<thead>
<tr>
<th>SAP Component</th>
<th>HA Capability</th>
<th>Features</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB, CI, ASCS, SCS</td>
<td>VMware High Availability</td>
<td>• Protection against server failure&lt;br&gt;• Restart of VM on another ESX host&lt;br&gt;• VMware out of the box configuration</td>
<td>• No application level monitoring&lt;br&gt;• Application not available during failover&lt;br&gt;• No ERS replication during CI, ASCS, SCS failover&lt;br&gt;• No Auto restart of SAP instance after failover.</td>
</tr>
<tr>
<td>DB, CI, ASCS, SCS</td>
<td>Microsoft Cluster (MSCS) / Veritas Cluster Server (VCS)</td>
<td>• Protection against server failure&lt;br&gt;• Application monitored by cluster resource&lt;br&gt;• Enables continuous availability of SAP locks due to ERS&lt;br&gt;• No guest OS boot-up during failover</td>
<td>• No VMotion of clustered VMs&lt;br&gt;• Clustered VMs cannot be part of HA/DRS.&lt;br&gt;• Application not available during failover&lt;br&gt;• Increase complexity</td>
</tr>
<tr>
<td>ASCS, SCS</td>
<td>VMware Fault Tolerance</td>
<td>• Protection against server failure&lt;br&gt;• Continuous availability of application.&lt;br&gt;• VMware out of the box configuration</td>
<td>• No application level monitoring&lt;br&gt;• Current vSphere 4.1 / 5.0 only support 1 vCPU.</td>
</tr>
</tbody>
</table>
High Availability Options with VMware / Windows

VMware HA

- VMware HA continuously monitors all ESX Server hosts in a cluster and detects failures.
- VMware HA agent placed on each host maintains a heartbeat with the other hosts in the cluster.
- Each server sends heartbeats to the others servers in the cluster at five-second intervals. If any servers lose heartbeat over three consecutive heartbeat intervals, VMware HA initiates the failover action of restarting all affected virtual machines on other hosts.
High Availability Options with VMware / Windows

VMware HA – Extended (Symantec Application HA Plug-in)

VMware integrated solution from Symantec
- Agents for DB and SAP installed in VM provide service monitoring and restart capability
- Integrated to vCenter via VMware HA API
- Application visibility from vCenter console
- Bridges gap between VMware HA and in-guest cluster solutions

(1) Attempt to restart CI in VM first
(2) If CI restart fails → VMware HA
High Availability Options with VMware / Windows

Clustering Software

- Only MSCS is supported by VMware. VCS support is by Symantec.
- Protecting SAP SPOF with MSCS on two Virtual Machine on two ESX server - SAP does not support MSCS on two Virtual Machines on the same ESX server (OSS Note 1374671 and 1613999)
- MSCS clustered virtual machines cannot be migrated via VMotion or be part of a DRS cluster.
- Installation similar to physical host
- Monitoring agents for SAP and DB
High Availability Options with VMware / Windows

VMware Fault Tolerance

- Enables a transparent failover with no disruptions of services in the event of hardware failures.
- Works with existing VMware HA or VMware DRS clusters and can be simply turned on or turned off for virtual machines.
- Limitation is the Fault Tolerance VM can only be assigned 1 vCPU.
## SAP with VMware High Availability Scenarios – Compared

<table>
<thead>
<tr>
<th>SAP in VM Scenario</th>
<th>ESX Server Protection</th>
<th>SAP Application Protection</th>
<th>Minimize OS Patching</th>
<th>Cost / Complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMware HA</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Low</td>
</tr>
<tr>
<td>VMware HA + Symantec AppHA</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Med</td>
</tr>
<tr>
<td>VMware FT</td>
<td>Yes</td>
<td>No*</td>
<td>No</td>
<td>Low</td>
</tr>
<tr>
<td>Clustering Software</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>High</td>
</tr>
</tbody>
</table>

### Final choice
- Depends on business requirements
- Can business tolerate planned downtime for software maintenance or short interruptions during host failure
- Trade-off: cost/complexity vs availability

* - Limitation of only 1 vCPU can be assigned to VM
Installation Types

Automatic Failover

- Distributed Installation
- Central Instance in one VM
- Dialog Instance in one VM
- DB Instance in one VM
- All VMs enabled for VMware HA

Note: All VMs are VMware HA enabled – SBX, DEV, QA, TRN, and Prod.

Automatic Failover + Fault Tolerance

- Distributed Installation
- Central Instance in one VM
- Dialog Instance in one VM
- DB Instance in one VM
- Standalone SCS in one VM
- Web dispatcher in one VM
- All VMs enabled for VMware HA
- SCS, WD VMs enabled for Fault Tolerance (Need to stress test)
Installation Types

Installation Standards Defined:

- Use virtual names for installation
  - "sapinst.exe SAPINST_USE_HOSTNAME = sapci00wp"
- Virtual naming standards for SAP Components (SAPXX##<SID>)
  - XX – CI (Central Instance), DI (Dialog Instance), WD (Web Dispatcher), AS (ASCS), SC (SCS)
  - ## - 00 for CI/DI, 10 for SC, 20 for AS, and 30 for WD
- Virtual naming standards for SAP DB (SAPDB<SID>)

Example

<table>
<thead>
<tr>
<th>SID</th>
<th>SAP Function</th>
<th>Instance Number</th>
<th>Virtual Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECP</td>
<td>CI</td>
<td>00</td>
<td>sapci00ecp</td>
</tr>
<tr>
<td>ECP</td>
<td>DI</td>
<td>00</td>
<td>sapdi00ecp</td>
</tr>
<tr>
<td>ECP</td>
<td>DI</td>
<td>01</td>
<td>sapdi01ecp</td>
</tr>
<tr>
<td>ECP</td>
<td>AS – ASCS</td>
<td>20</td>
<td>sapas20ecp</td>
</tr>
<tr>
<td>ECP</td>
<td>WD</td>
<td>30</td>
<td>sapwd30ecp</td>
</tr>
<tr>
<td>ECP</td>
<td>DB</td>
<td></td>
<td>sapdbecep</td>
</tr>
</tbody>
</table>
Installation Types

Central System – SBX, DEV, TRN

- Run sapinst with `SAPINST_USE_HOSTNAME = sapci00ecd`
- Run sapinst with `SAPINST_USE_HOSTNAME = sapdbecd`
- Run sapinst with `SAPINST_USE_HOSTNAME = sapci00ecd`
Installation Types

Distributed System – QA/PRD

- Optional Standalone Units
  - Adapter Engine
  - Advanced Adapter Engine Extended
    - Standard System
    - Distributed System
      - SCS Instance
      - Database Instance
      - Primary Application Server Instance
  - High-Availability System
    - First Cluster Node
    - Database Instance
    - Additional Cluster Node
    - Primary Application Server Instance
    - Additional Application Server Instance

- Additional SAP System Instances
  - Additional Application Server Instance
  - Enqueue Replication Server Instance
  - Split Off ASCS Instance from Existing Primary Application Server

- Standalone Engines
  - Content Server
  - Gateway
  - ikeCache
  - Search and Classification (TREX)
  - Diagnostics In SAP Solution Manager
  - Web Dispatcher
    - Web Dispatcher

Run sapinst with
SAPINST_USE_HOSTNAME = sapsc10pip

Run sapinst with
SAPINST_USE_HOSTNAME = sapdbpip

Run sapinst with
SAPINST_USE_HOSTNAME = sapci00pip

Run sapinst with
SAPINST_USE_HOSTNAME = sapdi00pip

Run sapinst with
SAPINST_USE_HOSTNAME = sapwd30ecp

OSS Note: 1603904 – Limited Support for standalone ASCS without MSCS on Windows
**VMware Feature Testing Results:**

<table>
<thead>
<tr>
<th>VMware Feature</th>
<th>Comment</th>
</tr>
</thead>
</table>
| Distributed Resource Scheduler / VMotion | • Central system where CI and DB reside on same VM have no issues (~4-6 mins)  
  • Distributed installations:  
    • Central Instance / Dialog Instance - with no to slight interruptions (~2-3 mins)  
    • DB Instance – Application connectivity Errors to DB (DBIF_RSQL_SQL_ERROR). Tested also a non-SAP DB load (e.g. BCP) also with error. Resolution is to go to vSphere 4.1 update 2 or vSphere 5.0 ([https://www.vmware.com/support/vsphere4/doc/vsp_esxi41_u2_rel_notes.html](https://www.vmware.com/support/vsphere4/doc/vsp_esxi41_u2_rel_notes.html))  
    • Web Dispatcher instance – no issues (~1-2 mins) |
| VMware HA               | • Restart time varies depending on the application. Below are some observations:  
  • ABAP Central / Dialog Instances - ~ 4-5 mins for OS restart and SAP to come online.  
  • Java Central / Dialog Instances - ~ 15-17 mins for OS restart and SAP to come online.  
  • DB Instance - ~4-5 mins for OS to restart and SQL Server to recover  
  • Web Dispatcher instance - ~ 3-4 mins.  
  **Note: Need to add “Autostart = 1” to START profile.** |
| VMware FT               | Worked as documented. No interruptions found during testing. |
| VMware SRM              | MPC infrastructure team is not ready to test. Planned and Work in progress. |
Marathon Petroleum SAP Landscape

<table>
<thead>
<tr>
<th>Product</th>
<th>Sandbox</th>
<th>Development</th>
<th>QA</th>
<th>Training</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI/Obj 4.0</td>
<td>BOX</td>
<td>BOD</td>
<td>BOQ</td>
<td>BOT</td>
<td>BOP</td>
</tr>
<tr>
<td>BPC 7.5</td>
<td>BPC</td>
<td>BPC</td>
<td>BPC</td>
<td>BPC</td>
<td>BPC</td>
</tr>
<tr>
<td>BW (N+1)</td>
<td>BW1</td>
<td>BW2</td>
<td>BW3</td>
<td>BWT</td>
<td>BWP</td>
</tr>
<tr>
<td>BW 7.01</td>
<td>BWX</td>
<td>BWD</td>
<td>BWQ</td>
<td>BJT</td>
<td>BJP</td>
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<td>BW Java</td>
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<td>BJD</td>
<td>BJQ</td>
<td>BJT</td>
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<td>CRX</td>
<td>CRD</td>
<td>CRQ</td>
<td>CRT</td>
<td>CRP</td>
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<tr>
<td>DS/MMM</td>
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<td>DSD</td>
<td>DSQ</td>
<td>DSP</td>
<td>DSP</td>
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<tr>
<td>ECC (N+1)</td>
<td>EC1</td>
<td>EC2</td>
<td>EC3</td>
<td>ECT</td>
<td>ECP</td>
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<tr>
<td>ECC 6.0</td>
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<td>ECD</td>
<td>ECQ</td>
<td>GAP</td>
<td>GPP</td>
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<td>GPQ</td>
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<td></td>
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<tr>
<td>GRC/PC</td>
<td>GPD</td>
<td></td>
<td>GPQ</td>
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</tr>
</tbody>
</table>

Legend:

- Saber: In place today (provisioned in 2011)
- 2012: Future (system builds expected in 2012)
## Marathon Petroleum SAP Landscape

<table>
<thead>
<tr>
<th>Product</th>
<th>Sandbox</th>
<th>Development</th>
<th>QA</th>
<th>Training</th>
<th>Production</th>
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<tbody>
<tr>
<td>OpenText</td>
<td>OCX</td>
<td>OCD</td>
<td>OCQ</td>
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<td>OCP</td>
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<tr>
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<td>PCD</td>
<td>PID</td>
<td>PIQ</td>
<td></td>
<td>PCP</td>
</tr>
<tr>
<td>PI 7.3</td>
<td>PIX</td>
<td>EP2</td>
<td>EP3</td>
<td></td>
<td>PIP</td>
</tr>
<tr>
<td>Portal (N+1)</td>
<td>EP1</td>
<td>EP2</td>
<td>EP3</td>
<td></td>
<td>EPT</td>
</tr>
<tr>
<td>Portal 7.01</td>
<td>EPX</td>
<td>EPD</td>
<td>EPQ</td>
<td></td>
<td>EPP</td>
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<td>Portal Extranet</td>
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<td>SBD</td>
<td>XPQ</td>
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<td>SBD</td>
<td>SMD</td>
<td>SBP</td>
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<tr>
<td>SolMan 7.01</td>
<td>SOX</td>
<td>SOD</td>
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<td>SMP</td>
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<tr>
<td>Sourcing</td>
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<td>SRD</td>
<td>SRQ</td>
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<td>SOP</td>
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<tr>
<td>SRM</td>
<td>TDD</td>
<td>UPF</td>
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<tr>
<td>TDMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>UPF</td>
</tr>
</tbody>
</table>

**Legend:**
- **Saber**
- In place today (provisioned in 2011)
- 2012
- Future (system builds expected in 2012)
Server Architecture – Blueprint Design

Sandbox  Development  Quality Assurance  Training  Production

SAP Solution Manager 7.01 (A+J)

SMD

OS
CI (SAPC/SMO)
DB (SAPD/SMO)
MDS5700

SMP

OS
CI (SAPC/SMO)
DB (SAPD/SMO)
MPS5700

OS
DB (SAPD/SMO)
MPS5709

SAP PI 7.3 SP03 (A+J)

PIX

OS
CI (SAPC/PIX)
DB (SAPD/PIX)
MSS5710

PIQ

OS
CI (SAPC/PIQ)
MPS5710

OS
DB (SAPD/PIQ)
MTS5710

OS
DB (SAPD/PIQ)
MTS5719

PIP

OS
CI (SAPC/PIQ)
MPS5717

OS
SAPC/PIQ
MTS5717

OS
SAPC/PIQ
MTS5719

OS
SAPC/PIQ
MP5717

OS
DB (SAPD/PIQ)
MP5719

OS
DB (SAPD/PIQ)
MPS5716

OS
DB (SAPD/PIQ)
MPS5719

OS
DB (SAPD/PIQ)
MPS5716

xxx5710 – SAP App Server (Central Instance)
xxx5711 – SAP App Server (Dialog Instance)
xxx5716 – Web Dispatcher
xxx5717 – SAP Msg/Enque Server
xxx5719 – SQL DB (for SAP PI)
## Estimating Hardware Requirements / Budgeting

| DateReq | Server | System | Env | SID | FUNCTION     | vCPUs | RAM  | FT | Dsk1 | Dsk2 | Dsk3 | Dsk4 | Dsk5 | Dsk6 | Dsk7 | Dsk8 | Dsk9 | Dsk10 |
|---------|--------|--------|-----|-----|--------------|-------|------|----|------|------|------|------|------|------|------|------|------|------|------|
| 3/7/2011 | MDS5700 | S01Mgr | Dev | SMD | CI/DB        | 4     | 16   |    |      |      |      |      |      |      |      |      |      |      |
| 9/5/2011  | MDS5760 | BPC    | Sbx | BPC | BPC.Net      | 2     | 4    |    |      |      |      |      |      |      |      |      |      |      |
| 3/7/2011  | MDS5760 | BPC    | Dev | BPC | BPC.Net      | 2     | 4    |    |      |      |      |      |      |      |      |      |      |      |
| 4/4/2011  | MDS5760 | BPC    | QA  | BPC | BPC.Net      | 4     | 8    |    |      |      |      |      |      |      |      |      |      |      |
| 10/3/2011 | MS55760 | BPL    | TM  | BPL | BPL.Net      | 2     | 4    |    |      |      |      |      |      |      |      |      |      |      |
| 9/5/2011  | MDS5710 | PL     | Sbx | PIX | CI/DB        | 4     | 16   |    |      |      |      |      |      |      |      |      |      |      |
| 1/9/2011  | MDS5711 | PI     | Sbx | PIE | CI/DB        | 4     | 16   |    |      |      |      |      |      |      |      |      |      |      |
| 3/7/2011  | MDS5710 | PI     | Dev | PID | CI/DB        | 4     | 16   |    |      |      |      |      |      |      |      |      |      |      |
| 5/13/2011 | MDS7510 | PI     | QA  | PIQ | CI          | 4     | 16   |    |      |      |      |      |      |      |      |      |      |      |
| 5/13/2011 | MDS7510 | PI     | QA  | PIQ | DI          | 4     | 16   |    |      |      |      |      |      |      |      |      |      |      |
| 5/13/2011 | MDS7516 | PI     | QA  | PIQ | WD          | 1     | 4    |    |      |      |      |      |      |      |      |      |      |      |      |
| 5/13/2011 | MDS7517 | PI     | QA  | PIQ | ASCS/SCS   | 1     | 4    |    |      |      |      |      |      |      |      |      |      |      |
| 5/13/2011 | MDS7519 | PI     | QA  | PIQ | DB          | 4     | 32   |    |      |      |      |      |      |      |      |      |      |      |      |
| 7/1/2011  | MDS5750 | Portal | Sbx | PX  | CI/DB        | 4     | 16   |    |      |      |      |      |      |      |      |      |      |      |

**Note:** The table includes columns for the date, server name, system, environment, SID, function, vCPUs, RAM, and various disk sizes.
## MPC Aggregate Server Requirements for SAP Hosting

<table>
<thead>
<tr>
<th>SAP Infrastructure</th>
<th>Non-Production Data Center</th>
<th>Production Data Center</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2011</td>
<td>2012</td>
</tr>
<tr>
<td>Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servers</td>
<td>55</td>
<td>74</td>
</tr>
<tr>
<td>Cores</td>
<td>194</td>
<td>239</td>
</tr>
<tr>
<td>RAM (GB)</td>
<td>784</td>
<td>1,068</td>
</tr>
<tr>
<td>Storage (TB)</td>
<td>27</td>
<td>29</td>
</tr>
<tr>
<td>HP Blades*</td>
<td>4.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

*HP BL685c G7 Blade Server 48 Core/512GB per Blade

### Production SAP Systems (not all systems shown)

<table>
<thead>
<tr>
<th>System</th>
<th>Servers</th>
<th>Cores</th>
<th>RAM (GB)</th>
<th>Storage (TB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW ABAP and Java</td>
<td>5</td>
<td>24</td>
<td>128</td>
<td>2.00</td>
</tr>
<tr>
<td>CRM</td>
<td>3</td>
<td>8</td>
<td>32</td>
<td>1.00</td>
</tr>
<tr>
<td>DataServices/MDM</td>
<td>3</td>
<td>20</td>
<td>136</td>
<td>1.00</td>
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<tr>
<td>ECC</td>
<td>5</td>
<td>21</td>
<td>116</td>
<td>5.00</td>
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<tr>
<td>GRC</td>
<td>4</td>
<td>16</td>
<td>64</td>
<td>0.50</td>
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<tr>
<td>PI</td>
<td>5</td>
<td>14</td>
<td>72</td>
<td>0.75</td>
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<tr>
<td>Portal (intranet)</td>
<td>4</td>
<td>13</td>
<td>68</td>
<td>1.00</td>
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<tr>
<td>Solution Manager</td>
<td>2</td>
<td>8</td>
<td>32</td>
<td>0.50</td>
</tr>
<tr>
<td>Sourcing</td>
<td>4</td>
<td>12</td>
<td>48</td>
<td>1.00</td>
</tr>
<tr>
<td>SRM</td>
<td>5</td>
<td>16</td>
<td>80</td>
<td>1.00</td>
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<tr>
<td><strong>Totals</strong></td>
<td>40</td>
<td>152</td>
<td>776</td>
<td>13.75</td>
</tr>
</tbody>
</table>
Marathon Petroleum SAP Data Centers

1000 mbps WAN to support SAN Replication, Backup Replication, General Network
<table>
<thead>
<tr>
<th>VMWare Cloud (Core Infrastructure Only*)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ESX Version</td>
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<td></td>
</tr>
<tr>
<td>Number of ESX Hosts</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Virtual Machines</td>
<td>1200</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VM SAP Footprint</th>
<th>Non-Production Data Center</th>
<th>Production Data Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESX Hosts</td>
<td>7 (expanding to 10)</td>
<td>6 (expanding to 10)</td>
</tr>
<tr>
<td>Virtual Machines</td>
<td>129</td>
<td>61</td>
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<tr>
<td>Storage (TB)</td>
<td>27</td>
<td>11</td>
</tr>
<tr>
<td>FC RAID-1</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>FC RAID-5</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>SATA RAID-6</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

VMWare Options Utilized

- Highly utilizing DRS to move VMs between hosts
- Storage DRS to move virtual disks between datastores
- Leveraging FastVP on the Symmetrix arrays to move storage between tiers
- VMWare HA
- PowerPath/VE

Blade Hardware

- HP BL685c G7 Blade Server (48 Core/512GB per Blade)
- 4x AMD Opteron processors (12-cores per processor)
- 512GB RAM
- 4x 10Gbit teamed NICs with Fiber Channel over Ethernet
SAP Backup Replication

Non-Production Data Center
- NetBackup File and System State Backups
  - Weekly - Full
  - Daily - Incremental
- SQL Server Agent Database Backups
  - Full - Daily Log - Hourly
- Non-replicated DD Sandbox and Training Backups
  - Full - Daily Log - Hourly

Production Data Center
- Instantaneous Replication
- Once a Day Replication
- Instantaneous Replication
- No Replication Local Copy Only

Data Domain Backup Appliance
- \FDYDDS\SVR001\SAPPROD
- \FDYDDS\SVR001\SAPTEST
- \FDYDDS\SVR001\SAPLOCAL

NetBackup Area
- \FDYDDS\SVR001\SAPPROD
- \FDYDDS\SVR001\SAPTEST
- \FDYDDS\SVR001\SAPLOCAL

SAP CI
SAP DI
SAP DB
SAP DB

SQL Server Agent Database Backups
- Full - Daily Log - Hourly

NetBackup File and System State Backups
- Weekly - Full
- Daily - Incremental

Non-replicated DD Production Area for non-replicated database backups

Real Experience. Real Advantage.
Marathon Petroleum – Challenges

- Monthly Windows OS Patching
- Backup / restore times for large databases
  - Restore times slow system copies
- VM sprawl for all the various SAP products/landscapes
  - 2011 – 89 virtual servers for SAP
  - 2012 – expanding to 190 virtual servers for SAP
Marathon Petroleum – Lessons Learned

- Establish Infrastructure Naming Standards
  - For servers, security groups, SAP SIDs, etc.
  - Keep good documentation
- You will need more servers than you think
  - Test, Dev, Sandbox, Evaluations, N+1
- You must have adequate RAM allocations (and CPU)
  - RAM more important than CPU
  - Java Stacks have heavy RAM footprint
- ESX 5.x provided much needed room for growth
  - Vertical vs. horizontal scaling
  - Still waiting for better VMWare Fault Tolerance
Marathon Petroleum – What’s Next

- Complete New Projects
- Implement New SAP modules
- Expand Use of BI and PI
- Improvements to RTO
- SAN Replication and SRM (VMWare Site Recovery Manager)
- Eliminate Single Points of Failure (more use of DB mirroring)
- Application HA
- Improvements in Backup/Restore (Performance, BMR, etc)
- Data Archiving – Reclaiming storage
- Evaluate SAP HANA
Learning Points - Summary

- Quickly provision infrastructure to support SAP rapid and agile deployment
  - Virtualization allowed for very rapid deployment
  - Flexibility
  - Good utilization of both processing and storage

- SAP high availability at reasonable costs with low complexity
  - Built-in VMWare HA provides very easy out-of-the-box HA
  - Consistent HA across various applications and server types

- SAP Virtualization at Marathon Petroleum – (lessons learned)
  - Adequate RAM is extremely important
  - IO is still king
Questions

Thank You!
Thank you for participating.

Please remember to complete and return your evaluation form following this session.

For ongoing education on this area of focus, visit the Year-Round Community page at www.asug.com/yrc
Windows Implementation Recommendations

Supported Hardware
- SAP supports all x64 based CPUs of the newer generations designed for Virtualization:
  - AMD-V or Intel VT (2006)

Supported Software
- Guest OS – SAP only supports Windows 64-bit operating system
- SAP supports 64-bit versions of SAP NetWeaver on VMware virtual infrastructure:
  - SAP NetWeaver 2004 (SAP Kernel 6.40) and above
  - BPC – OSS Note 1098847 (Virtual Machine Support for BPC)
  - MDM – OSS Note 1070760 (Running a virtual machine and MDM)
  - CRM Mobile Laptop – OSS Note 1336014
  - Business Objects – OSS Note 1223407 and 1303814
- VMware ESX Server 3.x, 4.x, and 5.x (vSphere)
- Microsoft Hyper-V on Windows Server 2008 and Windows Server 2008 R2
Virtual Machine Memory

- Must be reserved and ‘right-sized’ (i.e. set the reserved memory to the amount of memory the SAP instance or the database instance allocates). The memory reservation must be enforced in the productive SAP usage to guarantee the full configured amount of memory for the SAP application server or the database server. Memory over-commitment is not desired.

  Note: Reserving memory may limit VMotion – A virtual machine can only be migrated to the target ESX host that has free physical memory equal to or greater the size of the reserve

- Choose Optimum Memory Model - CPU bound Virtual Machines use “Flat Memory”
  1002587 - Flat Memory Model on Windows
Virtual CPU

- Setting a CPU Reservation sets a guaranteed CPU allocation for the virtual machine. **This practice is generally not recommended**, since the reserved resources are not available to other virtual machines and flexibility is often required to manage changing workloads.

Note that SAP has conducted tests on virtual CPU over-commitment, which is documented in OSS Note 1122388, and shows the performance degradation inside the virtual machines is linearly reciprocal to the over-commitment. As the performance degradation is “graceful,” any virtual CPU over-commitments can be effectively managed by using vMotion to migrate virtual machines to other ESX hosts to obtain more processing power.

- While larger virtual machines are possible in vSphere, VMware recommends reducing the number of virtual CPUs if monitoring of the actual workload shows that the SAP application is not benefitting from the increased virtual CPUs.
Windows Implementation Recommendations

SQL Server

- On a SAP central system, the same VM is shared by SQL Server and the SAP Central instance, recommendation is to allocate 30% to 40% of the memory to the SQL Server.

- On a dedicated database server with no other application service is running on the same server where SQL Server is installed. Recommendation is to leave roughly between 1.5GB (when having 8GB or less memory) and 6GB (when having 64GB or more memory).

- On SAP systems, SAP recommend setting the minimum and maximum server memory to the same value to avoid dynamic allocations.

Refer to OSS Note 1237682
Windows Implementation Recommendations

SAP Support Requirement

- Activate advanced SAP system monitoring
  - For SAP NetWeaver 7.2 or newer: Transaction ST06
  - For SAP NetWeaver 7.01, 7.02, 7.10 and 7.11: Transaction OS07
  - For SAP NetWeaver 6.40 and 7.00: Transaction OS07N

- Refer to Note 1409604 - Virtualization on Windows: Enhanced monitoring for information and steps on enable the monitoring for SAP systems running on Virtual Machines.

- SAP Note 1158363 - "vm-support" - Exporting Diagnostic Data from VMware – provides a description of information necessary for the SAP/VMware support in case of troubleshooting.
Additional Information

- 1409608 – Virtualization on Windows
- 1056052 – Virtualization: VMware ESX 3.x or vSphere Configuration guidelines
- 1409604 – Virtualization on Windows: Enhanced Monitoring
- 1260719 – SAPOSCCOL: Detailed virtualization data
- 1158363 - "vm-support" - Exporting Diagnostic Data from VMware – provides a description of information necessary for the SAP/VMware support in case of troubleshooting.
- SAP Solutions on VMware vSphere: High Availability: 
- Virtualized SAP Performance with VMware vSphere 4: 
- Configuration Maximums VMware® vSphere 4.0 and vSphere 4.0 Update 1
- Configuration Maximums VMware® vSphere 5.0
Sizing Approach

Since this is not a new installation but rather categorize more of a migration project, decision was to calculate current capacity and match it on x86 HW.

- IBM provided number of SAPS for each LPAR for existing.
- MPC IT HW building blocks were “HP ProLiant BL685c G7 Server Blade, four AMD Opteron 6176 12-core/2.3Ghz processors per blade, 512GB RAM per blade” as the SAP Cluster Pool.
- Leverage similar publish SAP benchmarks on similar hardware to determine SAPs per core ~ 1000 SAPS/core (Validated with HP)

<table>
<thead>
<tr>
<th>Key Considerations for Virtualization:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• SAP Applications can scale horizontally (8 vCPU is not a limiting factor)</td>
</tr>
<tr>
<td>• Will DB instance fit within the boundaries of vSphere 4.1 (8 vCPU/IOPS)</td>
</tr>
</tbody>
</table>
### Installation Selections:

#### Meet Current Business SLA Requirement:
- Datacenter Outage: RTO – 72 hours / RPO – 24 hours
- Local Server Outage: No HA implemented in as-is

#### Leverage Overall IT strategy on VMware for SAP:
- Use Hypervisor capability for HA (e.g. VMware HA and Fault Tolerance)
- Need to be able to leverage Site Recovery Manager and EMC replication for DR
- Reduce complexity and limit the number of vendors in the solution (e.g. MS, SAP, VMware)
  - MS CS solution was discouraged because of their previous experience and reduced VMware capabilities
  - Symantec Application HA not considered because of another vendor support in the stack

### Table: Cost / Complexity

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Automatic Failover</th>
<th>Low Continuous Availability</th>
<th>High Continuous Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solutions</td>
<td>VM HA</td>
<td>VM HA + VM FT</td>
<td>VM HA + VM FT + MSCS + DB Mirror</td>
</tr>
<tr>
<td>MPC Categorization</td>
<td>SolMan</td>
<td>GRC PC</td>
<td>BI 4.x</td>
</tr>
<tr>
<td></td>
<td>BPC</td>
<td>GRC AC</td>
<td>HP QC</td>
</tr>
<tr>
<td></td>
<td>BW</td>
<td>Pecaso</td>
<td>ARIS</td>
</tr>
<tr>
<td></td>
<td>EP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Initial Build Out Day 1 and Day 2*

*Possible Day 3 - Future*
Marathon Petroleum Data Center

Core Software in Use
- VMware ESXi 5.0
- Windows 2008 R2 EE
- SQL Server 2008 R2
- Symantec NetBackup 7.1

Media Types
- EFD 400 GB
  25 total, 1 for spare
- FC 15K 450 GB
  68 total, 4 for spare
- SATA 7.2K 2,000 GB
  52 total, 4 for spare

Storage Pools
- EFD Raid-1
  2.2 TB Usable
- EFD Raid-5
  5.2 TB Usable
- FC Raid-1
  3.5 TB Usable
- FC Raid-5
  16.4 TB Usable
- SATA Raid-6
  63.6 TB Usable

Real Experience. Real Advantage.
Storage Layout – Blueprint Design

EMC Symmetrix VMAX SAN with FAST

- **Flash Storage**
  - EFD Raid-1: 2.2 TB Usable
  - EFD Raid-5: 5.2 TB Usable

- **Fiber Channel**
  - FC Raid-1: 3.5 TB Usable
  - FC Raid-5: 16.4 TB Usable

- **SATA**
  - SATA Raid-6: 63.6 TB Usable

**EFD 400 GB**
- 25 total, 1 for spare

**FC 15K 450 GB**
- 68 total, 4 for spare

**SATA 7.2K 2,000 GB**
- 52 total, 4 for spare

Legend:
- Virtual Server
- VMware Data Store
- Logical Unit