Performance Testing Best Practices

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Agenda

- Introduction
- Performance Testing
  - Planning
  - Development
  - Execution & Analysis
- Rapid Load Testing
- Q & A

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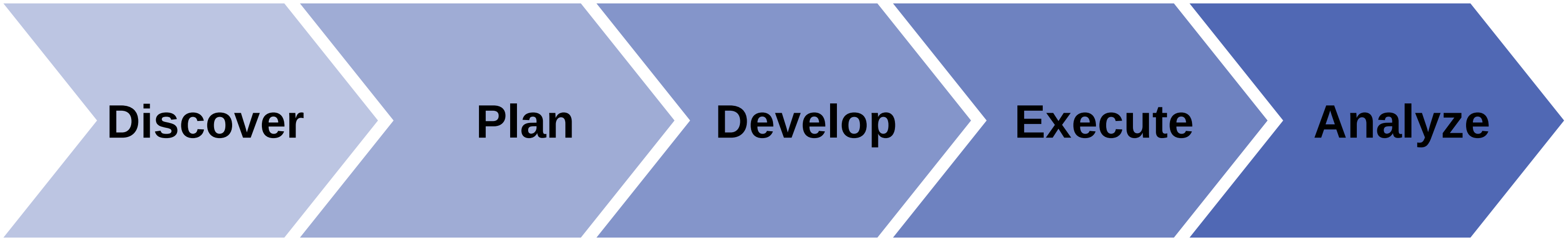
Performance Testing Process



Discover

Plan

Develop

Execute

Analyze

Terms

- **Load Generator** - Machine dedicated to hosting Virtual Users during a load test
- **Performance Test** - Often used as a general term for multi-user test. Specifically, a test that measures a system’s performance under varying conditions.
- **System Under Test** - The system that is the target of a performance test
- **Test Controller** - The machine hosting the software responsible for controlling execution of a performance test
- **Test Environment** - The environment (including all hardware and software) in which a performance test will be executed
- **Test Scenario** - The definition of the load test (e.g. number of virtual users, load distribution, load profile, etc.)
- **Test Scripts** - Script defining the actions that will be performed by the virtual users during the load test
- **Virtual User (Vuser)** - An instance of a load test script that emulates the actions of a real system user.

Resource Requirements

- Performance Test Engineer
  - Performance test process expertise
  - Test tool expertise
  - Coding experience
  - Familiarity with technology of system under test
  - Familiarity with functionality of system under test

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Discover Phase Activities

- Establish test objectives
- Research user and load profiles
- Investigate system under test

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Establish Test Objectives

- Test objectives must be clear and measurable
- Two main objective types
  - Is it good enough?

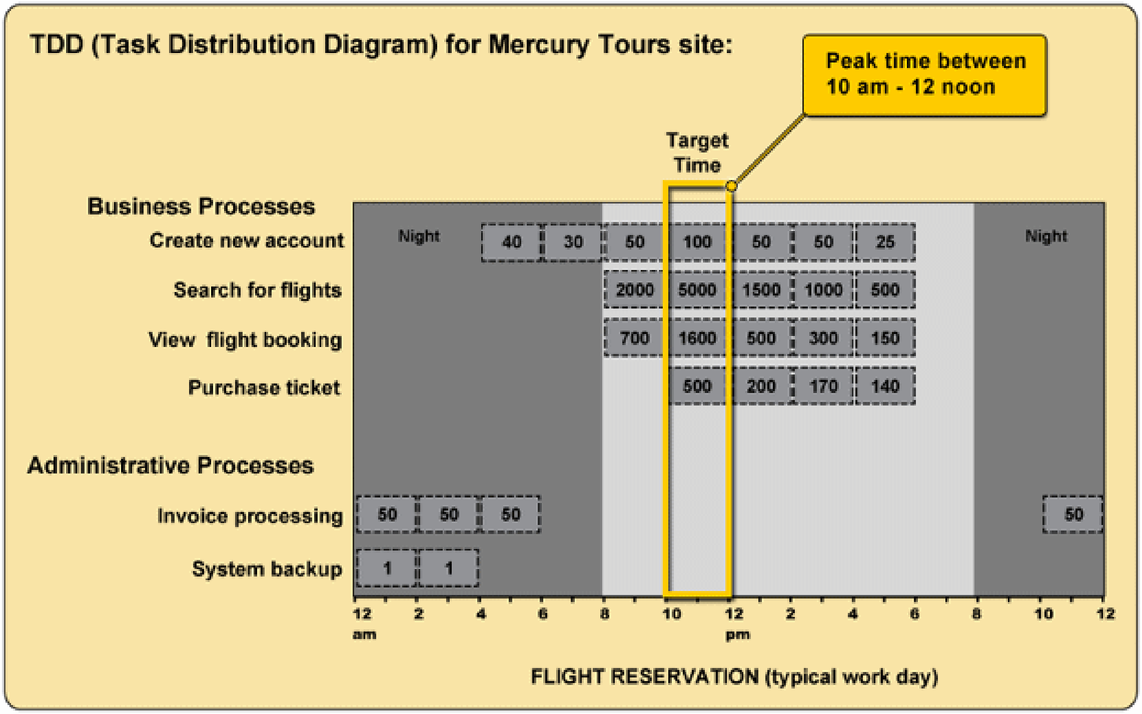
The Display Search Results transaction must complete in less than 30 seconds under a concurrent load of 50 users

  - How good is it?

Benchmark system response time and internal metrics under a concurrent user load of 750 users

Research User Profiles

- User Profiles define how the system is/will be used in the “real world”



TDD (Task Distribution Diagram) for Mercury Tours site:

Peak time between 10 am - 12 noon

	12am–2	2–4	4–6	6–8	8–10	10–12pm	12pm–2	2–4	4–6	6–8	8–10	10–12
Business Processes												
Create new account			40	30	50	100	50	50	25			
Search for flights					2000	5000	1500	1000	500			
View flight booking					700	1600	500	300	150			
Purchase ticket						500	200	170	140			
Administrative Processes												
Invoice processing	50	50	50									50
System backup	1	1										

FLIGHT RESERVATION (typical work day)

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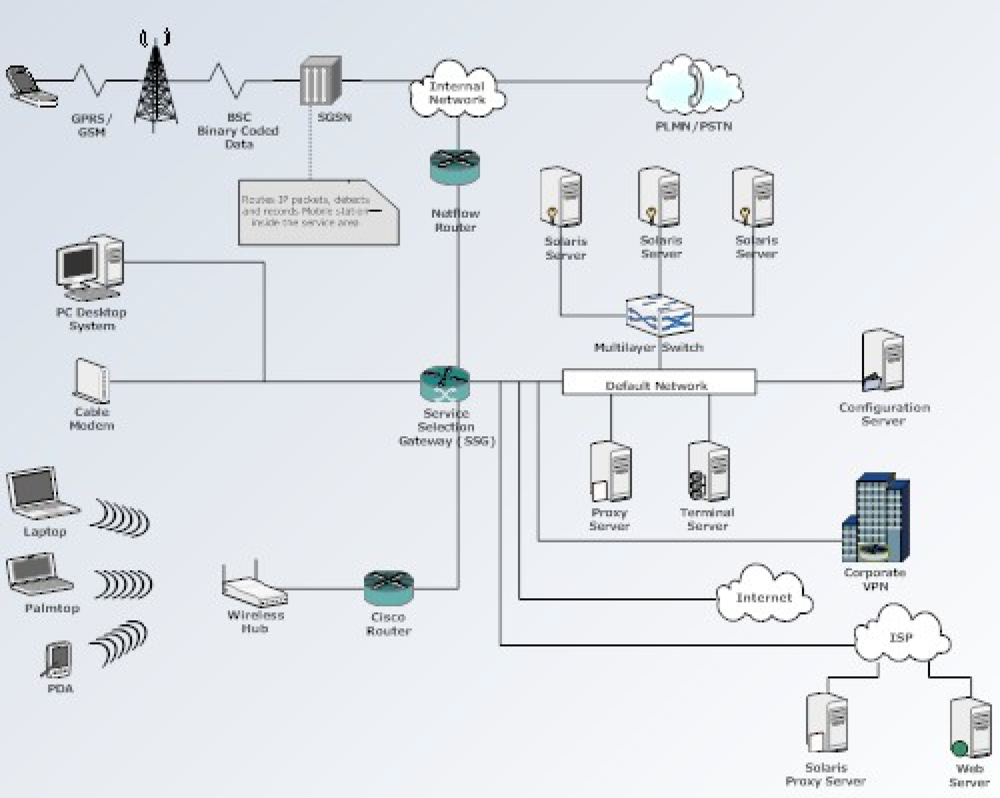
Investigate System Under Test



- Hardware
- Software
- Network Topology
- User Access Methods
- Test Considerations
  - WAN Simulation
  - Load Balancing

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Plan Phase Activities

- Select and document business processes
- Identify test data requirements
- Create test data management strategy
- Identify test scenarios (who, what, how many, and how long)
- Identify monitoring requirements
- Create test plan

PLANNING WILL MAKE OR BREAK A PROJECT

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Identify Business Processes

- Business Process = series of user actions that accomplish a business goal within a system
  - Amazon.com
    - User registration, search for title, purchase book
  - Oracle Financials
    - Create PO, post journal entry, create account
  - Warehouse Mgmt. System
    - Adjust Inventory, pick order, ship order

- Including 100% of system functionality is not practical

So what do we do?

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Business Process Selection

- Business critical
- High concurrency
- High throughput
- Heavy resource usage
- 80/20 Rule

DO NOT FOCUS ON FUNCTIONAL COVERAGE

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Business Process Selection

Business Process	Max Concurrency	Throughput		Resource Usage	Business Critical	Script
		Typical	Peak			
Login	50	15/hr	180/hr	Low	High	?
User Registration	10	5/hr	15/hr	Low	High	?
Search for Products	150	115/hr	225/hr	Medium	High	?
View Product Warranty	25	10/hr	15/hr	Low	Low	?
Purchase Product	35	35/hr	85/hr	High	High	?

Business Process Documentation

Hire Job Applicant

Login
Sort applicants
Hire applicant
Logout
Login
Approve hire
Logout

Business Process Documentation

Hire Job Applicant

Action	Data Requirements	Measure
Login to HRIS system as a Manager	HM_test_01 (volume of HM user ID's dependent on number of Vusers for this BP)	Yes
Navigate to Manage Applicants		
Sort applicants by Job Number	Job Number with active applicants (required volume TBD the number of Vusers x script iterations)	Yes
Select first employee in the list		
Press Hire Employee button		Yes
Logout of HRIS		
…		

Identify Test Data Requirements

- Two key data types
  - – Data input by test scripts
  - – Existing system data touched by test scripts
- Two key requirement types
  - – Content (driven by business process actions)
  - – Volume (driven by quantity of users and length of test)

YOU MUST UNDERSTAND TEST DATA REQUIREMENTS TO BE SUCCESSFUL

*Test data issues and techniques discussed later

Identify Test Data Requirements

Business Process Step Examples		
Create a single line order using the following data parameters: **Customer:** Any active customer with approved credit > US$100,000 **Order Type:** Customer Credit **SKU range:** LU10001-LU10100 **Qty range:** 10-20		

Identify Test Data Requirements

Business Process Step Examples	Data Requirements	
Create a single line order using the following data parameters: **Customer:** Any active customer with approved credit > US$100,000 **Order Type:** Customer Credit **SKU range:** LU10001-LU10100 **Qty range:** 10-20	Active Customer Products within SKU range of LU10001 through LU10100	

Identify Test Data Requirements

Business Process Step Examples	Data Requirements	Additional Considerations
Create a single line order using the following data parameters: **Customer:** Any active customer with approved credit > US$100,000 **Order Type:** Customer Credit **SKU range:** LU10001-LU10100 **Qty range:** 10-20	Active Customer Products within SKU range of LU10001 through LU10100	Volume of active customers must be sufficient to avoid unrealistic DB cache. A script data file containing the active customers to select must be created. Customers must have sufficient remaining credit to process required orders. A script data file containing the product SKU's must be created. Products in specified SKU range must have sufficient inventory for the volume of orders required for the test

Create Test Data Management Strategy

- How do we refresh the test data before each execution?
  - – Restore DB from “golden” copy
  - – Load empty database
  - – “Undo” transactions from previous execution
- Right approach will vary from system to system
- Performed once per system/environment

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Identify Test Scenarios

- Test scenarios define what “happens” during a load test
  - – Quantity of virtual users (from test objectives)
  - – Business process distribution (from user profile)
  - – Load Profile (shape of load curve)
- Typically 1 to 1 ratio between test objectives and scenarios

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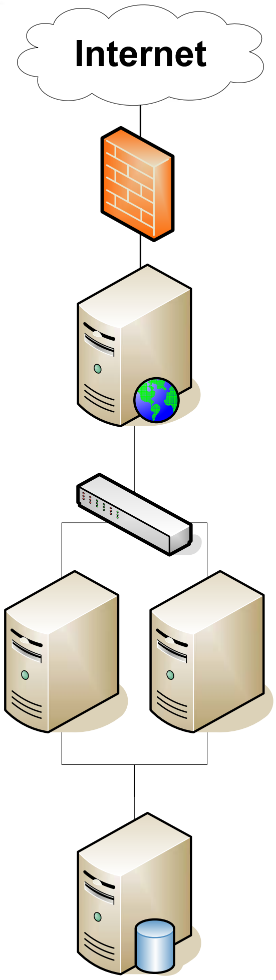
Identify Monitoring Requirements



User experience?

Firewall configured optimally?

Throughput?

Load balanced appropriately?

CPU Utilization?

Connection pooling?

- Response time is a symptom – you want the cause!
- Gather monitoring requirements from system experts
  - DBA's
  - Server administrators
  - Network administrators
  - Operations
- Too late to capture data after execution

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Create Test Plan

- Test plan captures output from planning activities…
  - Test objectives
  - Business processes
  - User & load profiles
  - Test environment
  - Roles and responsibilities

… and becomes the guide for the Develop and Execute phases

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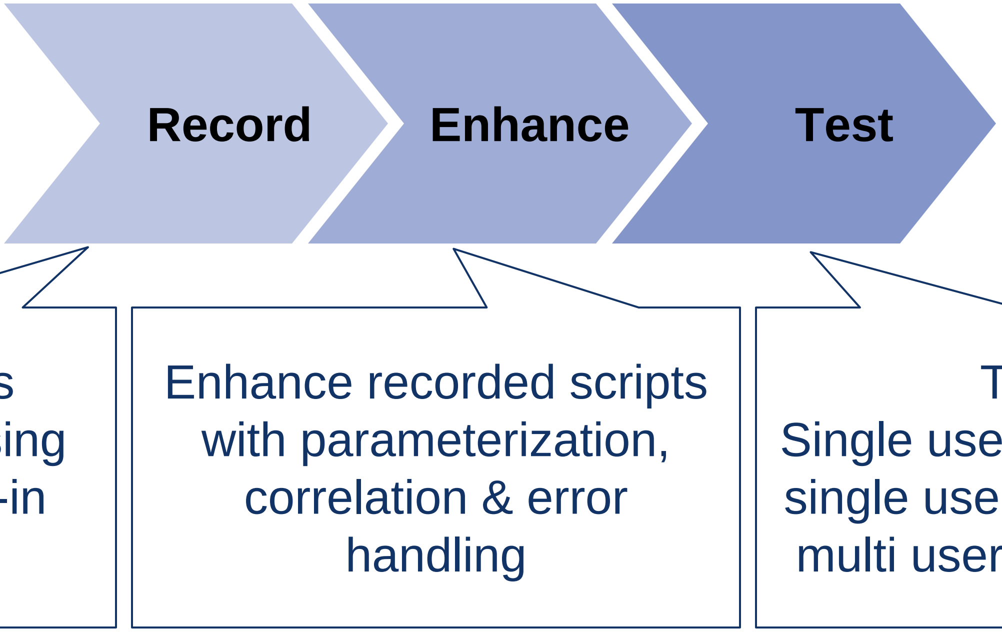
Develop Phase Activities

- Create test scripts
- Create test data
- Create test scenarios
- Install/configure monitors
- Execute “shakedown” test

Create Test Scripts



Record

Enhance

Test

Record business process actions using testing tool's built-in features

Enhance recorded scripts with parameterization, correlation & error handling

Test for:
Single user, single iteration
single user, multi iterations
multi user, multi iterations

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Create Test Scripts - Parameterize

- Why Parameterize?
  - Unique data constraints
  - Date constraints
  - Prevent possible DB caching
- Methods
  - Read from external file
  - Built in parameter types
  - Custom Code

PARAMETERIZE ONLY WHAT'S NECESSARY

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Create Test Scripts - Correlate

- What is correlation?
  - Using output of one script step and input in a subsequent step
- Why Correlate?
  - Dynamic data from server
  - Input dependent on output from previous step
- Methods
  - Built-in tool utilities
  - Custom code

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Create Test Data

- May have to create BOTH input data and underlying system data
  - – Volume of input data dependent on business process and user volumes
  - – Size of underlying system DB should be realistic
- Various techniques:
  - – Extract input data from DB
  - – Populate test DB from production
  - – Generate from scratch (SQL or test tool)

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Create Test Scripts – Think Time

- Think time represents periods of user inactivity
  - Vary think time by user type (e.g. beginner vs. advanced)
  - Can be used to simulate throughput of a greater number of virtual users (BE CAREFUL)
- Think time should not be inserted in response time measurements

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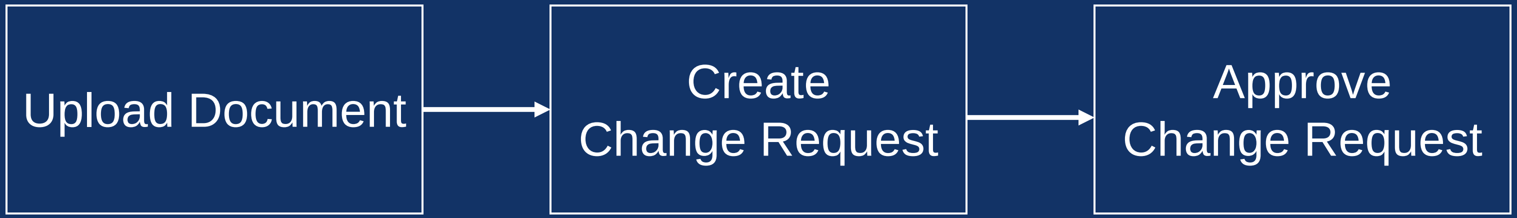
Scripting & Test Data Dependencies

Case Study - Document Management System

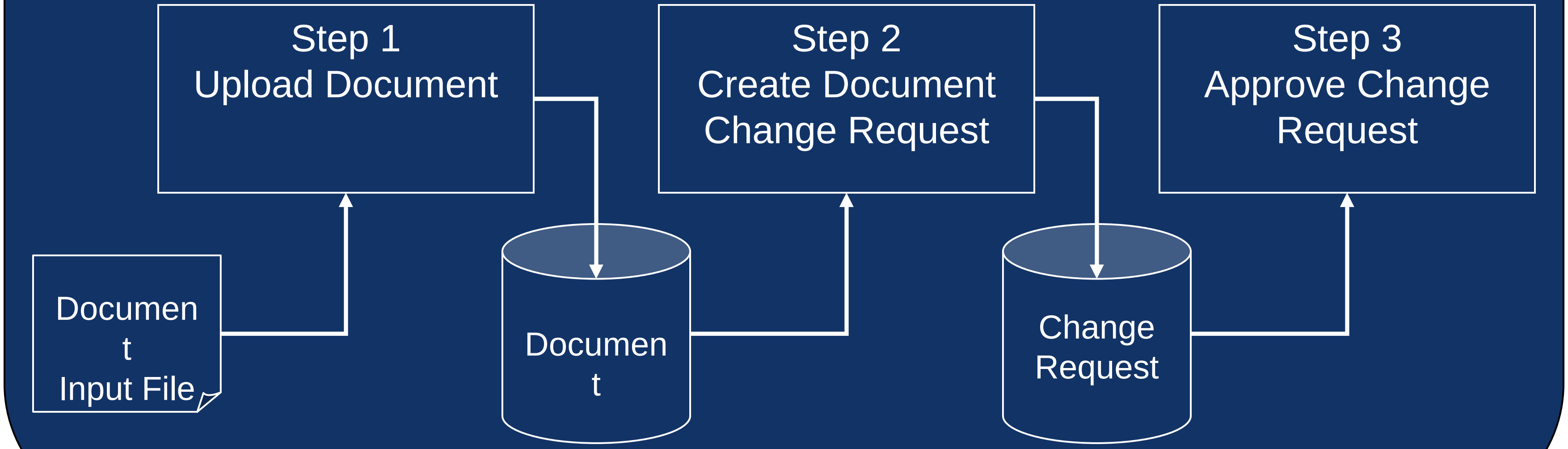
- 100 Users, 3 Business Processes
  - Upload document (20%)
  - Create change request (50%)
  - Approve change request (30%)
- Process Flow:



Scripting & Test Data Dependencies

Case Study - Document Management System

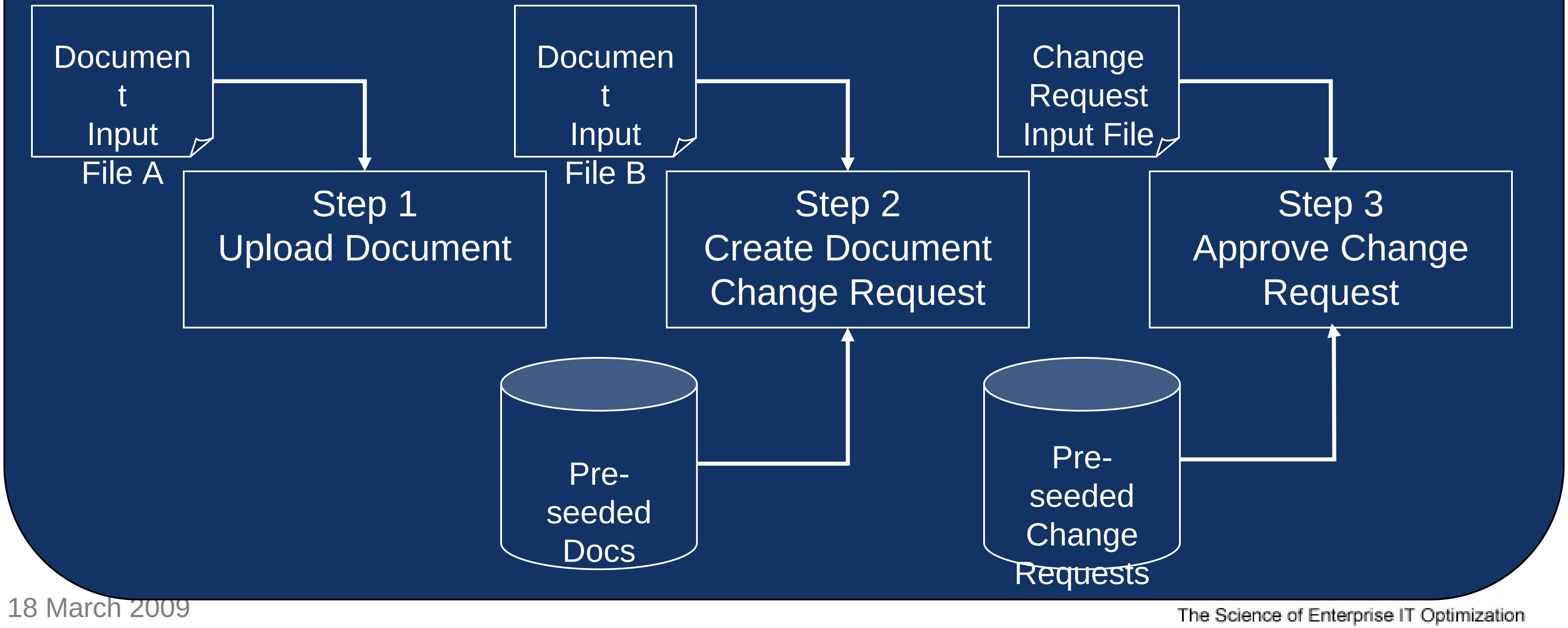
- Option 1 – One input file and script for all 3 BP's



Scripting & Test Data Dependencies

Case Study - Document Management System

- Option 2 – Separate scripts and input files for each BP



Document Input File A

Step 1 Upload Document

Document Input File B

Step 2 Create Document Change Request

Pre-seeded Docs

Change Request Input File

Step 3 Approve Change Request

Pre-seeded Change Requests

Create Test Scenarios

- Ensure test scenario(s) satisfy objectives
  - Basics
    - Quantity and distribution of virtual users
    - Load profile (ramp-up, steady state, ramp-down)
  - Advanced
    - Execution speed
    - Bandwidth emulation
    - IP spoofing
    - Browser settings
    - Etc…
- Scenario input derived from Plan phase

Install/Configure Monitors

- Common issues
  - – Inadequate permissions
  - – Monitoring over firewalls
  - – Failure to monitor load generators
- Discuss monitoring requirements with appropriate resources prior to execution
- Test tool monitors may not be enough

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Execute Shakedown Test

- Low volume execution of all business process scripts in target environment
- Ensures test readiness (system)
    - Test environment setup
    - System under test installed and configured
    - Test tool & monitors installed and configured
    - Scripts function correctly

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Execute & Analyze Phase Activities

- Ensure test readiness (organization)
- Execute test scenarios
- Evaluate high-level results
- Log test session
- Analyze results in detail
- Rinse & repeat as necessary

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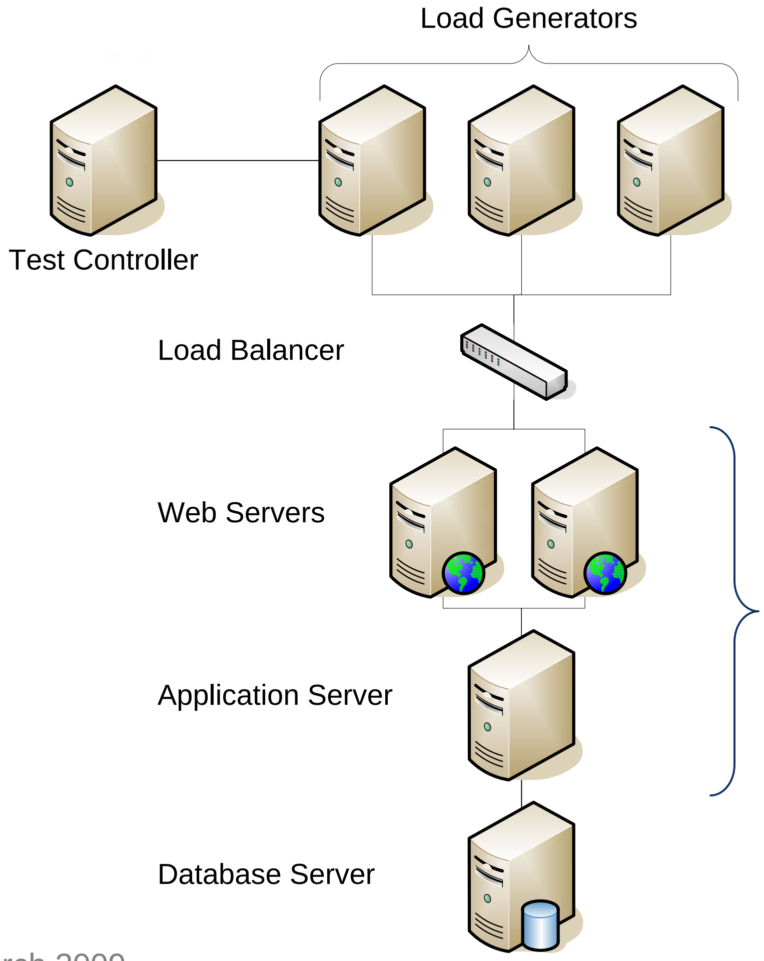
Ensure Test Readiness

- Execution Entry Gate Criteria
  - Shakedown test successful
  - Execution schedule understood and confirmed by ALL resources

Weekly Test Schedule							
	10/16	10/17	10/18	10/19	10/20	10/21	10/22
8:00		Reset Env.					
9:00				Reset Env.			
10:00		Benchmark Run					
11:00			Run 2		Run 3		
12:00							
13:00		Reset Env.					
…							

Team Execution



Performance Testing & Tool Experts

Network Administrators

System Administrators & Developers

DBA's

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Evaluate High-level Results

- Entry criteria for detailed analysis
  - – Timings are appropriate
  - – System metrics collected successfully
  - – Small percentage of virtual user errors/failures

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Log Test Session

Test Log			
Project:	Oracle Financials Performance Benchmark		
Test Run:	Initial test run		
Objectives:	Capture system response times and metrics under a load of 200 concurrent users		
Scenario:	\\QAFS\Oracle\Performance\Scenarios\Benchmark.lrs		
Results:	\\QAFS\Oracle\Performance\Results\Benchmark_102406		
Scripts:	\\QAFS\Oracle\Performance\Scripts\		
System Changes:	None – initial run		
Test Changes:	None – initial run		
Action	**Time**	**Total Users**	**Comments**
Start	3:45	50	
Ramp	4:00	100	
Ramp	4:15	150	Restarted a few vusers that failed to initialize
Ramp	4:30	200	
Steady State Start	4:45	200	Detected memory leak 20 minutes into steady state
Steady State Stop	5:30	200	
…			

Analyze Results

- Objectives satisfied?
  - Yes
    - Examine system metrics to understand “health” of system
    - Document results
  - No
    - Identify root cause of issue (aka bottleneck identification)
    - Document results

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Results Analysis

- Results analysis requires experts from multiple disciplines
- Repeat – response time is a symptom!
  - Overlay response time data on system metrics to identify correlations
  - Drill down with system experts to identify root cause of issues

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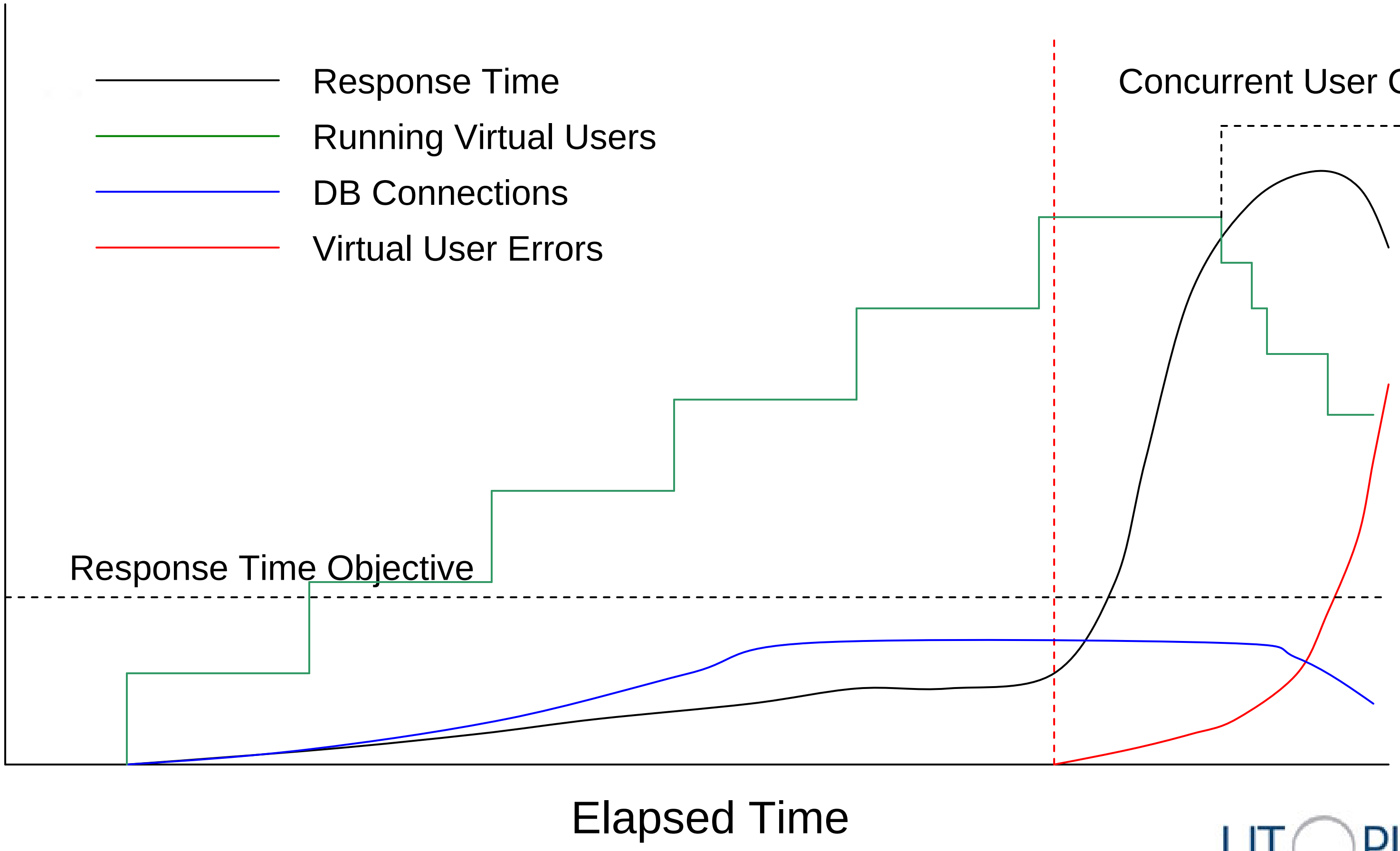
Bottleneck Identification



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Key Summary Points

- Don’t shortcut planning
- Start with clear and measurable objectives
- Be aware of test data issues
- Execution is a team effort
- Analysis must dig deeper than response time data

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