W11

A WORLD-CLASS INFRASTRUCTURE FOR PERFORMANCE TESTING

Naomi Mitsumori

Terri Vines

Annie Hoefs

IBM Global Services

Naomi M. Mitsumori

Naomi works for the IBM Global Testing Organization as a certified IT Specialist in System Integration and Test. She along with Terri Vines and Annie Hoefs led the team who planned, designed, implemented, and managed the IBM Performance Test infrastructure, known within IBM as the Cross-Application Performance Reliability Stress (XPRS) Test Center. She currently consults on both IBM internal and external e-Commerce projects implementing both Performance Testing and Regression Test Automation. Over the past fourteen years in IBM, Naomi has been a Test Manager, a Performance Tester, a Test Automation Programmer, a Database Application Programmer, a Database System Administrator, and an AIX System Administrator.

Naomi earned her BS degree in Chemical Engineering from the University of California Berkeley, and her MS in Computer Science from George Mason University.

Terri A. Vines

Terri is a certified executive project manager and a senior manager in the IBM Global Testing Organization. She was the responsible manager of the team led by Naomi Mitsumori that planned, designed, implemented, and managed the IBM Performance Test infrastructure, known within IBM as the Cross-Application Performance Reliability Stress (XPRS) Test Center. Terri has over seventeen years of project management experience and has successfully developed and managed large, complex projects with global teams. Additionally, Terri created and implemented the IBM Application Excellence Initiative and the IBM Global Application Delivery Worldwide Test Strategy across IBM and today, manages the IBM Global Testing Business Office and Technology Center.

Terri earned her BA degree in Business Administration from the University of San Francisco.

Annie T. Hoefs

Annie is a certified executive project manager and is a senior business area manager responsible for the application testing competency within the IBM Global Testing Organization. She was the senior manager responsible for the development and implementation of the Cross-Application Performance Reliability Stress Test Center and the development of performance testing as an offering within the testing organization. She has over 25 years of experience in the information technology industry including: marketing, application development, finance and planning, human resources and business development. She currently provides management direction for a $50+ million portfolio, 200+ projects providing application testing solutions to customers worldwide.

Annie earned her BS degree in Electrical Engineering from the University of California at Berkeley, Ca, USA.

A World-Class Infrastructure for Performance Testing

Naomi M. Mitsumori
Terri A. Vines
Annie T. Hoefs

Abstract:

In 1998, the IBM Global Testing Organization established a Performance Test infrastructure solely responsible for certifying the performance of all IBM enterprise Lotus Notes and Web applications before their worldwide deployment to IBM end-users. This infrastructure was designed and implemented in the spring of 1998, and is today a software testing best practice and a Standard requirement in the IBM Global Web Architecture and IBM Global Notes Architecture.

This paper documents how this infrastructure for performance testing was created, established and became an IBM best practice. The key areas illustrated include the test processes involved in planning testing tasks and daily workflow activities. Test methodologies covering entrance and exit criteria and modeling workload profiles and customer expectations are also detailed. Additional insight in the selection of performance and monitoring tools are discussed as well as the design of the appropriate test environment. In closing, this paper examines the critical management approaches, which ultimately ensured the success of the whole performance-testing infrastructure.

The IBM Cross-Application Performance Reliability Stress (XPRS) Test Center was created and

established as a performance-testing infrastructure in 1998 for the certification of enterprise web and

Lotus Notes applications for IBM end-users. XPRS evaluates and tests approximately 150 applications

per year in a single infrastructure prior to deployment. It is a mandatory step in IBM's internal application

development and maintenance methodology. The following discussion is a breakdown of the components

and processes that make XPRS a Best Practice.

Essential Building Blocks

XPRS was an effective performance test infrastructure due to five essential building blocks: Test Tools,

Test Environment, Test Methodologies, Test Processes and Management Support.

Figure 1
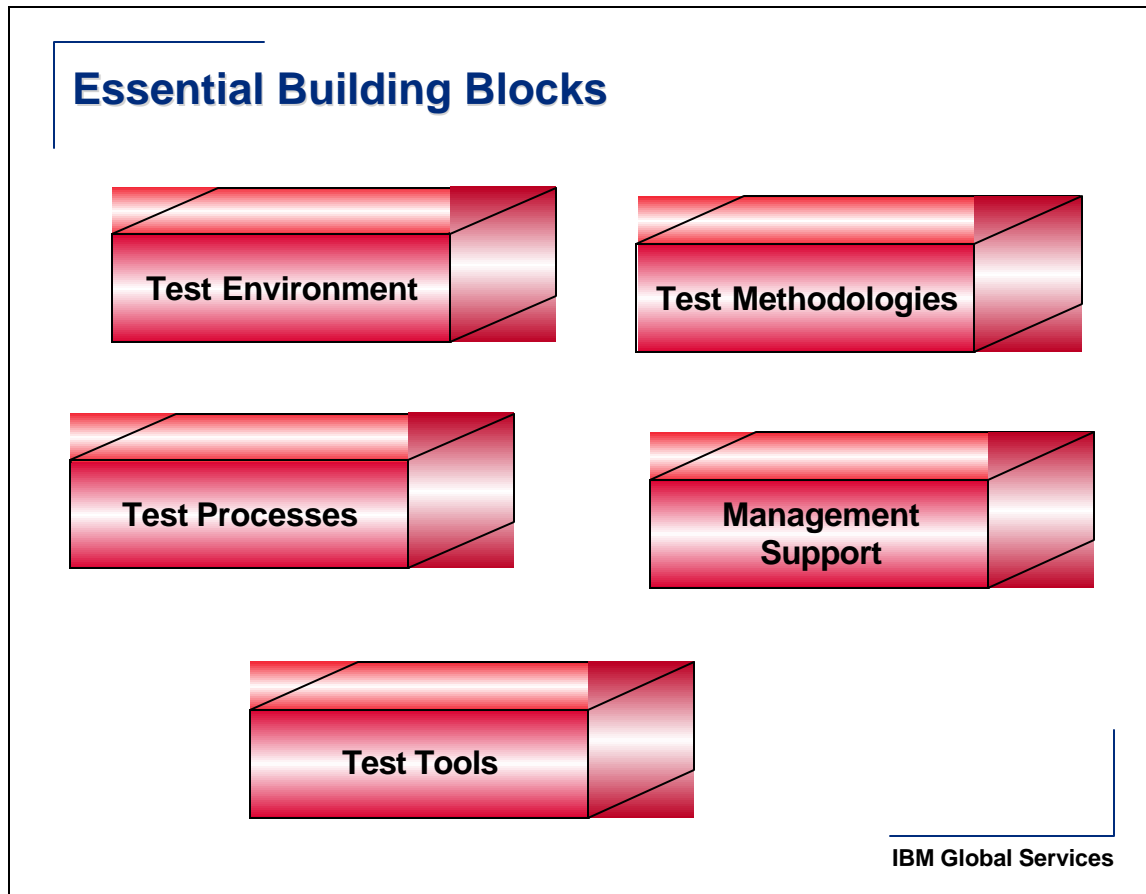
Test Tools

Before the test environment can be built, test methodologies established, and test processes implemented, appropriate test tools must be first selected. The tool considered was a performance test tool able to place a load on the applications and able to accurately report transaction rates and response times. The other required tools were monitoring tools to track CPUs, memory (RAM), and Disk I/O statistics.

Since the applications to be tested were web applications and Lotus Notes applications, two types of performance test tools were required. For the web applications, Mercury Interactive's LoadRunner tool was chosen and for the Lotus Notes applications, the tool selected was IBM's Solutions Evaluation Tool (SET). LoadRunner created a load via the protocol level using HTTP/S while SET was a non-intrusive hardware-based tool that drove a load from a box adjacent to individual workstations. The load ultimately came from the workstations. Because the servers were all AIX based systems, VMSTAT and IOSTAT were used to monitor CPU, RAM, and DISK I/O.

Suggested procedures for selecting a Performance Test tool:

- Via journals, Internet, and colleagues, compile a list of tool candidates and their features and functions. Be sure to include business states of tool vendors along tool support policies.

- Compile a list of application performance testing requirements…e.g. performance testing via HTTP or HTTPS, and/or Lotus Notes performance testing. Don't forget to include environmental needs such as utilizing UNIX performance load servers versus Windows NT performance load servers.

- Compare the lists: Tool features/functions versus application/environmental requirements. Reduce the list to two or three tools (vendors). Remember that the longevity of the vendor's company is also an important consideration when reducing the list.

- Schedule face-to-face demos and prototypes with each short-listed vendor.

- Make a final evaluation of the short-listed tools and choose one.

Test Environment

With the test tools selected, the test environment was then architected. In designing this environment the following was adhered to: ***Since the sole purpose of this test environment is to conduct performance tests, it must accurately represent the production environment.*** This was the driving force behind the creation of the environment, an Intranet/Internet architecture consisting of RISC 6000 Systems with WebSphere, Lotus Notes, and DB2 servers.

Figure 2
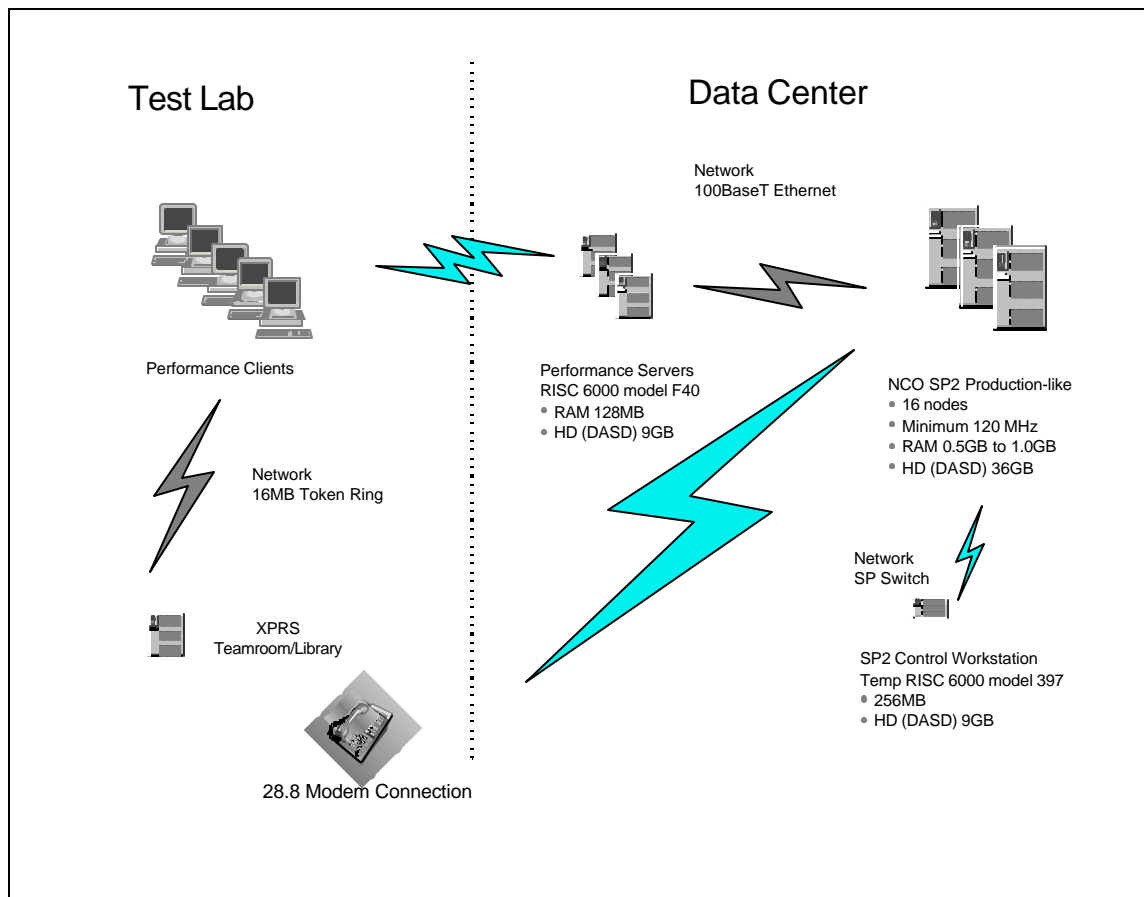
The following checklist was derived:

Hardware

- For application/web servers, database servers, and performance load servers: What types of

machines are needed and how many? What size CPU and how many? How big is the internal disk drive

and how many are there? What sort of network adapter is required and how many? And, how much

memory (RAM)?   Note: ***A rule of thumb for most performance test tools' memory requirements is 2***

to 4 megabytes (MB) of memory per virtual user depending on the scripts. For web scripts, 2 MB is

a good estimate.

- What types of storage devices are used and how many? How many hard disks and what size?

- What type of network is required (think of speed and minimizing potential bottlenecks)?

Software

- For application/web servers, database servers, and performance load servers: What types and version

of operating systems are required? What additional software is needed and what are the corresponding

versions? How should the software be configured after installation?

- For each application to be tested, how and where is the code to be installed and configured? If a

database is required, how is it to be built and loaded? How should the performance test tool be installed

and configured?

Network

- Ethernet or Token Ring? 10 or 100 MB or 4 or 16MB or higher? Multiple adapters or not?

Test Methodology

In this infrastructure, the goal of the tests is to certify the performance of the web or Lotus Notes

applications prior to deployment. The test methodology used for this certification was based on standard

performance test methods. As usual, the application was to meet the Entrance Criteria and upon

completion of the performance test, meet the Exit Criteria. The Entrance Criteria was as follows:

completion of System Integration Testing, application architectural/design documentation, access to the

problem reports, and application code ready for deployment or "Gold Code"   Exit Criteria was completion

of the to-be defined performance tests. Meeting the exit criteria did not necessarily mean that the

application is certified. In fact, if the measured response times or CPU or memory or disk I/O

measurements fail to meet specific targets, the application did not receive a performance certification for

deployment.

Figure 3

XPRS Test Center Entrance Criteria

- ■ **Gold Code validated by the NCO Project Office**
- ■ **Completion of System Test**
  - • No severity one or severity two defects
- ■ **System Test Plan & Test Cases**
- ■ **Architectural/Design Specifications**
- ■ **Installation Guides**
- ■ **Problem Management Report/Database**
- ■ **Performance Objectives**
  - • Workload profile to simulate the expected flow of work through the product at all load conditions
  - • User load (number of users)
  - • Transaction volumes (transactions/seconds)
    - ► Response Time
- ■ **Test data creation**
- ■ **Billing information**
- ■ **Application test schedules**
- ■ **NCO QA and Integration Test approvals**

IBM Global Services

Figure 4

XPRS Test Center Exit Criteria

PASS
- All defined test runs executed successfully
- Met target performance objectives
- Application is certified

Suspended
- Performance related problem fixes are imminent
- System related problem fixes are imminent

FAIL
- Failed to meet the Exit Criteria
- Corrective action to be taken by Development/Application Owner
    - Monitor and tune the application
    - Monitor and tune the system
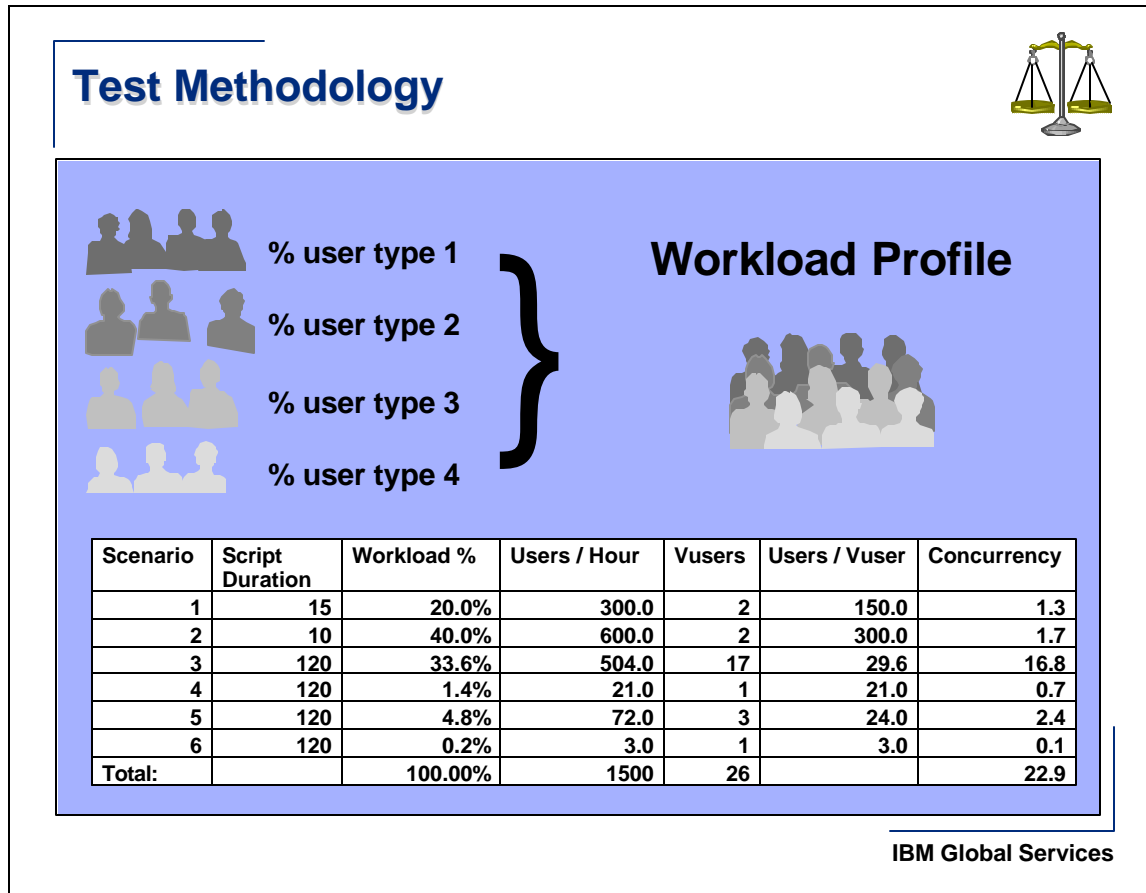   - Reevaluate the performance objectives

PASS or FAIL
- Final report provided to customer

IBM Global Services

The core, the most important part was the expected performance workload profile. The application owner defined that workload profile along with the expected transaction rates and expected number of concurrent users.

Figure 5

Test Methodology

Workload Profile

% user type 1

% user type 2

% user type 3

% user type 4

Scenario	Script Duration	Workload %	Users / Hour	Vusers	Users / Vuser	Concurrency
1	15	20.0%	300.0	2	150.0	1.3
2	10	40.0%	600.0	2	300.0	1.7
3	120	33.6%	504.0	17	29.6	16.8
4	120	1.4%	21.0	1	21.0	0.7
5	120	4.8%	72.0	3	24.0	2.4
6	120	0.2%	3.0	1	3.0	0.1
Total:		100.00%	1500	26		22.9

IBM Global Services

Using the performance test tool, the workload profile was created and executed against the application at three different transaction rates – 50%, 100%, and 150% of peak load. During the hour-long runs, transaction rate and response time measurements were taken along with server measurements such as CPU and memory utilizations and Disk I/O.

Test Processes

Now that the proper test tool was in place and the pertinent test methodology in the accurate test environment established, the appropriate test processes was created to ensure smooth day-to-day activities. The main reason to define the test processes was to establish expectations early-on. All the stakeholders (interested parties) as well as the test team understand his or her roles and responsibilities and how each application's performance test was to be carried out in a systematic manner.
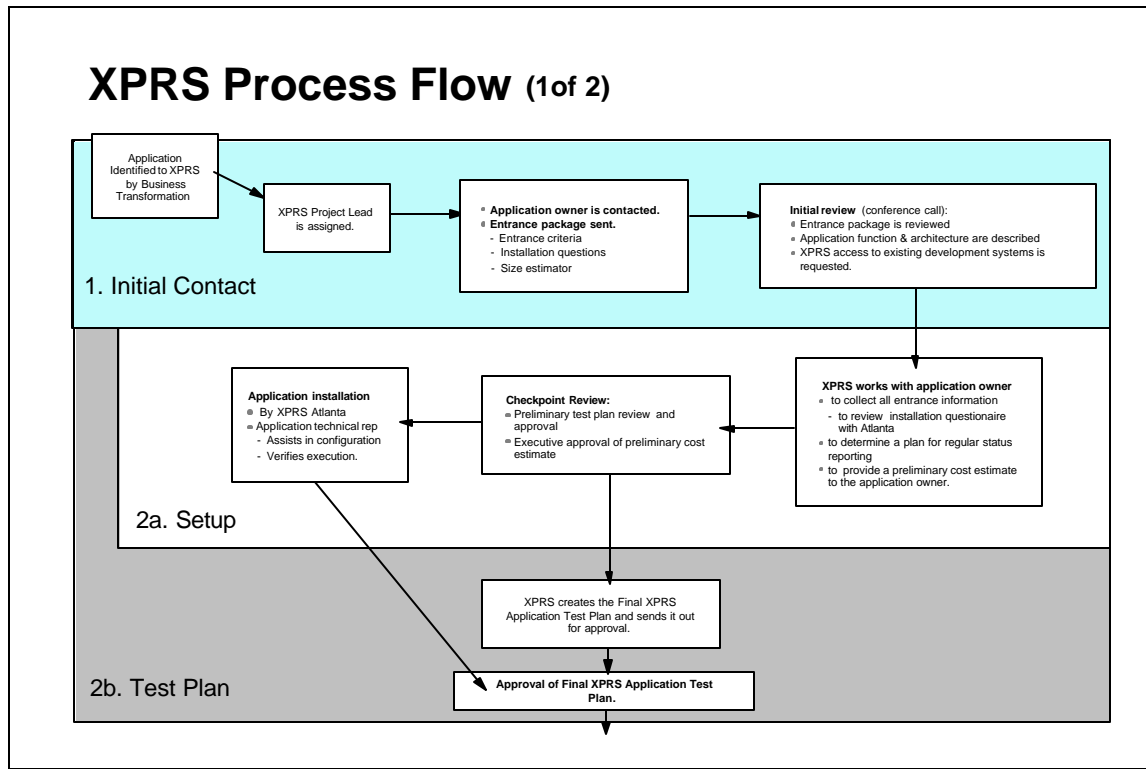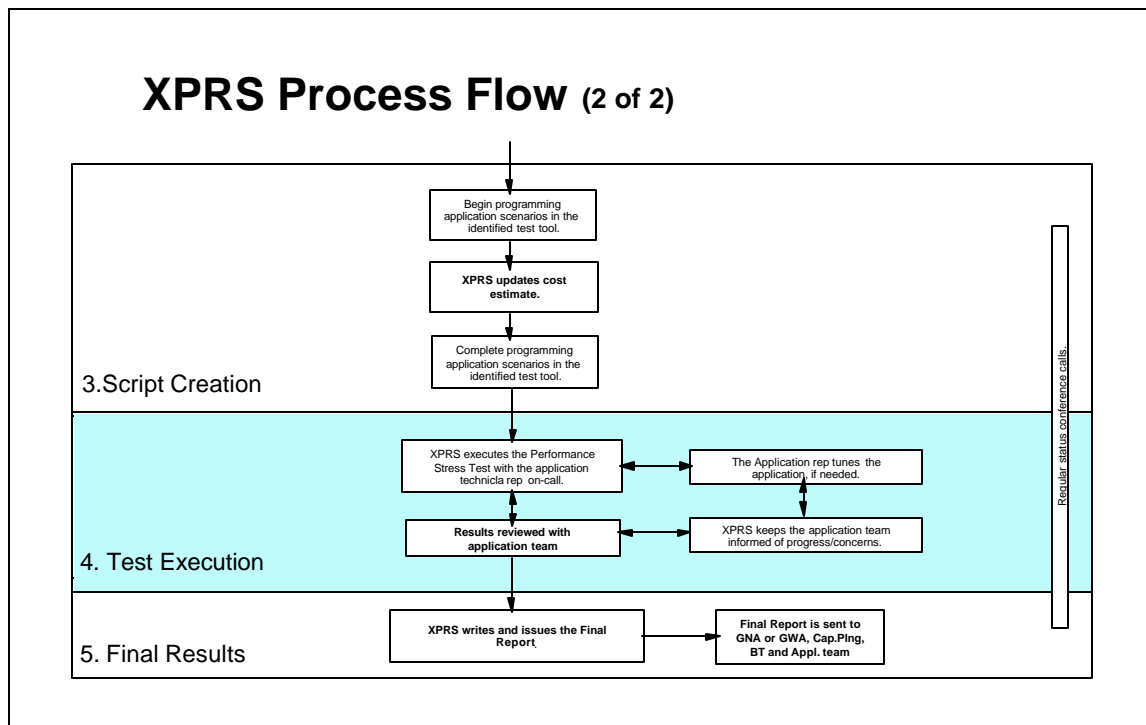
Figure 6

XPRS Process Flow (1of 2)

1. Initial Contact

Application Identified to XPRS by Business Transformation

XPRS Project Lead is assigned.

- **Application owner is contacted.**
- **Entrance package sent.**
  - Entrance criteria
  - Installation questions
  - Size estimator

Initial review (conference call):
- Entrance package is reviewed
- Application function & architecture are described
- XPRS access to existing development systems is requested.

2a. Setup

Application installation
- By XPRS Atlanta
- Application technical rep
  - Assists in configuration
  - Verifies execution.

Checkpoint Review:
- Preliminary test plan review and approval
- Executive approval of preliminary cost estimate

XPRS works with application owner
- to collect all entrance information
  - to review installation questionaire with Atlanta
- to determine a plan for regular status reporting
- to provide a preliminary cost estimate to the application owner.

2b. Test Plan

XPRS creates the Final XPRS Application Test Plan and sends it out for approval.

Approval of Final XPRS Application Test Plan.

Figure 7

XPRS Process Flow (2 of 2)

3.Script Creation

Begin programming application scenarios in the identified test tool.

XPRS updates cost estimate.

Complete programming application scenarios in the identified test tool.

4. Test Execution

XPRS executes the Performance Stress Test with the application technicla rep on-call.

The Application rep tunes the application, if needed.

Results reviewed with application team

XPRS keeps the application team informed of progress/concerns.

Regular status conference calls.

5. Final Results

XPRS writes and issues the Final Report

Final Report is sent to GNA or GWA, Cap.Plng, BT and Appl. team

Management Support

The critical success of XPRS was its management support structure. Management buy-in, investment funding and the availability of critical resources to establish the management support framework was essential. Figure 8 diagrams the Management Support components. IBM executive management originated the business requirement that the performance of enterprise applications be certified prior to deployment. This requirement became a mandate which crossed all IBM business process and information areas. A database registry system was the central repository for IBM application information and included a link to XPRS procedures and templates. Defect analysis was continuous to promote defect prevention, ensure implementation of corrective actions and communicate of lessons learned. Efficiency measurements based on the cost of finding, fixing and retesting defects were established and resulted in significant savings and cost avoidance. Additionally, the XPRS scorecard became the primary communication vehicle that kept all levels of IBM management apprised and current on XPRS effectiveness.

Figure 8
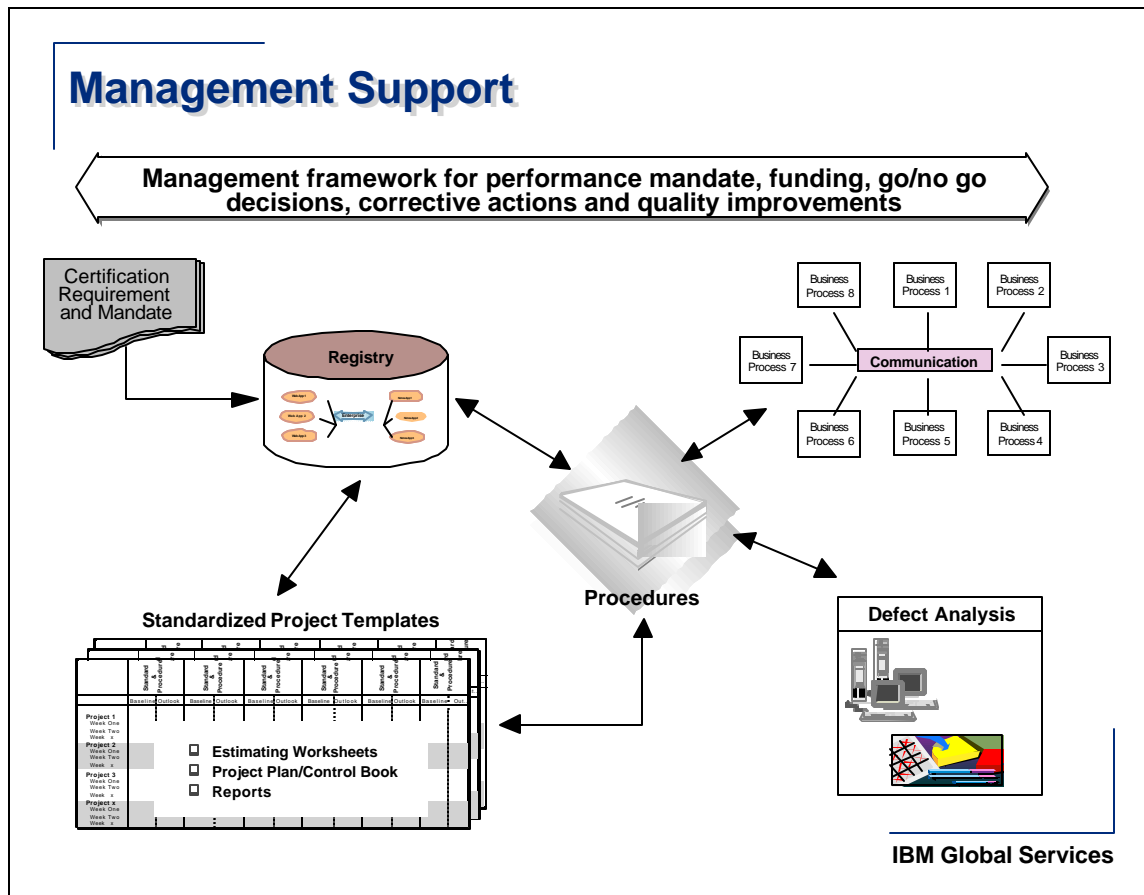
The XPRS building blocks worked in seamless relationship resulting in exceeding business expectations and elevating IBM best practices standards. These results included:

- 100% successful deployment of applications certified by XPRS,

- significant cost savings and avoidance to IBM,

- implementation of a worldwide application excellence initiative to drive testing early and throughout the development lifecycle to ensure IBM applications deploy with zero severity one and two defects, and

- establishment of a common development and test environment so that IBM applications can be developed and life-cycle tested in an environment that mirrors the IBM end-user environment.