# Operations Workbook Companion Guide for UNIX

## Introduction

This document is a companion to the *Blackboard Academic Suites Operations Workbook*. The *Operations Workbook Companion Guide* includes information on best practices, questions to consider, and other details to help administrators complete the workbook.

The *Blackboard Academic Suite Operations Workbook* is a planning and maintenance tool designed to record all the important information about the back-end system that runs the *Blackboard Academic Suite*. It is an open-ended template that can be modified by the administrator to meet the particular needs of the institution. Some of the uses of the Workbook include:

- Resource for coverage staff when the administrator is unavailable
- Guide for planning an implementation of the *Blackboard Academic Suite*
- Reference during troubleshooting and performance tuning
- Instructions for maintenance tasks
- Record of critical information about the software, servers, and network that support and integrate with the *Blackboard Academic Suite*

Updates and additions to this document since it was first published are listed at the end.

Other Blackboard documents referred to in this document can be found on the Behind the Blackboard extranet. Use the following URL to access Behind the Blackboard:

[http://www.blackboard.com/products/services/support.htm](http://www.blackboard.com/products/services/support.htm)

A login is required to access Behind the Blackboard. Users may create their own login for roles other than Administrator. Administrators must receive their Behind the Blackboard login from their Blackboard Account Manager.

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Network Diagram

Create a diagram of all relevant parts of the network. The diagram can be as complex or as simple as needed.

**Warning:** The examples below are meant as a starting point to help create a network diagram that matches the institution’s network structure. These designs should not be adopted without careful consideration, nor should these designs be considered as Blackboard recommended configurations.

**One Server Configuration Example**

![Network Diagram](image-url)
Two Server Configuration Example

Public network

Firewall

Switch

Web app server uses two different NICs: 1 for public connection to internet and one for private connection to database.

Switch

Database server

Network Backup device (optional)

private connection between the WebApp server, database server, and the backup device.
Multiple Web/App Servers Example

Each Web/app server uses two different NICS: one for public connection to Internet and one for private connection to database.

Collaboration Server handles all requests related to the Collaboration tool. Therefore, it does not take part in load balancing.

Private connection between the Web/app servers, database server, file system server, and backup device.

Backup device (tape drive)
Network Components

Users should fill out this section according to their configuration. Not all items that are listed will appear in each network diagram and there may be reason to add additional items.

Those users running the Blackboard Academic Suite on one server only need to document the one Blackboard Academic Suite Server. One server configurations do not use multiple Web/app servers, a separate collaboration server, a separate file system server, or a separate database server.

Those users running the Blackboard Academic Suite on two servers do not need to document a separate file system server or a separate collaboration server. The Web/app server handles both those tasks in a two server environment.

Even though it is not always necessary to document a separate file system server or a separate collaboration server it is important to include the appropriate configuration information about those parts of the system when documenting the server that handles those tasks. For example, in a one server configuration, include all the database configuration information, collaboration tool ports, and so forth under the Blackboard Academic Suite server specs.

Remember that the Workbook is a flexible tool that should be customized to meet the needs of the school.

**Web/App Servers**

List the important details about each Web/app server and the configuration settings. This information is critical for planning and troubleshooting the implementation.

**Collaboration Server**

List the important details about the dedicated collaboration server. This is only necessary if running the Blackboard Academic Suite with more than one Web/app server.

**File Server**

List the important details about the dedicated file server. This is only necessary if running the Blackboard Academic Suite with more than one Web/app server.

**Database Server**

List the important details about the database server and the configuration settings. This information is critical for planning and troubleshooting.

**Network Switches**

Include the configuration and other important information regarding any network switches shown in the network diagram.

**Firewalls**

Include the configuration of any firewalls that protect the servers in the network diagram. Include the ports that are open to allow communication. The standard Blackboard Academic Suite ports are:

- Web: 80
- TCP/IP connection to the Collaboration Tool: 8011
- HTTP connection to the Collaboration Tool: 8010

Also include static mappings to external servers. Include the source, destination, ports, and traffic patterns.

**DNS Server**

Include the configuration and other important information regarding the DNS Server.

**LDAP or Active Directory Servers**
Include the configuration information and other important information for any LDAP or active directory servers in the network diagram.

**SIS Systems**
Identify any SIS systems that are integrated with the *Blackboard Academic Suite*. Administrators may want to include detailed information about the SIS systems that integrate with Blackboard here or reference where to find more information.

**Backup Devices**
Include the configuration and other important information regarding any backup devices shown in the network diagram. Note that the backup mechanism must support open files.

**Jobs**
This section stores information on the various tasks that must be done to maintain the system properly. Several tasks are already identified and administrators should expand on this list to be as inclusive as needed.

If this section is fully-formed, it can serve as an invaluable resource to new staff and to coverage staff when the administrator is unavailable.

**Tasks List**
Identify the tasks that need to be performed daily, weekly, monthly, annually, and at any other defined points in time (such as at the end of each semester). Each of these tasks should be described later in this section and the procedure for each job clearly mapped.

**Downtime**
Identify the times when the system can be taken down for maintenance. Include daily, weekly, monthly, annually, and any special circumstances (such as holidays or the end of a semester) when downtime will have the least impact on users.

The downtimes identified can then be used to plan out when to run backups and other tasks important to maintaining the system.

**Backup Plan and Procedures**
A good backup plan is critical to consistent and predictable performance of the system. It is much easier to quickly restore the system following a server failure or other emergency if the backup plan is carefully detailed and fully implemented.

The first consideration in creating a backup plan is determining what needs to be backed up. Include everything necessary to restore the system to working condition following a system failure. Consider the following areas when creating a backup plan:

- Application files.
- Configuration settings.
- Content.
- Data.

The first two, application files and configuration settings, are much more static and do not require a sophisticated backup plan. The Blackboard Settings section and other areas of the workbook should be sufficient to record where the application files and configuration settings can be found to restore the system.

The backup plan should then focus on content and data. Course content is stored in the file system and data is stored in the database.

*Content Backup*
Content refers to files stored in the file system that are used as images throughout the system, content displayed within or attached to a content item, and so forth. Content is stored in a directory structure where each virtual installation has its own folder for content. Even if virtual installations are not in use, the directory follows this structure.

Content files are found in /usr/local/blackboard/content/vi/bb_bb60, where bb_bb60 is the name of the virtual installation (bb_bb60 is the default name of the virtual installation created at install, and is the folder name that holds content files for those schools that choose not to use additional virtual installations).

The folder for each virtual installation includes the following subfolders:

- **admin**: This directory stores images associated with System Reporting.
- **branding**: This directory stores the HTML that determines how the Gateway page is displayed. Information for modifying the Gateway page can be found in the *Blackboard Academic Suite Administrator Manual*.
- **courses**: This directory includes storage areas for each course and organization. Content items uploaded to the course or organization are stored here.
- **images**: This directory stores images used on the system.
- **modules**: This directory stores .jsp pages for portal modules.
- **plugins**: This directory stores System Extensions.
- **recyclebin**: This directory includes deleted course content. Content must be removed from this directory or it will be stored indefinitely. The recyclebin should, in almost all cases, be omitted from the backup plan.
- **sessions**: This directory stores session-specific data for users. The sessions directory should be omitted from the backup plan.
- **sponsors**: This directory stores sponsorship information and images.

Use this information to determine the content that should be backed up.

Content backups will most likely be done by automated jobs. It is possible to plan the content backup so that between each full backup a backup of only those files that have been added or changed since the last full backup is made. This allows for less downtime while increasing the frequency of backups for more coverage.

**Data Backup**

The *Blackboard Academic Suite* database stores attributes about courses, users, enrollments, catalog categories, and several other entities. Data changes frequently, and the effects of missing even one day of data transactions can be extreme to the teachers, students, and other users that rely on the system.

In general, database backup plans often include regular, full backups supported by incremental backups of transactions since the last full backup. This method allows for coverage while limiting downtime. For example:

A full backup is done every Monday morning at 2:00 a.m. This is the time when the system can most tolerate downtime. Every other day of the week, a backup of the data transactions for that day are done at 2:00 a.m., with significantly less downtime than the full backup that occurs every Monday morning.

If the system fails and need to be restored on a Thursday afternoon, the system can be restored first by applying that week’s full backup and then the transaction backups for Tuesday, Wednesday, and Thursday. Note that any data transactions that occurred between Thursday at 2:00 a.m. and the time of the system failure are lost.
**Warning:** Oracle supports a limited number of backup methods. Make sure that the backup plan uses an Oracle-supported backup tool, such as RMAN.

**Scheduling Backups**
To decide when to run backups, consider the following:

- How important is it not to lose any changes?
- How much downtime can be tolerated to run the database and content backups?
- When does the system experience the greatest and least use? Make sure to include information on whatever intervals may be used for backups (weekly, daily, and so forth)
- What events should trigger an immediate backup?
- How fast is the backup tool? (MB/minute)
- How large is the database (MB)? How large is the content (MB)?

Once a plan is in place, it must be reviewed regularly to meet the needs of a growing database and file system. The speed of the backup and the size of the database and file system must allow the backup to occur within the downtime window.

Make sure to record any relevant information about the automated jobs that are configured to run the backups. Instructions for performing a manual backup may be a useful reference to include.

**Hint:** It is critical to test both the backup and restore procedures (the restore procedure is covered later in this document). A backup is only costing valuable time and space if it cannot be restored.

**Storage**
Record information in the Operations Workbook on the storage system used to keep backups. Consider the following issues:

- The media used
- Location of backups (consider storing some backups in an off-site, secure location)
- Rules in place for rotating media and backups
- How long should backups be kept? Should some be kept longer?

**Startup Procedures**
List sequentially the steps necessary to bring the Blackboard Academic Suite back online after it has stopped. The examples below include the minimum number of steps and details. Make sure to customize the examples to fit, for example, use the machine names of the servers running the Blackboard Academic Suite or add details such as a test login to the Blackboard Academic Suite.

**Example 1, one server configuration**
The system must be started in this order:

**Step 1**  Boot the Blackboard Academic Suite server.
**Step 2**  Check to make sure that the Small-scale database software started automatically at boot.
**Step 3**  Services are set to start automatically. If services do not start, run the following command to start the Blackboard Academic Suite services:

```
/usr/local/blackboard/tools/admin/ServiceController services.start
```

**Step 4**  Login to the Blackboard Academic Suite and confirm that it is working correctly.

**Example 2, two server configuration**
The system must be started in this order:

**Step 1**  Boot the Blackboard Academic Suite database server.
Step 2  Check to make sure that the Oracle database software started automatically at boot.
Step 3  Boot the Web/app server.
Step 4  Services are set to start automatically. If services do not start, run the following command to start the Blackboard Academic Suite services:

```
/usr/local/blackboard/tools/admin/ServiceController services.start
```

Step 5  Login to the Blackboard Academic Suite and confirm that it is working correctly.

**Example 3, multiple Web/app server configuration**
This example assumes that the collab server is run on a dedicated machine and not one of the Web/app servers.

The system must be started in this order:

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Boot the database server.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2</td>
<td>Check to make sure that the Oracle database software started automatically at boot.</td>
</tr>
<tr>
<td>Step 3</td>
<td>Boot the file system server. Check to make sure that the shared directory is available.</td>
</tr>
<tr>
<td>Step 4</td>
<td>Boot the primary Web/app server.</td>
</tr>
</tbody>
</table>
| Step 5 | Services are set to start automatically. If services do not start, run the following command to start the Blackboard Academic Suite services:

```
/usr/local/blackboard/tools/admin/ServiceController services.start
```

**Note:** An error will occur stating that the collaboration server startup failed. This is expected because the machine dedicated to running the collaboration server has not yet been booted.

<table>
<thead>
<tr>
<th>Step 6</th>
<th>Stop the bb-collab service.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 7</td>
<td>Use a browser to login to the Blackboard Academic Suite and ensure that content items load properly.</td>
</tr>
<tr>
<td>Step 8</td>
<td>Bring the other Web/app servers online, in proper sequence, using the same steps (4 through 6) used to bring the primary Web/app server online.</td>
</tr>
<tr>
<td>Step 9</td>
<td>Boot the collaboration server.</td>
</tr>
<tr>
<td>Step 10</td>
<td>Services are started automatically.</td>
</tr>
<tr>
<td>Step 11</td>
<td>Stop the bb-tomcat service.</td>
</tr>
</tbody>
</table>

**Shutdown Procedures**
List sequentially the steps necessary to take the Blackboard Academic Suite offline. When taking the system offline for maintenance (such as installing a Blackboard Academic Suite update) do not shut down the database.

**Example 1, one server configuration**

The system must be stopped in this order:

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Logon to the Blackboard Academic Suite server.</th>
</tr>
</thead>
</table>
| Step 2 | Run the following command to stop the Blackboard Academic Suite services:

```
/usr/local/blackboard/tools/admin/ServiceController services.stop
```

| Step 3 | Perform maintenance tasks and restart services or shut down the server. |

**Example 2, two server configuration**

The system must be stopped in this order:

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Logon to the Blackboard Academic Suite Web/application server.</th>
</tr>
</thead>
</table>
| Step 2 | Run the following command to stop the Blackboard Academic Suite services:
Step 3  Perform maintenance tasks and restart services or shut down the Web/app server and continue with the next step.

Step 4  Logon to the database server.

Step 5  Shut down the database server.

This example shows the value of identifying the servers by name or number in the Operations Workbook. Someone attempting to follow the steps in the example would have an easier time if the instructions referenced the server name and not "Blackboard Academic Suite Web/application server".

**Blackboard Academic Suite Log Rotation**

Record the frequency that logs should be rotated. If this information is shared with other staff it may be helpful to also provide instructions for setting the frequency through the Blackboard Academic Suite interface (see the Blackboard Academic Suite Administrator Manual for more information).

When logs are rotated they are not deleted, rather, they are compressed into an archive file. These archive files should be regularly removed and either stored or deleted to prevent them from taking up too much disc space. Include information on how frequently these archive files should be moved and where they should go, and when, if ever, they should finally be deleted.

These archive files cannot be handled automatically through the Blackboard Academic Suite interface, but it is possible to schedule an automated task through the operating system to regularly clean out the archived log files. Remember to record all the important information about the scheduled task including the frequency and the name of the task. If the archived files will be managed manually, record when they should be moved or deleted and provide sequential steps for doing so.

While the Blackboard Academic Suite logs can easily be managed through automation, there may be events that require that logs are rotated or archived log files moved immediately. Make note of these events and the procedure that should be followed.

It is possible to set the verbosity of some logs. If these settings are changed, make note of it here.

**Operating System Logs**

Record any information on the management of operating system logs.

**Database Logs**

Record any information on the management of database logs.

**Empty /blackboard/recyclebin**

Files that are deleted, particularly content files, may show up in the \blackboard\recyclebin directory. This is a safety in the event that a file is accidentally deleted. The recyclebin can grow quickly and should be regularly emptied to save disc space.

Through the operating system, a scheduled task can be built to regularly empty the recyclebin. Record all the important information about the task, including the name and frequency. If the recyclebin will be manually emptied, include how often it should be emptied and sequential steps. Also, remember to include the full path to the recyclebin and any events that should trigger an immediate emptying of the recyclebin.

Remember that it is not possible to restore a course from the recyclebin. Make sure that courses are backed up so that recovery is simple following an accidental deletion. It is possible to recover...
some files from the recyclebin to help rebuild a lost course, but it cannot be restored completely from the recyclebin.

**Empty Operating System Temp Directory**

The **Blackboard Academic Suite** will also add files to the operating system’s temp (/tmp) directory. This directory should be cleaned out regularly to save disc space. Through the operating system, a scheduled task can be created to empty the temp directory.

Record information about the tasks scheduled to manage the size and age of the temp directory and how frequently they are run. If these directories are emptied manually, include steps for doing so. Finally, be sure to include any events that would require these directories to be emptied immediately.

**End of Semester Tasks**

Define any tasks that must be done to close out a semester.

**Running a Blackboard Academic Suite Update**

Document the process for running an update or hotfix to the **Blackboard Academic Suite**.

Some important points to consider when defining the process:

- Scheduling Downtime
- Testing the update before putting it into production
- Backing up configuration files
- Reviewing the Release Notes

**Patching the Operating System or Database**

Blackboard supports all operating system and database service packs and security patches for those systems supported for use with the **Blackboard Academic Suite**. This does not include support for major releases! For example, Blackboard supports Red Hat Linux 7.2 with the latest service patches but does not automatically support a new version of the Red Hat Linux operating system.

Use this space to record the procedures for maintaining the operating system and database on the latest service packs and security patches. Make sure to include system downtime and testing into the procedure.

Remember that the **Blackboard Academic Suite** must initially be installed on the supported operating system and database patch levels documented in the **Blackboard Academic Suite Hardware and Software Requirements** document. After installation, service patches may be applied. This is true anytime the system must be reinstalled.

**Blackboard Settings**

**Configuration File Settings**

Include any customizations made to the **Blackboard Academic Suite** configuration files. As an alternative, simply open the configuration files in a text editor and copy and paste the contents into the Workbook. This will provide a hardcopy backup of configuration settings to go along with the regularly scheduled backups of the configuration files themselves.

The files that have settings that can be modified are:

- bb-config.properties
- authentication.properties
If, for some reason, other files are customized, record the modifications and save a backup of the original file.

**Authentication Settings**

Include information on how users are authenticated at login. Many schools will choose to use the default, Blackboard database method of authentication. Those that integrate the Blackboard Academic Suite with another authentication system at the school should fully document the authentication model.

**Integration Settings**

Include information on the model used to integrate the Blackboard Academic Suite with other information systems at the school.

For example, if using Snapshot to integrate, the following information would be valuable:

- schedule of activity
- data source key conventions
- identify the system that owns each attribute
- samples of snapshot files
- instructions for running a manual snapshot process

**Virtual Installations**

The hostname of each virtual installation should be recorded as well as the name of the production database used with each virtual installation. For security reasons administrators may not want to record the database user password for each virtual installation in the Workbook although it is important not to lose this password.

**Naming Conventions**

Determine the standard structure for User Names, Courses, Course Categories, Organizations, and Organization Categories. Standard naming conventions will make it easier to find and manage data.

The following special characters should never be used in an attribute such as a User Name, password, database user, Course ID, and so forth.

```
%&#<>+=
```

These characters are only safe to use when adding content into a text box, such as adding the description for a course.

When creating attributes a good rule to follow is to only use alphanumeric characters, underscores, dots, and dashes (do not use spaces!).

When creating passwords it is a good idea to use as many different characters (including upper and lower case letters) as possible. Keep in mind that Oracle does not accept @ in passwords for Oracle users.

**Performance**

**Peak Load**

List the times and circumstances when the system is expected to be running under peak load. Make sure to continue to track system usage and update this information regularly. Information on how and when users are maximizing their use of the system is invaluable for tuning the system and predicting future needs.
The number of users, frequency of hits on the server, and the areas of the Blackboard Academic Suite application that are hit at peak should be recorded along with any other information needed by the institution.

**Tracking**

Describe the data-gathering tools and methodologies used to measure system performance and usage. Include information on how often data is gathered, where it is stored, and how it can be used to for troubleshooting and predicting future trends.

**Tuning**

The Apache Web server settings can be configured to tune system performance. For more information on how these settings affect performance, please see the Blackboard Academic Suite Setup Guide for UNIX.

The table below details the variables that may be set to enhance the performance of the Web server.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MaxClients</td>
<td>The maximum number of child processes the server will spawn. The MaxRequestsPerChild variable is essential—by setting this value to 300 in laboratory testing, each child was able to serve a request without ever having to re-compile the application or create a new database connection.</td>
</tr>
<tr>
<td>MaxRequestsPerChild</td>
<td>The maximum number of requests an individual child will process before restarting.</td>
</tr>
<tr>
<td>StartServers</td>
<td>The number of children to initially create when starting up the server.</td>
</tr>
<tr>
<td>MinSpareServers</td>
<td>The minimum number of children awaiting requests.</td>
</tr>
<tr>
<td>MaxSpareServers</td>
<td>The maximum number of children awaiting requests.</td>
</tr>
</tbody>
</table>

Thorough data reporting should provide all the information necessary to regularly review and update network settings to keep the system operating smoothly. Include information on how often performance is reviewed and settings reconfigured to optimize the system.

Do not forget to include information on other steps taken to optimize system performance.

**Planning for Future Growth**

Keep track of usage patterns over time and use that data to help anticipate short-term and long-term growth. Usage measurements should include:

- number of courses: total courses in the system.
- number of users: total users in the system.
- average course size: Average disc space used by each course.
- concurrent users at peak: Server requests under peak load.
- usage patterns: Areas of the system used most often.
- usage patterns at peak: Areas of the system used most often under peak load.

Administrators should expand this list to track other data relevant to their institution.

**Hardware Planning**
Use this area to record the current available resources and their ability to meet the future needs of the system. Focus on both short and long-term planning to assure that hardware acquisition is done without unnecessary expense or waste.

**Troubleshooting**

**Recovery Plan**

Recovery plans should include instructions for restoring the database and file system content to the most recent backup as well as plans for fully restoring the system due to catastrophic failure. When developing a recovery plan, consider:

- Location and frequency of backups
- Instructions for applying database and content backups
- Instructions for restoring configuration settings
- Operating system and database recovery

It is also a good idea to look at how the system is designed to prevent failures from shutting down the system. Storing the file system in a redundant RAID array and running in a load-balanced environment are two methods that can keep the system running during a partial failure.

**Blackboard Contact Information**

List the required information to contact Blackboard Support as well as contact information for your Blackboard Account Administrator.

**Reinstall instructions**

Outline the steps for reinstalling the applications after a catastrophic failure. The outline can detail every step or reference other resources. For example, instead of listing all the steps to install the Blackboard Academic Suite software, simply reference the Blackboard Academic Suite Setup Guide. The outline created here will put the installation of the software in the proper sequence; the person performing the install can then reference the other document for more details.

**Location of Installers and Backups**

Keep track of where backups of file system content and the database are stored (as well as any other backups necessary to restore all or part of the system).

Also, record where the software installers and updaters are stored in case applications need to be reinstalled. To save time when reinstalling the Blackboard Academic Suite, save a copy of the full installer for the current version instead of the original installed version and any updaters. Also, the latest version of the Blackboard Academic Suite can always be downloaded from Blackboard (it is still helpful to have a local backup).

It is important to save the Blackboard Academic Suite license file! This file is required every time the installer is run. If the license file is lost or unavailable, contact your Blackboard Account Manager.

Do not forget to include information on the operating system, database, and other supporting software (including license keys and registration information). Be sure that these installers and any patches can be easily found in case they need to be reinstalled.

**Contingencies**

List common problems and the approach that should be used to resolve each problem. Besides common or anticipated problems, it may be helpful to also outline approaches to complex problems or those that are unlikely but potentially catastrophic.
Maintenance Log

Use this section of the workbook to log all maintenance tasks on the system. Include at a minimum the date, time, user performing maintenance, and the tasks. Optimally, the log will include not only what was done, but the exact steps and commands used to perform the task.
Updates and Additions

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