Instruction Sheet-1	Learning Guide #1

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics.

- Identifying Diagnose Tool based on organizational database requirements
- determining and recording inappropriate use of database

This guide will also assist the trainee to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, the trainee will be able to:

- Identify Diagnose Tool based on organizational database requirements
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Learning Instructions:

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2. Read the information written in the "Information Sheets 1". Try to understand what are being discussed. Ask your teacher for assistance if you have hard time understanding them.
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MODULE TITLE: **Identify and Resolve Database Performance Problems**

MODULE CONTENTS:

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LO1. Diagnose problems

1.1 Identify Diagnose Tool based on organizational ***database*** requirements
- 1.1.1 Obtain Diagnose Tool
- 1.1.2 Run diagnostic tools
  - 1.1.2.1 Identify latch contentions
  - 1.1.2.2 Identify events causing waits and record outcomes

1.2 determining and recording inappropriate use of database

1.4 Fixing the Database based on diagnostic results

- **Identify Diagnose Tool based on organizational *database* requirements**

Diagnosis is the process of identification of the nature and cause of a certain phenomenon.
It is used in many different disciplines with variations in the use of logics, analytics, and experience to determine "cause and effect".
In database system, it is typically used to determine the causes of the database problem, and the solutions.
Database problems can be detected and solved by using:

- **Performance monitoring** for physical and virtual databases
- **Query monitoring** to see the causes of blocks and deadlocks
- **History browsing** to find and troubleshoot past issues
- **Predictive alerting** with settings to avoid false alerts
- **Capacity Planning** to minimize server collapse

- **Obtain Diagnose Tool**

Microsoft SQL Server is a database management system designed to store massive amounts of data for use in other applications. This set of applications gives you additional tools for working with SQL Server and its databases.
The tools include:

- Monitoring tools,
- Comparison tools,
- Search tools,
- Query builders, etc.

1. MS **SQL** Maestro is an excellent Microsoft **SQL** database administration tool. It has all the functions that you would ever need such as: managing your **SQL** server, creating and dropping databases, managing data inside the tables, executing **SQL** queries, and more.
2. SQL Server Comparison Tool is a Windows program for analyzing, comparing and documenting SQL Server databases.
3. SQL Server Comparison Expert is a database software tool which provides you with very useful comparison functionality, such as database analysis, repairing, comparison and synchronization, backup and restore.
4. SQL server have interface manager which is the development interface on the SQL Server

- ✓ Database performance: it is directly linked with the avocation of resource used by the database management system (DBMS).
- ✓ The complex relationship b/n numerous DBMS resource makes identifying diagnosing and performance tuning complex and time consuming tasks.
- ✓ Database administrations (DBA) are needed to initially tune a DBMS for performance and then to retune the DBMS as a DB grows and work load change.
- ✓ Automatic diagnosis and resource management remove the need for DBA. Then greatly the cost of owner ship for the DBA.
- ✓ An automated system also allows the DBMS to respond more quickly to changes in the work load as performance can be monitored to 24 hours a day.
- ✓ One of the key issues in automatic resource management is the capability of the system to diagnose resource problems.
- ✓ Diagnosis of resource allocation problem is the first step of tuning the resource.
- ✓ To increase the performance of a database is enterprise integrity

In general identifying and resolving DB performance problem can be done in the following steps

1. **Identify**: where does the problem originate.
2. **Diagnose**: what is the causing problem.
3. **Solve**: what is the best solution to fix the problem.
4. **Prevent**: how do we keep problems happening in the first place.
   - ✓ Database slow down can heavily me act IT costs and resource in un happy customer missed service used agreement and cost revenue.
   - ✓ Improving database performance can have substantial's affect a business.
   - ✓ Then the DBA a responsibility handle the performance of the DB which is coup up the ever -growing work load.

1. <u>Identify</u>

- ✓ The performance problems happen with warning the first step in confronting a performance issue is identification. Where does the problem originate is it on going or has it concluded and it so while it record?
- ✓ Identification is not a ways single it can take hour or day with one the right tool.
- ✓ Accuracy and speed in determining a problems source are critical.

2. <u>Diagnose</u>

To diagnose the DBA most quickly and accurately determine the specific root causes of poor performance, such as resource shortage or exceptional problem.

- ✓ The DB performance solution pack offers rich diagnostic capabilities.
- ✓ OMEGAMON XE for DB2 performance expend measures the time elapsed during every step in a transaction including.
  - Work load response time
  - Time spent in

✓ Organization can monitor and report a transaction response time by user application. Application server transaction report or other classification.

3. **<u>Solve</u>**

A performance problem usually has multiple solutions and is not a ways obvious which one is base.

- DBAS and team should not think in terms of one SQL statement or one users issue applying an improvement strategy that worked an one SQL statement to different types of statement may not produce the same positive outcome.
- Leverage the DB performance solution pack provide export advice and help point the way to solution that come save the IT staff considerable time.

4. **Prevent**

By tuning queries and workloads proactivity organization can support the business transparently rather than address. A DB performance issue after the service has already degraded has occurred.

- To dig nous database performance problem
  1. Obtain diagnose tools
  2. Run diagnostic tools

1.1.1.1 Identify latch contentions

Some of database problem that are affecting the performance of database can be

1. **Latch contention**
2. **Wait events**

Latches are low level serialization mechanisms used to protect shared data structures system global area.
The implementation of latches is operating system dependent, particularly in regard to whether a process will wait for a latch and for how long.
A latch is a type of a lock that can be used to prevent more than one process from executing the same piece of code at a given time.

What is latch?

- Latches are serialization mechanism that protects areas of oracles shared memory (SGA).
- Latch prevents two processes from simultaneously accessing and possibly corrupting the same area of the SGA.

What is SGA?

- The SGA (System Global Area) is the chunk of memory that is allocated by an oracle instance and is shared among oracle processes.

What is latch contention?

- Latch contention is the completion among oracle process to access SGA.
- It is the number of times the task was switch out because it needed to wait for a latch.

How latch contention occurs?

- Because the duration of operation against memory is very small (in order of nanosecond) and the frequency of latch request is very high or must system. A single machine instruction called test and set is used to see if the latch is taken and it not acquire it a latch is already in use oracle can assume at will not be in use for long so rather than go in to a passive wait oracle retry the request to access for SGA (Latch) member of times before give up (interrupt the process) and this is called **Latch contention**.

How latch contentions affect performance?

- The subsequent waits will increase and in extern circumstance may reach 100s of millisecond in a system suffering from contention for latch these wait will have impact on response time then the time delay will happen which is a type of performance problem.

1.1.2.3 Identify events causing waits and record outcomes

SQL Server Extended Events (Extended Events) is a general event-handling system for server systems.
The Extended Events infrastructure supports the correlation of data from SQL Server, and under certain conditions, the correlation of data from the operating system and database applications.
In the latter case, Extended Events output must be directed to Event Tracing for Windows (ETW) in order to correlate the event data with operating system or application event data.

Determining and recording inappropriate use of database

Fixing The Database based on diagnostic results

When problems occur with a system, it is important to perform accurate and timely diagnosis of the problem before making any changes to a system. Often a database administrator (DBA) simply looks at the symptoms and immediately starts changing the system to fix those symptoms. However, long-time experience has shown that an initial accurate diagnosis of the actual problem significantly increases the probability of success in resolving the problem.

Automatic Database Diagnostic Monitor

The types of problems that ADDM considers include:

- CPU bottlenecks
- Undersized Memory Structures
- I/O capacity issues
- Database configuration issues
- Concurrency issues

In addition to problem diagnostics, ADDM recommends possible solutions. When appropriate, ADDM recommends multiple solutions for the DBA to choose from.
The recommendations include:

- Hardware changes - Adding CPUs or changing the I/O subsystem configuration
- Database configuration - Changing initialization parameter settings
- Schema changes
- Application changes

Wait event

- When oracle/SQL executes an SQL statement it is not constantly executing same times it has to wait for a specific event to happen before it can proceed.

  For example if oracle or SQL statement

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This learning guide is developed to provide you the necessary information regarding the following content coverage and topics.

- Adopting Distributed files architecture to minimize I/O (input/output) contention
- Database back-up procedures
- Configuring and testing database performance

This guide will also assist the trainee to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, the trainee will be able to:

- Adopt Distributed files architecture to minimize I/O (input/output) contention
- Database back-up procedures
- Configure and test database performance

Learning Instructions:

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LO2. Configure database

2.1 Adopting Distributed files ***architecture*** to minimize I/O (input/output) contention.
- 2.1.1 Ensuring Database back-up procedures

2.2 Database back-up procedures
- 2.2.1 Backup Option/Tool
  - 2.2.1.1 Recovery Manager (RMAN)
  - 2.2.1.2 Secure Backup
  - 2.2.1.3 A user Managed Backup
- 2.2.2 Backup type
  - 2.2.3 Full Backup
  - 2.2.4 Incremental Backup
- 2.2.5 Backup Mode
  - 2.2.5.1 Offline
  - 2.2.5.2 Online

2.3 Reconfiguring rollback segments

2.4 Configuring and testing database performance

➢ Adopting Distributed files *architecture* to minimize input/output contention.

Distributed file system is a method of storing and accessing **files** based in a **client/server architecture**.
In a distributed file system, one or more central servers store files that can be accessed, with proper authorization rights, by any number of remote clients in the network.
Like an operating system organizes files in a hierarchical file management system, the distributed system uses a uniform naming convention and a mapping scheme to keep track of where files are located.
When the client device retrieves a file from the server, the file appears as a normal file on the client machine, and the user is able to work with the file in the same ways as if it were stored locally on the workstation.
Distributed file systems can be advantageous because they make it easier to distribute documents to multiple clients and they provide a centralized storage system so that client machines are not using their resources to store files.

Backup and Recovery

What is backup and recovery?

- Backup and recovery refers to various strategies and procedure involved in protecting your database against data and reconstructing the DB after my kind of data loss.

Physical and logical Backup

A Backup is a copy of data from your database that can be used to recover the lost data.
Physical Backup is backing up of the actual data. Such as data files control files and archived redo logs.
Every physical backup is a copy of files storing database information to other lactation whether on the disk or some other offline storage like DVD.
Logical Backup is a strategy of duplicating logical data such as DB schema and stored procedure.

Physical DB structure used in recovering Data

- The file and other structure that make up oracle or SQL Server database store data and safeguard it against possible failure.
- The physical structure that make up oracle DB and their role in reconstructing the DB from backup are
  - Data files and data blocks
  - Redo logs
  - Undo segment
  - Control files

1. Data file and data blocks

- An oracle DB consists of one or more logical storage unit called table spaces.
- Each table space in an oracle DB one or more files called data files.
- Data blocks are the smallest unit of storage that the database can use or allocate.

2. Redo logs

- Redo logs record all change made to a database file.
- Each time data is changed in a DB the change is recorded in the online redo logs first before it is applied to the data files.
- Because the redo logs contains a record of all changes to the data files, if a backup copy of a data files from same point in time and complete set of redo logs from that time to record are available the DB can reapply changes recorded in the redo logs in order to reconstruct the file content.

3. Control files

- Contain the record of the physical structure of the DB and their status several types of information stored in control file are related to backup and recovery.

Like DB information, Table space and data file records

4. Undo segment

- Used to store undo information
- Used to undo the effect of uncommitted transaction. I.e. Transaction is a sequence of operation performed as a single logic unit of work.

➢ Error and failure requiring recovery from backup

While there are several types of problem that can halt the normal operation of database or affect the I/O operation. There are two major problems (failure) that result in data loss.

1. **USER ERROR**: occur when either due to an error in application logic or a manual miss step data in your DB is deleted or modified incorrectly data loss due to user includes as dropping important table or delete or change the content of the table.
2. **Media Failure/Problem**: it is a failure or a read or write of disk required to run the DB. Due to physical problem with the disk such as head crash any data base file vulnerable to media failure.

➢ Ensuring Database back-up procedures

Backup is the process by which you make a copy of your work for safekeeping in an alternate location, in case your current work becomes lost or corrupt. The backup copy is only as recent as the last time it was modified. The more work you do, the more frequently you should back up your work.

Before creating databases and schema repositories, administrators should establish procedures and schedules for regular backups.

- Backups can be performed using backup tools provided by the database vendors and third parties.
- Backups should also be performed before moving schema repositories or user databases.

Backup all databases at the same time, including schema repositories and all associated user databases preserves both data and customizations, and ensures that schema repositories and user databases are synchronized in case they need to be restored from a backup.

› Backup Option/Tool

To perform backup and recovery based on physical backup we have many solutions available. There are only two commands for backup, the primary is BACKUP DATABASE. This allows you to do a complete backup of your database as well as differential, file, etc.

The BACKUP DATABASE command gives you many options for creating backups.

› Create a full backup to disk

The command is BACKUP DATABASE database Name. The "TO DISK" option specifies that the backup should be written to disk and the location and filename to create the backup is specified.

Example:
```
BACKUP DATABASE DatabaseName  TO DISK = 'D:\backupFileName.BAK'
```

› Create a differential backup

This command adds the "WITH DIFFERENTIAL" option.

Example:
```
BACKUP DATABASE databaseName TO DISK = 'D:\BackupFileName.BAK' WITH DIFFERENTIAL
```

› Create a full backup to multiple disk files

This command uses the "DISK" option multiple times to write the backup to three equally sized smaller files instead of one large file.

Example:
```
BACKUP DATABASE databaseName TO DISK = 'C:\backupfileName.BAK',
                                DISK = 'D:\backupfileName.BAK',
                                DISK = 'E:\backupfileName.BAK'
```

› **Create a full backup with a password**

This command creates a backup with a password that will need to be supplied when restoring the database.

Example:
```
BACKUP DATABASE databaseName TO DISK = 'D:\backupfileName3.BAK'WITH PASSWORD = 'Abc\123'
```

› **Create a mirrored backup**

This option allows you to create multiple copies of the backups, preferably to different locations.

Example:
```
BACKUP DATABASE databaseName TO DISK = 'C:\backupFileName.BAK'
        MIRROR TO DISK = 'D:\backupFileName_mirror.BAK' WITH FORMAT
```

› **Specifying multiple options**

This next example shows how you can use multiple options at the same time.

Example:
```
BACKUP DATABASE databaseName TO DISK ='C:\backupFileName.BAK'MIRROR TO   DISK = 'D:\backupFileName_mirror.BAK' WITH FORMAT, STATS, PASSWORD = 'abc/123!'
```

The following are three basic backup option/tools

✓ **Secure Backup**

Passwords are not required to perform backup operations, but they provide an added level of security. You can use them in addition to using SQL Server security roles. The use of password protection helps guard against unauthorized or unintentional actions such as:

- Restoration of databases
- Appends to the media
- Overwriting of the media

✓ **A user Managed Backup**

In order to select a proper backup type, a SQL Server administrator needs to understand the difference between the major backup types clearly. You should always have proper backup plan in place to protect your database from failures. It is a strategy where you directly manage the file that make up your database with a mixture of host as commands and SQL plus backup and recovery related capability.

✓ **Recovery manager (RMAN)**

- Using tools (with command line and enterprise Manager GUI which is the development interface on the SQL Server) perform backup and recovery activities as well as maintaining repository of historical data.

- **Backup type**

SQL Server has different types of backups

✓ Full Backup
✓ Incremental Backup
✓ Transaction Log backup
✓ Differential backup
✓ File and file group backup

Difference between: Full, Differential, and Incremental Backup

Type	Definition	Benefits	Drawbacks
Full Backup	A complete backup of everything you want to backup.	Restoration is fast, since you only need one set of backup data.	The backing up process is slow. High storage requirements.
Differential Backup:	The backup software looks at which files have changed since you last did a full backup. For restoring all the data, you will only need the last full backup, and the last differential backup.	Faster to create than a full backup. Restoration is faster than using incremental backup. Not as much storage needed as in a full backup.	Restoration is slower than using a full backup. Creating a differential backup is slower than creating an incremental backup.
Incremental Backup	The backup software creates copies of all the files, or parts of files that have changed since previous backups of any type (full, differential or incremental).	This method is the fastest when creating a backup. The least storage space is needed.	Restoring from incremental backups is the slowest because to restore the data would require you to process the full backup

Note: The database must have full back up in order to take a differential backup, it only backups the changes since Last full backup.

Full/Differential/Transaction Log Backup using SQL Server Management Studio

- Right click on the database name
- Select Tasks > Backup
- Select backup type either "Full" or "Differential" or" Transaction Logl"
- Select the appropriate Backup Destination and click "OK"

File or File Groups Backup using SQL Server Management Studio

- Right click on the database name
- Select Tasks > Backup
- Select backup type either "Full" or "Differential"
- Select Backup component as "Files and file groups"
- Select the appropriate file group
- Select the appropriate Backup Destination and click "OK"

- **<u>Backup Mode</u>**
  - ✓ **Offline**

Offline backup is a way to store files from a network so that they will be accessible even when the user is not connected to the network they are stored on.

- ✓ **Online**

Online backup, also known as remote backup, is a method of offsite data storage in which files, folders, or the entire contents of a hard drive are regularly backed up on a remote server or computer with a network connection.
Online backup means to back up data from your hard drive to a remote server or computer using a network connection.

- **Configuring and testing database performance**

You need to configure the SQL server database to work with the application properly.

You can improve performance by considering the following items when configuring the database and log files.

1. Pre-allo/cating the space required for database files and log files will improve performance.
2. Allowing the log files to grow automatically is required to ensure that unexpected errors do not occur.
3. Placing the data files and log files on separate physical disk drives will improve performance substantially. Make sure that these physical disk drives have enough free space to allow for database growth.
4. The database must be backed up regularly, and other database maintenance tasks must be performed from time to time.

Database maintenance

After the application has been successfully installed, a database maintenance plan must be established.

Use the 'Maintenance Plan Wizard' to create the plan and schedule it. In the wizard, select these options:

- Check database integrity
- Shrink the database
- Reorganize the index
- Update statistics
- Do a full backup of the database

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- Monitoring and tuning efficiency of structured query language
- monitoring and measuring Performance of shared pool, blocks and buffers
- Detecting, identifying and resolving contentions that arise in the real-time operation of the database
- Reconfiguring the database according to specifications

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LO3. <u>Tune database</u>

- Monitoring and tuning efficiency of structured query language
  3..1 Tune I/O
- monitoring and measuring Performance of shared pool, blocks and buffers
  3..1 Check the SQL query optimization
  3..2 Tune memory
- Detecting, identifying and resolving contentions that arise in the real-time operation of the database
- Reconfiguring the database according to specifications

LO3. Tune database

Database tuning describes a group of activities used to optimize and homogenize the performance of a database. Database tuning aims to maximize use of system resources to perform work as efficiently and rapidly as possible.

- **Monitoring and tuning efficiency of structured query language**

Microsoft SQL Server provides a comprehensive set of tools for monitoring events in SQL Server and for tuning the physical database design. The choice of tool depends on the type of monitoring or tuning to be done and the particular events to be monitored.

- **Tune I/O**

Hardware and software configuration of disk subsystems MUST examine:

- RAID levels and configuration,
- Block and stripe size allocation,
- The configuration of disks, controller cards, storage cabinets, and external storage systems.

Frequently accessed tables and indexes are placed on separate disks to balance I/O and prevent read queuing.

- **Monitoring and measuring Performance of shared pool, blocks and buffers**
- **Check the SQL query optimization**

Query optimization is a function of many relational database management systems. The **query optimizer** attempts to determine the most efficient way to execute a given query by considering the possible query plans.
Indexing a column is a common way to optimize the search result.

SQL Tuning/SQL Optimization Techniques:

1) The SQL query becomes faster if you use the actual columns names in SELECT statement.

Example: SELECT Id, FirstName, LastName, Age, subject FROM student_details; Instead of:
SELECT * FROM student_details;

2) Use operator EXISTS, IN and table joins appropriately in your query.

a) IN is efficient when most of the filter criteria is in the sub-query, but Usually IN has the slowest performance.

b) EXISTS is efficient when most of the filter criteria is in the main query.

Example:
```
Select * from product p
        where EXISTS (select * from order_items o
                      where o.product_id = p.product_id)
Instead of:
      Select * from product p
            where product_id IN(select product_id from order_items
```

- **Tune memory**

Each process running on a computer requires a certain amount of memory to temporarily store its machine code and data. Database management systems (DBMS) also employ shared memory to store data used by many client applications. Memory tuning involves the allocation of the memory resource to the various components of the database management system.
Memory management is all about allocation of objects. A correctly tuned memory management system minimizes the overhead inflicted by garbage collection and makes object allocation fast.

Note: - Contentions are detected, identified and resolved that may arise in the real-time operation of the database.
- Database *must be* reconfigured according to organizational specifications