Microsoft Premier Field Engineering

Microsoft Dynamics AX 2012
Health Check Soler & Palau

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Microsoft Dynamics

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Contents

Revision and Sign-Off

Change Record

Date	Author	Version	Change Reference
26/02/2014	Carlos Ochoa Esteve	1.01	Start draft.
17/03/2014	Carlos Ochoa Esteve	1.02	Close draft.

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Health Check Overview

Program Goals:

- Assess risks and evaluate health of the Dynamics AX environment using a powerful suite of data collection and analysis tools, and in-depth operational interviews.
- Identify key areas where the environment deviates from Microsoft best practices and configuration guidance.
- Establish assessment results that can generate a remediation plan used to complete improvements to the health of the environment and to resolve or mitigate risks.

Program Phases:

- Environmental Assessment: Accredited Microsoft Engineers collect data from the environment focusing on key known areas.
- Analysis and Reporting: The engineer analyzes the results to compare against best practices, identify risks and health related problems, and prepares a findings report.
- Remediation Planning: Once problems and risks have been discovered, a full remediation action plan should be established to assist in the effort to remediate and stabilize the environment.

Additional Considerations:

- This assessment focuses on infrastructure health and the core components of Dynamics AX that are common across the entire application. Health Checks that focus on the specifics of your functional configuration for modules such as Finance, Trade and Logistics, Production, or Manufacturing are available as separate engagements.

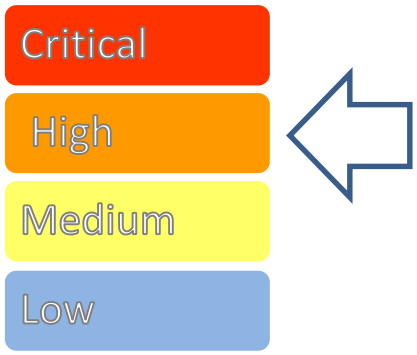
Risk and Health Assessment Methodology

The overall results of the assessment are split into two main parts – Health and Risk. This is done to provide a more accurate view of the overall environment.

- Overall Health Result
  - Primarily relates to the current state of the environment. Includes key components and services functioning the way they should, systems online and responsive, and so on.
  - Typical health issues equate to active problems.
- Overall Risk Result
  - Primarily relates to the potential future state of the environment. Includes the processes, documentation and systems that would help mitigate future problems. This can include change control, monitoring, service level agreements, training, and so on.
  - Typical risk issues equate to increased chances of new or worsening problems in the future.

The risk and health issue severity levels are critical, high, medium, and low. These severity levels are used to describe overall health/risk and are also assigned to each individual issue identified in the report.

Overall Health Result

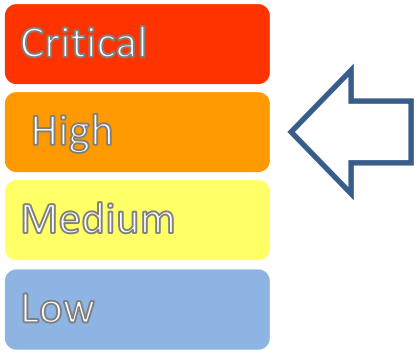


The Overall Health Issue score is **HIGH:**

The following **High** health issues were reported:

- Batch configuration.
- AOS Load Balancing and High Availability.
- Trace Flag 4199.
- Max degree of parallelism.
- TempDB data and log files location.
- TempDB Data & Log file auto growth increment.
- Index maintenance on the AX database.

Overall Risk Result



The Overall Risk Issue score is **HIGH**:

The following **High** risk issues were reported:

- AX Database Recovery Model.
- TempDB Data files count.
- Disaster recovery plan.
- High Availability for SQL.

Scorecards

The scorecards for the Microsoft Dynamics™ AX environment are provided below. These scorecards are a composite view based on the data collected and the answers given throughout the course of interviews and surveys to illustrate the possibility of encountering issues in a specific area. The scorecards show the state of the system with respect to health (current issues) and risk (potential for future issues).

Issue Severity Levels
Critical
High
Medium
Low
No Issues

Scorecards	Current Health Issues	Future Risk Issues
Configuration		
Application	No Issues	High
AOS Server	High	Medium
SQL Server	High	Medium
Database	High	High
Operations		
Operating Environment	High	Medium
Monitoring & Maintenance	High	High
AOS Event Logs	High	Medium
Security		
Application	Medium	Low
SQL Server / Database	Low	Low
Performance	High	High

Issues & Recommendations

The issues identified in the Health Check are summarized below. Each issue indicates whether it pertains to the existing health of the system or the risk of future issues. Each issue is also assigned a severity level based on the impact to the system:

Configuration Score Card

Current Health / Future Risk

Application Configuration

Issue 1: Client Performance Options	
Issue Type: Health	**Issue Severity:** Medium
No timeout is set of the queries in the Client Options Form. It is recommended to set a timeout for queries. A reasonable value would be from 1 to 5 seconds. This settings is system-wide affecting all users.	

Issue 2: Batch configuration	
Issue Type: Health	**Issue Severity:** High
One AOS instance enabled for Batch processing. If instance is stopped all batch jobs will not run. Currently only one AOS is enabled for Batch with default 8 threads.	

Info: Latest Application and Kernel	
Issue Type: Health	**Issue Severity:** Medium
It is recommended to keep planning the deployment of the latest fixes available. There are already some kernel released and a Cumulative Update is expected to be released.	

AOS Server

Issue 1: Power Management Settings	
Issue Type: Risk	**Issue Severity:** Medium
Power Management Settings was set to Balanced and changed to High Performance.	

The recommended configuration for AOS servers is to be set for High Performance. In virtual environments confirm Host grants high priority resources to the AOS server. On physical servers confirm BIOS power options are also set to high performance of CPUs.

Issue 2: AOS Table cache	
Issue Type: Health	**Issue Severity:** Low
Entire Table Cache was changed during the onsite set to 128KB. It is recommended to increase the value to 16 pages, so 128 KB. The fact that we were able to change it so smoothly reflects to facts, that there is a great operational flexibility over the environments but no change control procedure was applied.	

Issue 3: AOS Load Balancing and High Availability	
Issue Type: Health	**Issue Severity:** High
Only one AOS is in the AOS cluster which is a single point of failure for the AX sessions It is recommended to have at least 2 AOS in the transactional cluster for High Availability. Recommendation is also to implement an NLB for AOS Services.	

SQL Server

Issue 1: Trace Flag 4199	
Issue Type: Health	**Issue Severity:** High
Trace Flag 4199 is not enabled This trace flag is recommended to improve Dynamics AX performance. It should be validated on test environment before setting in production. Check the Trace flag chapter in the document for further details.	

Issue 2: Max degree of parallelism	
Issue Type: Health	**Issue Severity:** High
Max degree of Parallelism is set to 0. Following best practice recommendations, Max degree of Parallelism should be set to 1. This could improve performance of AX application but should be validated on test environment before setting it on production	

Issue 3: Server authentication	
Issue Type: Risk	**Issue Severity:** Medium
SQL Server Authentication is set to Mixed. The recommendation is to set it to Windows Authentication.	

Issue 4: Default index fill factor	
Issue Type: Health	**Issue Severity:** Low
SQL Server Property "Default Index fill factor" is set to 0 (= 100). The recommendation is to set to a specific value (70 to 90 for instance) to limit the number of page splits; this would impact performance. This value can be specified in the Index Rebuild scripts or Maintenance plans instead.	

Issue 5: SQL Server network configuration	
Issue Type: Health	**Issue Severity:** Low
SQL Server Network Configuration: Shared Memory and Named Pipes are enabled Only necessary protocols should be enabled. Verify if the Share Memory and Named Pipes are necessary; otherwise disable it to improve the network stack performance and reduce the security boundaries.	

Issue 6: Perform volume maintenance	
Issue Type: Health	**Issue Severity:** Medium
Perform volume maintenance task: Rights not granted to SQL Server Service Account but to Administrators group where the account is added. This right should be granted to SQL Server Service Account to allow Instant File Initialization.	

Issue 7: Lock Pages in Memory	
Issue Type: Health	**Issue Severity:** Medium
Lock Pages in Memory: No rights granted to the SQL Server Execution Account This right should be granted to SQL Server service Execution Account according to Best Practices. It can reduce paging of buffer pool memory.	

Database (Dynamics AX database and TempDB)

Issue 1: Recovery Model	
Issue Type: Risk	**Issue Severity:** High
Current model is Simple It is strongly recommended to have FULL model.	

Issue 2: TempDB data and log files location	
Issue Type: Health	**Issue Severity:** High
TempDB data and log files are on the same disk as the Dynamics AX database It is recommended that data and log files are on separated drives: one dedicated drive for Data, one drive for Log, and one for TempDB (Data and Log).	

Issue 3: TempDB Data & Log file auto growth increment	
Issue Type: Health	**Issue Severity:** High
TempDB data and log file auto grow increment is 10% Recommended values are between 200 and 500 MB.	

Issue 4: TempDB Data files count	
Issue Type: Risk	**Issue Severity:** High
TempDB data files should be equal to the numbers of cores and up to 8. Depending on processors' technologies and architectures (NUMA nodes) it could be tested if 2 or 4 provides better performance in conjunction with the storage system settings, otherwise apply the general rule, 1 per core up to 8.	

Operations Scorecard

Operating environment

Issue 1: Disaster recovery plan	
Issue Type: Risk	**Issue Severity:** High
Business continuity / disaster recovery There is not recovery plan defined. Therefore all risks are not currently being covered by the backup plan. The recommendation is to define the recovery plan and in accordance agree on the backup plan of each component. It is also recommended to document and periodically test the procedures to measure recovery times to agree on potential SLAs and guarantee successfulness of the tasks defined in the plans.	

Issue 2: Change control procedures	
Issue Type: Health	**Issue Severity:** Medium
No structured change control procedures documented. Please review the Code Promotion for best practices.	

Issue 3: High Availability for SQL Server	
Issue Type: Risk	**Issue Severity:** High
There is a single instance for SQL Server. This is a single point of failure. The recommendation is to setup an Active / Passive SQL Server cluster to maintain High Availability of the database.	

Monitoring and Maintenance

Issue 1: Database Backup	
Issue Type: Risk	**Issue Severity:** High
SQL Server has no Log Backup maintenance plan set up. It is recommended to run the FULL back up every day and the Transactional Log every few hours to ensure best SLAs. More information on the backup and restore strategies in SQL Server can be found here: http://msdn.microsoft.com/en-us/library/ms191239.aspx	

Issue 2: Index maintenance on the AX database	
Issue Type: Health	**Issue Severity:** High
Index maintenance plan should be periodically reviewed.	

This is highly recommended to improve performance. Maintenance plans or specific jobs can be used on specific indexes which requires more maintenance. Further index optimization is needed to be done periodically.

Issue 3: AX Standard Clean Up jobs	
Issue Type: Health	**Issue Severity:** Medium
AX standard cleanup jobs are not planned. Regularly execute AX standard cleanup jobs to avoid database growth.	

AOS Event Logs

Issue 1: AOS Event log Errors	
Issue Type: Health	**Issue Severity:** Medium
AOS Event Logs Some of AOS Event log should be reviewed and require further investigation. Recommendation is to keep on monitoring AOS event logs to detect potential issues, like client version mismatch events. Also, Remove AOS startup parameter to limit the memory usage to 75% as there were connections being dropped because of such limit being reached.	

Security Scorecard

Dynamics AX Security

Issue 1: Dedicated Services Account	
Issue Type: Risk	**Issue Severity:** Medium
AOS, SQL Service Accounts should be dedicated for its own purpose. **Also the Business Connector Proxy Account needs to be a dedicated account.** Recommendation is to use different and dedicated Active Directory accounts for AOS, SQL and Business Connector. These account should not be granted excessive privilege, like SQL Server account being Local Administrator in current environment.	

Issue 2: Database logging	
Issue Type: Risk	**Issue Severity:** No issue
Database logging should be reviewed and periodically clean up when used.	

Performance Scorecard

Server Utilization

Issue 1: Disk Latency	
Issue Type: Health	**Issue Severity:** Medium
Disk latency on logical drives on AOS and SQL have peaks Investigate the peaks and make sure both drives are dedicated to avoid conflict of resource after Go Live. This is related to the SQL recommendations to split the Data, Log and TempDB files.	

Issue 2: Implement DynamicsPerf in TEST environment	
Issue Type: Risk	**Issue Severity:** Medium
In order to detect potential issues before moving to production, it is recommended to use DynamicsPerf in test environment to detect potential performance issues.	

Scorecard Detail

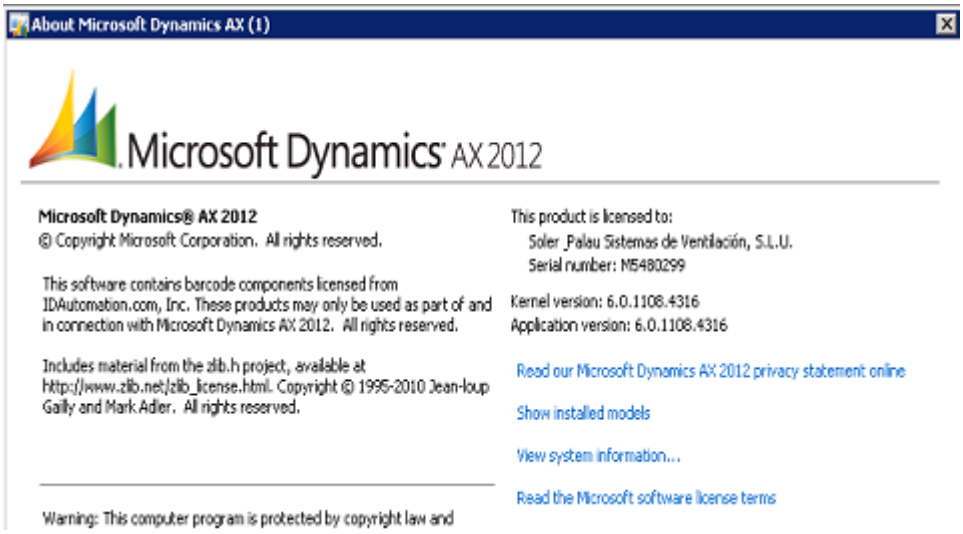
Configuration Score Card

Dynamics AX Configuration

Version	Best Practice	Actual
Kernel Version	AX Client Kernel and application versions should be at the same service pack level.	1108.4316 CU5
Application Version	Kernel and application versions should be at the same service pack level.	CU5
AX Client and AOS Kernel Version	AX Client and AOS Kernel Version should be the same build	Yes
AX Client Configuration	All AOS listed	Yes
Configuration keys – Key Update Objects	Disabled Found in: Administration > Setup > System > Configuration	Disabled
Number Sequence Settings	Cache settings optimized based on workload.	Several sequences to review
Entire Table Cache for tables	Don't set "entire table" cache to big tables See "Entire table cache" note below for details	N/A
Entire Table Cache for tables frequently updated	Don't set "entire table" cache to big tables See "Entire table cache" note below for details	N/A
Batch Configuration	Appropriate server and thread configuration for workload.	Few groups. Default 8 threads.

Dynamics AX Version

Cumulative Update 5	6.0.1108.4316	29 Apr 2013	KB2828929



Currently several Hot Fixes are available to customer and partner. Please read the following site for complete list of Hot Fixes released: http://blogs.msdn.com/b/axsupport/archive/2012/03/29/overview-of-ax-build-numbers.aspx

Here is the top of the list as of today:

Version	Build number	Comment	Comment/Link
Recent published kernel build	6.0.1108.6414	30 Jan 2014	KB2865738

The hotfix list is available at customer source: Hot Fixes Released For Microsoft Dynamics AX 2012

If you wish to download one Hot Fix, Kernel or Application, please read the following article: http://technet.microsoft.com/EN-US/library/jj161010

Please read the following TechNet article for Best practices on installing a new Hot Fix on Dynamics AX 2012: http://technet.microsoft.com/en-us/library/dd309578.aspx

Configuration Key – Keep Update Objects

- The Dynamics AX configuration key Keep update objects is de-activated in Dynamics AX production environment: this is the best practice.

The configuration key can be adjusted in the following location:
System Administration > Setup > Licensing > License Configuration

Number sequences

Organization administration **>** Common **>** Number sequences **>** Number sequences

You can get the information on number sequences below by running the following query in the DynamicsPerf database:

```
select N.DATAAREAID as [CompanyID], N.[Number sequence total],
isnull(N.[Number sequence continuous],0) AS [Number sequence continuous],
isnull(N.[Number sequence non continuous],0)AS [Number sequence non continuous],
isnull(N.[Number sequence non continuous with pre-allocation],0)AS [Number sequence non
continuous with pre-allocation]
from (
SELECT DISTINCT
      DATAAREAID,
      (SELECT COUNT(*) FROM AX_NUM_SEQUENCES_CURR_VW NT1
            WHERE NT.DATAAREAID = NT1.DATAAREAID  AND NT1.NEXTREC > 0
            GROUP BY NT1.DATAAREAID) AS [Number sequence total],
      (SELECT COUNT(*) FROM AX_NUM_SEQUENCES_CURR_VW NT2
               WHERE NT.DATAAREAID = NT2.DATAAREAID AND NT2.CONTINUOUS = 1  AND
NT2.NEXTREC > 0
               GROUP BY NT2.DATAAREAID) AS [Number sequence continuous],
      (SELECT COUNT(*) FROM AX_NUM_SEQUENCES_CURR_VW NT3
                WHERE NT.DATAAREAID = NT3.DATAAREAID AND NT3.CONTINUOUS = 0  AND
NT3.NEXTREC > 0
               GROUP BY NT3.DATAAREAID) AS [Number sequence non continuous],
      (SELECT COUNT(*) FROM AX_NUM_SEQUENCES_CURR_VW NT4
               WHERE NT.DATAAREAID = NT4.DATAAREAID AND NT4.CONTINUOUS = 0 AND
NT4.FETCHAHEAD <> 0
                           AND NT4.NEXTREC > 0
               GROUP BY NT4.DATAAREAID) AS [Number sequence non continuous with pre-
allocation]
FROM AX_NUM_SEQUENCES_CURR_VW NT )as N
```

The current Number Settings for :

Number sequence total	Number sequence continuous	Number sequence non continuous	Number sequence non continuous with pre-allocation
6966	**3635**	**3331**	**1224**

General best practices

Continuous means requirement to keep a list of used numbers per sequence and the list management might be a reason of performance degradation especially in posting and import processes.

With this pre-allocation option performance for non-continuous numbers sequences can be greatly improved. Pre-allocation is a standard functionality which can be enabled in Number Sequence form inside Dynamics AX.

Recommendation is to leave only necessary sequences as “Continuous” (normally it will be 2-3 per AX company in dependence on local law) and keep others as non-continuous. Then it needs to be decided which number sequences can be speeded up by pre-allocation.

Continuous Number Sequences

The following SQL Script gives the number of continuous number sequences consumed during the On Site:

```
WITH OrderedStatsCollections AS
(
    SELECT run_name,
    ROW_NUMBER() OVER (ORDER BY stats_time) AS 'RowNumber'
    FROM stats_collection_summary
)
-- Select max created rows, in all stats collections, for each continuous
numbersequence/dataareaid.
SELECT [DATAAREAID], [NUMBERSEQUENCE], [TXT], MAX ([TOTAL NUMBERS CONSUMED])AS  [TOTAL
NUMBERS CONSUMED], duration, FORMAT
from
(
       SELECT   RUN1.DATAAREAID, RUN1.NUMBERSEQUENCE as NUMBERSEQUENCE , RUN1.TXT AS TXT,
                     RUN2.NEXTREC - RUN1.NEXTREC AS  [TOTAL NUMBERS CONSUMED],
                      duration = 'In ' +  STR((DATEDIFF(hh,RUN1.STATS_TIME,
RUN2.STATS_TIME)),2) + 'hour periods' ,
                     RUN1.[FORMAT]
       FROM     [AX_NUM_SEQUENCES_VW] RUN1
                     INNER JOIN   [AX_NUM_SEQUENCES_VW] RUN2
                                          ON RUN1.NUMBERSEQUENCE = RUN2.NUMBERSEQUENCE
                                          AND RUN1.DATAAREAID = RUN2.DATAAREAID
                   INNER JOIN OrderedStatsCollections S1
                          ON  S1.Run_Name = RUN1.Run_Name

                   INNER JOIN OrderedStatsCollections S2
                          ON  S2.Run_Name = RUN2.Run_Name
                   WHERE
                          RUN1.[CONTINUOUS] = 1
                          AND S2.RowNumber = S1.RowNumber + 1
                          AND RUN2.NEXTREC > RUN1.NEXTREC
                          AND DATEDIFF(hh,RUN1.STATS_TIME, RUN2.STATS_TIME) = 3
) RES

GROUP BY      [DATAAREAID], [NUMBERSEQUENCE], [TXT] , duration, FORMAT
ORDER BY [TOTAL NUMBERS CONSUMED] DESC;
```

NUMBERSEQUENCE	TXT	TOTAL NUMBERS CONSUMED	duration	FORMAT

EST2-1114	Acti_141	22	In 5hour periods	IT-T-######
EST2-1113	Acti_140	13	In 5hour periods	C001-#####
EST2-1115	Acti_142	10	In 5hour periods	IT-T-#####

Non-Continuous Number Sequences with a Pre-allocation Quantity of 0

To reduce database calls and improve performance, it is recommended to review the sequences that are currently set to non-continuous but have a pre-allocation value of 0 and select an appropriate value for the fetch-ahead quantity.

This is the query that will help you get the list of number sequence that were consumed more than 100 numbers.
In the current scenario the outcome is meaningless. Start using it in test environment to isolate potential number sequences candidates for optimization.

```
WITH OrderedStatsCollections AS
(
    SELECT run_name,
    ROW_NUMBER() OVER (ORDER BY stats_time) AS [RowNumber]
    FROM stats_collection_summary
 )
-- Select max created rows, in all stats collections, for each non-continuous + no-
prefetch numbersequence/dataareaid.
SELECT [NUMBERSEQUENCE], [TXT],
 MAX ([TOTAL NUMBERS CONSUMED])AS  [TOTAL NUMBERS CONSUMED],
 MAX ([AVG HOURLY CONSUMPTION RATE]) AS [AVG CONSUMPTION in 1 hour periods],
 FORMAT
from
(
       SELECT    RUN1.NUMBERSEQUENCE as NUMBERSEQUENCE , RUN1.TXT AS TXT,
                       RUN2.NEXTREC - RUN1.NEXTREC AS [TOTAL NUMBERS CONSUMED],
                      (RUN2.NEXTREC - RUN1.NEXTREC)/(DATEDIFF(hh,RUN1.STATS_TIME,
RUN2.STATS_TIME)) AS [AVG HOURLY CONSUMPTION RATE],
                       RUN1.[FORMAT]
       FROM     [AX_NUM_SEQUENCES_VW] RUN1
                       INNER JOIN   [AX_NUM_SEQUENCES_VW] RUN2
                                       ON RUN1.NUMBERSEQUENCE = RUN2.NUMBERSEQUENCE
                     INNER JOIN OrderedStatsCollections S1
                             ON  S1.Run_Name = RUN1.Run_Name

                     INNER JOIN OrderedStatsCollections S2
                             ON  S2.Run_Name = RUN2.Run_Name
                     WHERE
                             ((RUN1.[CONTINUOUS] = 0) AND (RUN1.FETCHAHEADQTY = 0))
                             AND S2.RowNumber = S1.RowNumber + 1
                             AND RUN2.NEXTREC - RUN1.NEXTREC > 100
) RES
GROUP BY      [NUMBERSEQUENCE], [TXT] , FORMAT
ORDER BY [TOTAL NUMBERS CONSUMED] DESC;
```

These results are an interpretation only of the monitoring period activity and cannot presume of other number sequences which might be highly used in specific periods of activity. In our case, 0, as explained above.

Number sequence information can be reviewed/changed in the following location:

1. Basic > Setup > Number Sequences > Number Sequences.
2. On the Overview tab select a Number Sequence Code.
3. Click on the General tab to review the parameters for that specific Number Sequence Code. Under the Setup heading is a checkbox labeled Continuous that enables/disabled continuous numbering.
4. If continuous numbering is not required, uncheck the Continuous checkbox.
5. Once you uncheck the Continuous checkbox the pre-allocation option on the Performance tab become available. This is where you can specify how many numbers will be allocated per AOS. If for example you specify 50 as the quantity, an AOS will only have to request a number from the database every 50th time it needs one.

Number sequences with 20% or fewer numbers remaining

The goal of this rule is to identify number sequences where the customer may run out of numbers in the near future. The output should give the customer enough information to uniquely identify the number sequence that needs attention.

```
--AX 2012 R2 Only
SELECT        NST.NUMBERSEQUENCE AS [NumberSequence]
            , NST.TXT AS [Text]
            , CAST ((CAST((NST.HIGHEST - NST.NEXTREC) AS
DECIMAL(20,2))/(CAST((NST.HIGHEST - NST.LOWEST) AS DECIMAL(20,2))) * 100) AS
DECIMAL(5,2)) AS [PercentRemaining]
            , NST.HIGHEST - NST.NEXTREC AS [NumbersRemaining]
            , P.NAME AS [PartitionName]
            , NST.NUMBERSEQUENCESCOPE
FROM NUMBERSEQUENCETABLE NST
      JOIN PARTITIONS P ON  NST.PARTITION = P.RECID
      JOIN NUMBERSEQUENCESCOPE NSS ON NSS.RECID = NST.NUMBERSEQUENCESCOPE
WHERE INUSE = 1 AND CAST ((CAST((HIGHEST - NEXTREC) AS
DECIMAL(20,2))/(CAST((HIGHEST - LOWEST) AS DECIMAL(20,2))) * 100) AS
DECIMAL(5,2)) <= 20
ORDER BY 3
```

Using the Enhanced Number Sequence Framework in Microsoft Dynamics AX 2012
http://technet.microsoft.com/en-us/library/hh209457.aspx

Entire table cache

When you set a table's CacheLookup property to EntireTable, all the records in the table are placed in the cache after the first select. This type of caching follows the rules of single record caching in which the SELECT statement WHERE clause fields must match those of the unique index defined in the table's PrimaryIndex property.

An EntireTable cache is flushed whenever an insert, update, or delete is made to the table. At the same time, the AOS notifies other AOSs that their caches of the same table must be flushed. After the cache is flushed, a subsequent select on the table causes the entire table to be cached again. Therefore, avoid caching any table that's frequently updated. Regardless of when updates are made, EntireTable caches are flushed every 24 hours by the AOS.

When tables that are larger than 128K (16 pages) are cached, the AOS is forced to write them to disk instead of keeping them in memory. Because of this limitation it's better to use a different kind of cache for tables that meet this condition.

Every time a table that is configured to use entire table cache gets updated, all AOS servers must flush it from cache and reload it. This is an expensive operation, so tables that are updated frequently are not ideal candidates for entire table caching.

The scripts below (which you can execute on DynamicsPerf database) will perform the following:

```
SELECT DISTINCT A.TABLE_NAME as [Table Name],
       APPLICATION_LAYER as [Application Layer],
       PAGE_COUNT as [Page Count]
FROM   AX_TABLE_DETAIL_CURR_VW A,
              INDEX_STATS_CURR_VW I
WHERE  A.DATABASE_NAME = I.DATABASE_NAME
AND           A.TABLE_NAME = I.TABLE_NAME
AND           CACHE_LOOKUP = 'EntireTable'
AND           (INDEX_DESCRIPTION  = 'HEAP' OR INDEX_DESCRIPTION LIKE 'CLUSTERED%')
AND           PAGE_COUNT > 16
ORDER BY PAGE_COUNT DESC
```

We used the number pages because the current setting is 128 KB in the AOS [performance optimization settings.]

- This returns 1 tables: It is recommended to change the cache type of these tables starting with the largest one and highest update rates.

Table Name	Application Layer	User Updates
DMFDEFINITIONGROUPENTITY	fpk	67

User Update for table in cache

List all tables with the EntireTable cache lookup and how often they are updated:

```
SELECT DISTINCT A.TABLE_NAME as [Table Name],
                A.APPLICATION_LAYER as [Application Layer],
                I.USER_UPDATES as [User Updates]
FROM   AX_TABLE_DETAIL_CURR_VW A,
               INDEX_STATS_CURR_VW I
WHERE  A.DATABASE_NAME = I.DATABASE_NAME
AND            PAGE_COUNT > 0
AND         USER_UPDATES >= 50
AND            A.TABLE_NAME = I.TABLE_NAME
AND            CACHE_LOOKUP = 'EntireTable'
AND            (INDEX_DESCRIPTION  = 'HEAP' OR INDEX_DESCRIPTION LIKE 'CLUSTERED%')
ORDER BY USER_UPDATES DESC
```

- This returns 1 table. Recommendation is to not set "entire table" cache to big tables. Similarly after the cache is flushed, a subsequent select on the table causes the entire table to be cached again. Therefore, avoid caching any table that's frequently updated.
- Keep on monitoring on test environment to identify potential candidates to improve performance.

Record caching

This script will perform the following:

- List all tables that have a cache setting other than Entire Table but don't have the primary key or unique index required to allow caching to take place.
- List all tables that have the primary key or unique index required to allow caching to take place, but don't have caching configured in the AOT.

```
SELECT I.TABLE_NAME, AXTD.CACHE_LOOKUP
from INDEX_STATS_CURR_VW I
       INNER JOIN AX_TABLE_DETAIL_CURR_VW AXTD
         ON I.TABLE_NAME = AXTD.TABLE_NAME
WHERE AXTD.CACHE_LOOKUP <> 'None' AND AXTD.CACHE_LOOKUP <> 'EntireTable'
       AND I.TABLE_NAME NOT IN
         (SELECT DISTINCT I2.TABLE_NAME
          FROM INDEX_STATS_CURR_VW I2
          WHERE I2.INDEX_DESCRIPTION LIKE '%PRIMARY%')
GROUP BY I.TABLE_NAME, AXTD.CACHE_LOOKUP
ORDER BY I.TABLE_NAME
```

- tables have been found:

TABLE_NAME	CACHE_LOOKUP
DEL_PDSINVENTSUM	NotInTTS

HRMABSENCETABLE	NotInTTS
HRMAPPLICANTROUTING	Found
HRMAPPLICATION	Found
HRMCOMPELIGIBILITY	FoundAndEmpty
HRMCOMPELIGIBILITYLEVEL	FoundAndEmpty
HRMCOMPEVENT	NotInTTS
HRMCOMPEVENTEMPL	NotInTTS
HRMCOMPEVENTLINE	NotInTTS
HRMCOMPEVENTLINECOMPOSITE	NotInTTS
HRMCOMPEVENTLINEFIXED	NotInTTS
HRMCOMPEVENTLINEPOINTINTIME	NotInTTS
HRMCOMPFIXEDACTION	FoundAndEmpty
HRMCOMPFIXEDBUDGET	FoundAndEmpty
HRMCOMPFIXEDPLANTABLE	FoundAndEmpty
HRMCOMPFIXEDPLANUTILMATRIX	FoundAndEmpty
HRMCOMPORGPERF	FoundAndEmpty
HRMCOMPPERFALLOCATION	NotInTTS
HRMCOMPPERFALLOCATIONLINE	NotInTTS
HRMCOMPPERFPLANEMPL	FoundAndEmpty
HRMCOMPPROCESS	NotInTTS
HRMCOMPPROCESSLINE	NotInTTS
HRMCOMPPROCESSLINEACTION	NotInTTS
HRMCOMPVARENROLLEMPL	NotInTTS
HRMCOMPVARENROLLEMPLLINE	NotInTTS
HRMCOMPVARPLANLEVEL	NotInTTS
HRMCOMPVARPLANTABLE	FoundAndEmpty
HRMCOMPVARPLANTYPE	FoundAndEmpty
HRMCOURSEAGENDA	NotInTTS
HRMCOURSEAGENDALINE	NotInTTS
HRMCOURSEATTENDEE	NotInTTS
HRMCOURSEATTENDEELINE	NotInTTS
HRMCOURSEHOTEL	NotInTTS
HRMCOURSELOCATIONPICTURE	Found
HRMCOURSEROOM	Found
HRMCOURSESESSION	NotInTTS
HRMCOURSESESSIONTRACK	NotInTTS
HRMCOURSETABLE	Found
HRMCOURSETABLEINSTRUCTOR	Found
HRMRECRUITINGJOBAD	Found
HRMRECRUITINGMEDIA	Found
HRMRECRUITINGTABLE	Found
KMKNOWLEDGECOLLECTORPLANNINGTABLE	NotInTTS
KMQUESTIONNAIRESTATISTICSTABLE	NotInTTS
PDSCATCHWEIGHTITEM	FoundAndEmpty
PROJCONTROLPERIODCOSTGROUP	NotInTTS
PROJCONTROLPERIODTABLE	NotInTTS
PROJCONTROLPERIODTABLECOLUMN	NotInTTS
PROJCOSTPRICEEXPENSE	Found
PROJCOSTTRANS	NotInTTS

PROJEMPLTRANS	NotInTTS
PROJFORECASTCOST	NotInTTS
PROJFORECASTEMPL	NotInTTS
PROJFORECASTONACC	NotInTTS
PROJFORECASTREDUCTIONHISTORY	NotInTTS
PROJFORECASTREVENUE	NotInTTS
PROJHOURCOSTPRICE	Found
PROJONACCTRANS	NotInTTS
PROJREVENUETRANS	NotInTTS
PROJWIPTABLE	Found
PSAACTIVITYGROUPFORHIERARCHY	Found
PSAVENDORRETENTIONTERMSTABLE	Found
SIGPARAMETERS	Found
SIGPROCSETUPFIELD	FoundAndEmpty
SIGREASONCODE	NotInTTS
SIGSIGNATUREDELEGATION	NotInTTS
SIGSIGNATURELOG	NotInTTS
SMASERVICEBOMTABLE	Found
SMATEMPLATEBOMTABLE	Found
SMMLEADPRIORITYTABLE	Found
SMMLEADRATINGTABLE	Found
SMMLEADRELTABLE	Found
SMMLEADTABLE	NotInTTS
SMMLEADTYPETABLE	Found
TRVCASHADVANCE	NotInTTS
TRVCREDITCARDS	Found
TSTIMESHEETTABLE	Found

Notes:

Record caching is enabled for a table when all the following statements are true:

- The CacheLookup property on the table is enabled by setting it to one of the following values:
  - notInTTS
  - Found
  - FoundAndEmpty

- The table's PrimaryIndex property is set to a unique index that exists on the table. The RecId index does not qualify as a caching index unless you set the table's PrimaryIndex property to this index.

- The record buffer disableCache method has not been called with a parameter of true.

The fields in the table's unique index make up the caching key. A record is placed in the cache when the following criteria are met:

- The table is cached by setting the CacheLookup property to notInTTS, Found, or FoundAndEmpty.

- The SELECT statement that selects the records uses an equal operator (==) on the caching key. The fields in the WHERE clause of the SELECT statement match the fields in the index referenced by the table's PrimaryIndex property.

Cache settings for a table can be found in the following location:
AOT > Data Dictionary > Tables > TableName > Properties > CacheLookup.

For more information on caching please refer to the following MSDN article:
http://msdn2.microsoft.com/en-us/library/bb278240.aspx

- Review in test environment while running test to locate potential candidates to improve performance.

Batch Configuration

Dynamics AX batch Settings	Best Practice	Actual
Batch		
AOS dedicated to batch	Dedicated for heavy workloads	Single AOS.
Maximum batch threads	Adjusted – 8 by default	8
Batch scheduling		24h
Batch Group	System Admin - Setup - Batch group	N/A

Batch group

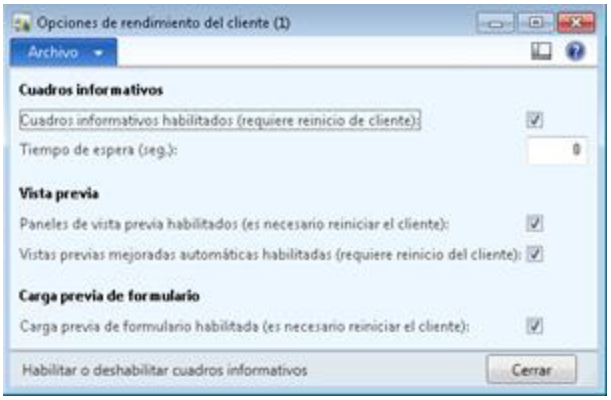
- It is recommended to create one batch group for each batch activity with dependent tasks. This will facilitate the maintenance of the batch over all AOS and define the parallelism of jobs.

General Batch recommendation are:

Please take these general advices into consideration:
- 2 to 4 Threads per Core for Dedicated Batch Servers
- Heavy Duty transactions that are long running should be 1 Thread Per Core
- Batches Are Assigned to Batch Groups
- Batch Servers Participate in Batch Groups
- Batch Threads are allocated on Batch Servers
- Make Sure your Batch Group Allocation does not cause Resource conflicts for other batch jobs.
- Avoid locking and blocking

AX Client configuration

Dynamics AX client Settings	Best Practice	Actual
Client Settings		
General		
Partition	R2 only	Not apply.
Company	Empty by default	Empty
Command to run at application startup	Empty	Empty
Configuration command to run at kernel startup	Empty	Empty
Startup message	Empty	Empty
Connection		
Server names	Only available AOS's	1 AOS listed.
TCPIP	2712	2712
WDSL Port	8201	8201
Connect to printers on the servers	Disabled	Disabled
Encrypt client to server communication	Enabled	Enabled
Developer		
Enable user breakpoints to debug code in the Business Connector	Disabled	Enabled
Enable global breakpoints to debug code running in the Business Connector or client	Disabled	Enabled
Performance		
Cache settings	Least Memory for RDP	Default
Client Performance Options	Setup – System	
Fact boxes	If Fact Boxes are enabled be aware of performance impact.	Enabled
Timeout (sec)	2 to 5	0
Preview panes	If Preview panes are enabled be aware of performance impact.	Enabled
Automatic enhanced previews enabled	Enabled	Enabled
Form Pre-loading enabled	Enabled	Enabled



Client performance options

In order to improve the overall performance of the client, it is recommended to investigate each setting for the client.

You can read the following article for explanation on Client settings and optimization:
http://blogs.msdn.com/b/axperf/archive/2011/11/07/ax2012-client-performance-options.aspx

AOS Server Configuration

Dynamics AX AOS Settings	Best Practice	Actual
Server Hardware / Windows Settings		
OS Version	Windows Server 2008 SP2 or later	Windows Server 2008 R2 SP1
OS Edition	64 bit Standard or Enterprise Edition	X64 Standard
Memory	8 to 16 GB	8 GB
Processors	4 to 8 cores	4
Virtualization	Certified virtualization platform if VM	Hyper-V
Power Management Settings	High Performance	Remediated set to High Performance
Processor Scheduling	Background Services	Background Services
AOS Settings		
AOS Instance Count	-	1
AOS Settings		
Configuration command to run at kernel start up	Empty	Empty
TCP/IP	2712	2712

Services WSDL	8101	8101
Allow clients to connect to printers on this server	Disabled	Disabled
Enable breakpoints to debug X++ code running on this server	Disabled	Disabled
Enable global breakpoints	Disabled	Disabled
Enable the hot-swapping of assemblies for each development session	Disabled	Disabled
Database Tuning		
Statement Cache	256	256
Maximum Buffer Size	24 (default)	48
Generate ORDER BY clauses from WHERE clauses	Disabled	Disabled
Performance		
Minimum Packet size to compress	1 KB	1 KB
Processor Affinity	Only applicable if more than 1 instance on same AOS Server	1 instance
AOS Total Cache Size Limit	128KB is recommended	32 Remediated to 128

Named user license counts

This report contains information about the users who are assigned to security roles in Microsoft Dynamics AX. The report analyzes the roles and privileges that are assigned to each user and then calculates the number of licenses that are required for each user type.

The information in the report is current as of the date that the batch was last run. This report was run during the Onsite.

System administration -> Reports -> Licensing -> Named User License Counts:

http://technet.microsoft.com/EN-US/library/hh335160.aspx

Load balancing

Read the High Availability White Paper for more details:
http://technet.microsoft.com/en-us/library/dd309704.aspx

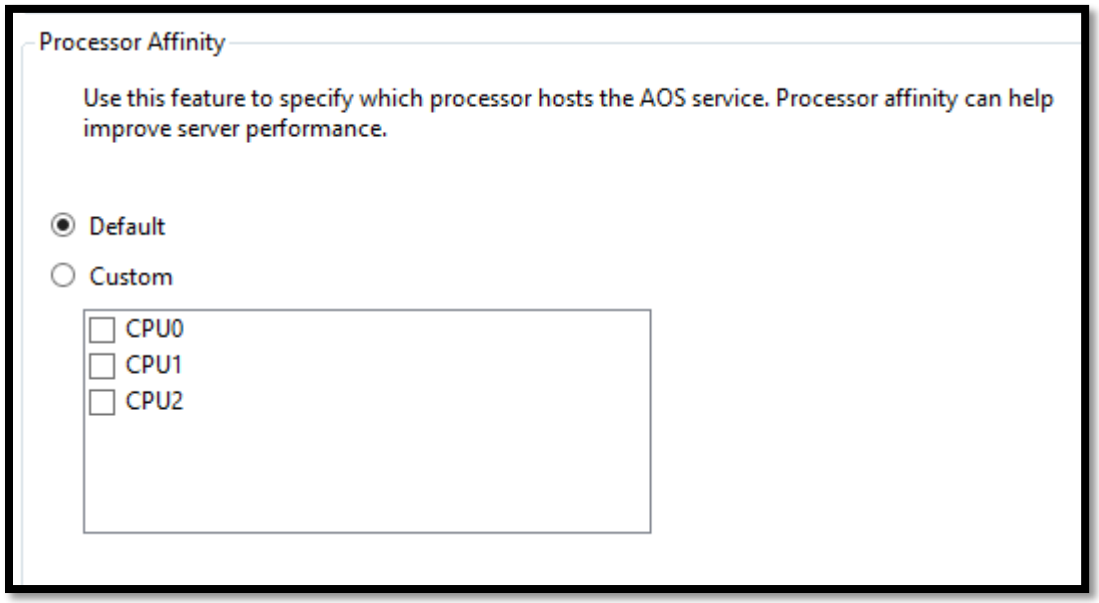
Please go the TechNet for full details:
http://technet.microsoft.com/en-us/library/dd309704.aspx

Processor Affinity

You can successfully run multiple AOS instances simultaneously with AX 2012 as long as the server has enough system resources and processor affinity is set appropriately in the Dynamics AX Server Configuration utility. Each active AOS instance should be configured to use separate processors to avoid high levels of context switching. For example, if you have 2 instances installed on a 4 processor server, you should configure the first instance to use processors 0 and 1 only. The second instance should be configured to use processors 2 and 3 only.

Dynamics AX Server Configuration Utility > Performance tab >Processor Affinity:

- The default option allows the AOS instance to use all available processors.
- Select the “Custom” option to set the affinity.



Maximum Buffer Size

The maximum buffer size determines the maximum amount of data that the AOS can retrieve from the database per database call. A larger buffer allows more rows to be retrieved per database call. The default value of 24K is used when the “Maximum buffer size” box is blank.

No Microsoft performance testing has been done on values other than the default one. So changes to this setting should be done carefully. Small increases in the buffer size are probably not going to have a negative impact. But, any value beyond 50 is worth investigating further. One of the main concerns with a higher value is increased AOS memory consumption.

Some custom code may require you to increase the buffer size in order to display more information on a grid. If you change the Maximum open cursors or Maximum buffer size you may be limiting the number of clients each AOS can support, as each client will utilize more memory.

The error message you will see if the size of the buffer is reached by one specific X++ code is:

"*Warning: the total, internal size of the records in your joined SELECT statement is XXXXX bytes, but Microsoft Dynamics is by default performance-tuned not to exceed 24576 bytes.*
It is strongly recommended that you split your table(s) into smaller units.
Alternatively, you have to specify a 'buffer size' value of 25 Kbytes or higher in the 'SQL' tab page in the Microsoft Dynamics Configuration Utility. The default value is 24 Kbytes.
Exit Microsoft Dynamics immediately, and follow the directives above. Use of the table(s) will cause unpredictable results."

Performance Optimization

Definition

In previous versions of Microsoft Dynamics AX, users could not specify the number of records that would allow the system to cache; they also did not have a way to track the performance of caching. Since users had no way to specify the number of records to cache, they could get into a scenario where the number of records that they wanted to cache was larger than the max size defined by the system. This would result in the system having to flush records from cache to allow new entries. In Microsoft Dynamics AX 2012 the Application Object Server, AOS, is a 64-bit application, and has the ability to allow more memory to be used for caching.

If users had an AOS with enough memory they may want to increase the number of customer records that the AOS caches. This could assist users in getting better performance on queries related to the custtable as they could use cached data instead of reading data from the database. For example, in Microsoft Dynamics AX the custtable's cacheLookup property is set to found. This means that as customers records are used in queries they are added to cache. In previous versions of Microsoft Dynamics AX, the max size for a table was 2000. This meant once users had 2000 customer records in cache the system would have to start removing some of the records.

In Microsoft Dynamics AX 2012, the size of some cache limits has increased and is configurable. Therefore, if users want to allow more records to be cached for main tables, they are able to do so. To accomplish this, the Performance Optimization section has been added on the Server configuration form:

Go to System Administration, click Setup, click System, and then click Server configuration.

Performance settings for all AOS instances	By Default	Customer value
Error on invalid field access	No	No
Error on exceeding maximum number of tables in join	No	No
Maximum number of tables in join	26	26
Client record cache factor	20	20
Timeout for user modified queries	0	0

Cache limits	By Default	Customer	R2 Default
Entire table cache size	32	32	96
Global Object Cache elements	100,000	100,000	100,000
Record cache elements for Framework table group	2000	2000	2000
Record cache elements for Parameter table group	2000	2000	2000

Record cache elements for Reference table group	2000	2000	2000
Record cache elements for Group table group	2000	2000	2000
Record cache elements for Main table group	2000	2000	**6000**
Record cache elements for Miscellaneous table group	2000	2000	2000
Record cache elements for Transaction table group	2000	2000	**8000**
Record cache elements for Transaction Header table group	2000	2000	**6000**
Record cache elements for Transaction Line table group	2000	2000	**6000**
Record cache elements for Worksheet table group	2000	2000	**6000**
Record cache elements for Worksheet Header table group	2000	2000	**6000**
Record cache elements for Worksheet Linetable group	2000	2000	**6000**

Cache limits for this AOS instance	By Default	Custom AOS
Entire table cache size	0	0
Global Object Cache elements	0	0
Record cache elements for Framework table group	0	0
Record cache elements for Parameter table group	0	0
Record cache elements for Reference table group	0	0
Record cache elements for Group table group	0	0
Record cache elements for Main table group	0	0
Record cache elements for Miscellaneous table group	0	0
Record cache elements for Transaction table group	0	0
Record cache elements for Transaction Header table group	0	0
Record cache elements for Transaction Line table group	0	0
Record cache elements for Worksheet table group	0	0
Record cache elements for Worksheet Header table group	0	0
Record cache elements for Worksheet Linetable group	0	0

Entire table cache size
Size beyond which the table cache will be flushed to disk.

- See Entire Table Cache section for more details. We recommend to increase that value to 128 KB.

Global Object Cache elements
Number of elements that can be stored in the Global Object Cache. We don't recommend changing this setting before a proper analysis is run in test environment.

Please read this article for detailed explanation:
http://blogs.msdn.com/b/axperf/archive/2011/12/29/using-sysglobalobjectcache-sgoc-and-understanding-it-s-performance-implications.aspx

Client Record cache factor
The Server configuration form also allows you to modify the number of records that would be stored at the client level. This is accomplished by modifying the 'client record cache factor' field. The number of records stored at the client level is a factor of records stored at the AOS. If you have 2000 records stored at the AOS and the client record cache factor is 20 you will have 100 records per table stored at the

client. Therefore, if you want more records to be stored at the client you would decrease the value in the 'Client record cache factor' field.

However, if you are deploying Microsoft Dynamics AX 2012 clients on a Terminal Server or Citrix Server where the size of each client is a concern you might want to increase value the 'Client record cache factor' so that each client has less records being stored. For example, if you change the 'Client record cache factor' to be 40 and the AOS is set to 2000 records you would have 50 records per table being stored in cache at the client. The caching settings from this form are stored in the table called SysGlobalConfiguration

Labels

Development Workspace > Tools > label > label log

In Microsoft Dynamics AX 2012, label files, or ALD files, are part of models. A label file must be added to a model before the model can be installed. After a model has been installed, ALD files are pulled from the model store to the local of Application Object Server (AOS) instance when the AOS is started

The current labels ID are:
Development Workspace – AOT – Label Files

C:\Program Files\Microsoft Dynamics AX\60\Server\MicrosoftDynAX2012R2\bin\Application\Appl\Standard

Help Server

Help Server settings	
Help Service URL	http://sv00055:8080/DynamicsAX6HelpServer/HelpService.svc
Web Service is running	Yes
Customization	No
Language available	All
Windows Search Service is running	Yes
AX client Help Viewer	Yes

The Help Server is a new component in Microsoft Dynamics AX 2012 and hosts fully customizable content on a standard Internet Information Services (IIS) web server. A help viewer provides searchable access to the server content, as well as access to Internet help resources.

Use the application workspace and then click System Administration, Setup, and System and then click Help System parameters. The Help System Parameters window opens and displays the URL of the Help service.

Windows Search Service: Check whether the Windows Search Service (WSS) is running on the server. WSS plays an important role in the publishing of content elements. A content element will not appear in the Help viewer until it has been indexed by WSS. If WSS is not running, use the Services window to restart the service. Allow WSS to find and index the files you published to the Help server.

The service was running during the onsite:

Enterprise Portal – SharePoint Server

Here are the notes for the installation requirements of the different versions of SharePoint and AX 2012.

Requirements:

- IIS 7.0, IIS 7.5, or IIS 8.0 (supported only with Microsoft Dynamics AX 2012 R2)
- ASP.NET 2.0
- Microsoft SharePoint Foundation 2013 (supported only with Microsoft Dynamics AX 2012 R2)

–or–
Microsoft SharePoint Server 2013, Standard Edition or Enterprise Edition (recommended) (supported only with Microsoft Dynamics AX 2012 R2)
–or–
SharePoint Foundation 2010
–or–
SharePoint Server 2010, Standard Edition or Enterprise Edition (recommended)

- SQL Server 2008 R2 Analysis Management Objects (AMO)
-

Notes:

Because Enterprise Portal runs on SharePoint, the server where you install Enterprise Portal must meet the hardware and software requirements for the version and edition of SharePoint that you are using. For more information, see the TechCenter for SharePoint (http://technet.microsoft.com/en-US/sharepoint/).

• To use SharePoint 2013 with Microsoft Dynamics AX, you must install several updates. For more information, see Enterprise Portal on Microsoft SharePoint 2013 (http://technet.microsoft.com/ENUS/library/dn169057.aspx).

• To deploy Enterprise Portal in an environment where ASP.NET impersonation and claims-based authentication are enabled, you must first install the Microsoft Dynamics AX hotfix from Knowledge Base article 2823664 (http://go.microsoft.com/fwlink/?LinkId=294944).

• SharePoint Server 2010 can support Enterprise Portal and Enterprise Search. If you plan to use SharePoint Foundation 2010 for Enterprise Portal, you must also install one of the search server applications that are listed for Enterprise Search.

• You must install the SQL Server 2008 version of AMO, even if you are using SQL Server 2012.

Dynamics AX AOS Settings	Best Practice	Actual
Server Hardware / Windows Settings		

OS Version	Windows Server 2008 SP2 or later	Not Deployed
OS Edition	64 bit Standard or Enterprise Edition	Not Deployed
Memory	-	Not Deployed
Processors	-	Not Deployed
Virtualization	Certified virtualization platform if VM	Not Deployed
Power Management Settings	High Performance	Not Deployed
AX EP Settings		
AX Business Connector (BC) build (Microsoft.Dynamics.AX.ManagedInteropCore.dll)	Same as AX AOS kernel build	Not Deployed
Business Connector (BC) connection	Multiple AOS servers	Not Deployed
SharePoint Settings		
SharePoint version	See note below	Not Deployed
Secure Sockets Layer (SSL)	Enabled for external sites	Not Deployed
SQL Server Analysis Management Objects (AMO)	Installed	Not Deployed
Internet Information Services (IIS) 7.0 or 7.5	Installed	Not Deployed
ASP.NET	Installed	Not Deployed
Microsoft .NET Framework 3.5 SP1 or 4.0	Installed	Not Deployed
EP bindings	Default is Port 80	Not Deployed
Load balancing	Server Farm	Not Deployed
EP user relation	Set System Admin – Users	Not Deployed
SharePoint Health Analyzer	No issues detected	Not Deployed
Administration of Web Sites		
Encryption - Enable encryption	Enabled by default	Not Deployed
Encryption - expiration interval (days)	1 by default	Not Deployed
Image – resize image	Enabled by default	Not Deployed
Image – size small	75 by default	Not Deployed
Image – size large	150 by default	Not Deployed
Image – Maintain aspect ration	Enabled by default	Not Deployed
Website - Internal URL	http://sharepoint/sites/DynamicsAX	Not Deployed
Website - External URL	http://sharepoint/sites/DynamicsAX	Not Deployed
Website - Anonymous access	Disabled by default	Not Deployed
Website – Partition independent	Enabled	Not Deployed
Website - Company independent	Enabled by default	Not Deployed
Website - Type	Full	Not Deployed
Website - Language dependent	Disabled by default	Not Deployed
Report Server – use default configuration	Enabled by default	Not Deployed

SharePoint Compatibility

Editions (Foundation, Standard & Enterprise)

There are 3 editions of SharePoint: http://sharepoint.microsoft.com/en-us/buy/Pages/Editions-Comparison.aspx.

The core difference, as it applies to Dynamics AX, appears to centre around Search (beyond all the core feature differences between the editions).

If the customer plans to use Microsoft SharePoint Foundation 2010 (free download) for Enterprise Portal, they must also install one of the search server applications (listed in the next point) for Enterprise Search.

Microsoft Dynamics AX 2012 uses the SharePoint Business Data Connectivity Service (BCS) and SharePoint Search Server to provide a unified Enterprise Search experience for Enterprise Portal and the Microsoft Dynamics AX client. All search administration is managed in SharePoint Search Server. All aspects of crawling, indexing, and retrieving Microsoft Dynamics AX data and metadata for search (i.e. all search administration) are performed by one of the following products:

- Microsoft SharePoint Server 2010
- Microsoft Search Server 2010
- Microsoft Search Server Express 2010 (a free download)
- Microsoft FAST Search Server 2010

One of these products must be available in the computing environment before you can install Enterprise Search. We recommend that you use SharePoint Server if your business or organisation intends to deploy Enterprise Portal. SharePoint Server is the only product that will host Enterprise Portal and Enterprise Search.

FAST Search for SharePoint 2010 is Microsoft's premium Enterprise Search solution. FAST is licensed via a server and a Client Access License model. The SharePoint Enterprise CAL is required for accessing FAST Search for SharePoint 2010 content. If the customer wanted to use FAST Search then they would require SharePoint Enterprise CALs.

Search Server

Enterprise Search in Microsoft Dynamics AX 2012 enables users to search through data, metadata, and documents that are attached to records by using either the Microsoft Dynamics AX client or Enterprise Portal for Microsoft Dynamics AX. Users can search for common nouns, such as 'customer' and 'cash flow report.'

Users can also search for specific data, such as a customer name, product ID, or telephone number. The search box is prominently displayed in the Microsoft Dynamics AX client, and users can view recent search terms in a list.

Load Testing

You can find the “Testing best practices for Microsoft Dynamics AX 2012” for more details here:
http://community.dynamics.com/ax/f/33/t/102959.aspx

Here are some interesting article and sites to start Web Performance with Visual Studio:

Web Test Authoring and Debugging Techniques for Visual Studio 2010:

http://blogs.msdn.com/b/edglas/archive/2010/03/24/web-test-authoring-and-debugging-techniques-for-visual-studio-2010.aspx

Web Performance Test Results Viewer Overview
http://msdn.microsoft.com/en-us/library/vstudio/dd997556(v=vs.100).aspx

Web Performance & Load Testing in Visual Studio 2010
http://davefancher.com/2010/10/01/web-performance-load-testing-in-visual-studio-2010/

Reporting Server

Report Servers Settings	Best Practice	Actual
Report Server Settings		
Service account	Should be BC Proxy account	N/A
Execution account	Should be BC Proxy account	N/A
Reporting Services mode	Native	N/A
Server name	MSSQLSERVER by default	N/A
Server instance name		N/A
Report manager URL	http://servername/reports by default	N/A
Web Service URL	http://servername/ReportServer by default	N/A
AX report folder	Dynamics AX by default	N/A
AOS name		N/A
TCP port	80	N/A
SQL Certificate	Not selected	N/A

SQL Server Configuration

SQL Server Settings	Best Practice	Actual
Server Hardware / Windows Settings		
OS Version	Windows Server 2008 SP2 or later	Microsoft Windows Server 2008 R2 Enterprise Version 6.1.7601 Service Pack 1 Build 7601
OS Edition	x64 Enterprise or Standard	x64

Memory	-	16GB
Processors	-	2 x Processor Intel(R) Xeon(R) CPU X5460 @ 3.16GHz, 3166 Mhz, 4 Core(s), 4 Logical Processor(s)
Disk Alignment	1MB or SAN vendor recommended value	Aligned
Cluster size	64 KB	4KB
Server Virtualization	Not recommended	System Model IBM eServer BladeCenter HS21 -[8853G7G]-
Power Management Settings	High Performance	High Performance
Hyper Threading	Supported	-
Processor Scheduling	Background services	Background services
SQL Server High Availability		
HA Solutions	For Dynamics AX 2012 see options for Microsoft SQL Server high availability at http://technet.microsoft.com/en-us/library/dd362068.aspx	No, cluster or High availability groups is being considered for the future.
SQL Server Settings		
SQL Server Version	SQL Server 2008 SP2 CU1 (10.0.4266.0) or later	2008 R2 SP1 Enterprise
SQL Server Edition	x64 Enterprise	XMixe64
Max Degree of Parallelism	1	0
Min Server Memory		0
Max Server Memory	-	13500
Max worker threads	Check to see if the default setting for max worker threads has been modified, which may cause performance problems. By Default is 0.	0
Priority Boost	Disabled	0
Lightweight pooling	Disable the lightweight pooling option unless you were instructed by Microsoft support to enable it. This option may cause performance issues.	0
Server Authentication	Windows Authentication mode	Mixed
Default Index fill factor	70 to 90 for instance is fine – this can give proper default value for index rebuilds	0
Compress backup	Recommended	DPM
SQL Server Configuration		
Network Configuration	Only necessary protocols enabled	Named Pipes, Shared Memory, TCP/IP.
Lock Pages in Memory	Right granted to SQL Server Service Account (to allow Instant File Initialization)	Not granted

Performance volume maintenance	Granted (Trace flag 845 for Standard Edition)	Granted through Administrators membership.
Trace Flags Enabled	4199 is recommended in most cases. Other trace flags are recommended on a case by case basis.	NONE

SQL Server Disks sector alignment

Volumes created with Windows Server 2008 or later automatically aligns the volumes on disks.

Disks' sector size

It is recommended to use 64 KB as cluster size for volumes where SQL databases' data or log files are stored. Current setting is 4KB.

RAID configuration

Current configuration of the storage engine is using RAID5. It is recommended to use RAID 1+ 0 for performance considerations and proper testing needs to be done in order to consider the benefit of each based on read/write impact and space available.
Take in to account that compression can also have an impact on the amount of operations happening on disks.

Servicing SQL

The SQL Server version running is Microsoft SQL Server 2008 R2 (SP1) - 10.50.2500.0 (X64). Enterprise Edition (64-bit) on Windows NT 6.1 <X64> (Build 7601: Service Pack 1)

Please note the SQL Server Enterprise Edition is highly recommended and it supports Database Compression, Transparent Data Encryption, Multi-Node Clustering, and many other useful features not included with Standard Edition. For more details on comparing editions, please visit:
http://www.microsoft.com/sqlserver/en/us/product-info/compare.aspx

For official support please check the Sustained Engineering blog:
http://blogs.technet.com/b/dynamicsaxse/

And the System Requirements of AX 2012:
http://www.microsoft.com/en-us/download/details.aspx?id=11094

Max degree of parallelism

The recommended setting for Dynamics AX is 1. This is because Microsoft Dynamics AX transactional workloads generally perform better when intra-query parallelism is disabled.

Please note that if heavy SQL Server batches or queries are run, this would differ from pure transactional workload, and using some degree of query parallelism can be beneficial.

In this case setting Max degree of parallelism to 2 or 4 is probably a better value, to take into account both types of queries. This should be validated.

Furthermore, it is often beneficial to set this setting to a higher value when you are not running transactional tasks in SQL Server, but batches or decisional queries. This usually happens often out of daily work hours or at the weekend. Testing is necessary to find the best value in your environment.

Max server memory (MB)

Windows 2008 includes improvements to memory management that make explicitly setting maximum SQL Server memory unnecessary (assuming the host is a dedicated to running a single SQL Server instance); see http://support.microsoft.com/kb/918483

If the \Memory\Available Mbytes performance counter consistently falls below the 100MB mark, it may be necessary to restrict SQL Server memory using the max server memory setting.

Data Compression (Enterprise Edition Only)

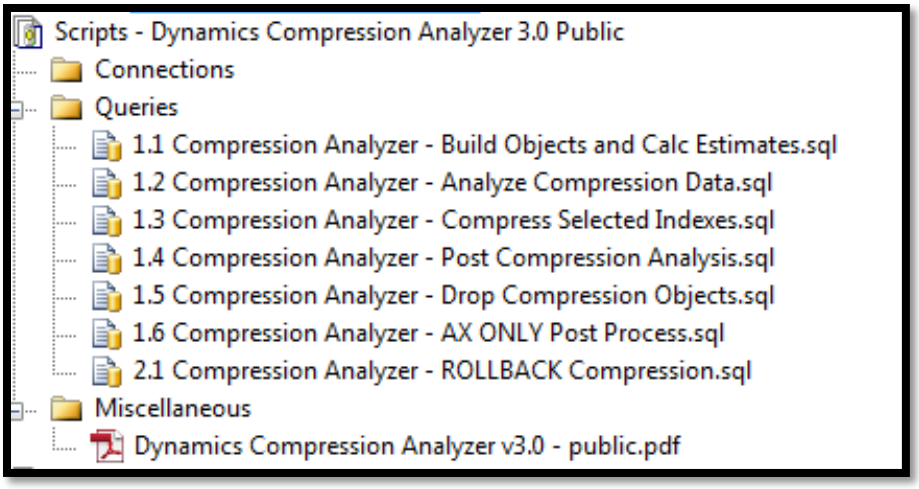
- This feature is supported in Dynamics AX 2012 but only available for Enterprise Edition of SQL Server.

Internal testing has shown that page level compression can decrease the size of a standard Dynamics AX database by 50% or more. In some cases this also increases performance with only slightly higher levels of CPU utilization which shouldn't be an issue on the 32-core server.

To understand Data compression, you can refer for instance to Data Compression: Strategy, Capacity Planning and Best Practices at http://msdn.microsoft.com/en-us/library/dd894051(v=sql.100).aspx

In Dynamics AX 2012, go to System Administration > Periodic > SQL Administration.
Then select an index or table and click on Table and index options. Mark the "Enable Compression" box and select the compression type (none, row, and page). Then from the Table actions you can apply compression.

Please read the following script Dynamics Compression Analyzer 3.0 Public:



Names Pipe and Shared Memory protocol are enabled

- Shared Memory protocol is currently enabled on the SQL Server instances used for Dynamics AX. This is not following the best practice.

It is a best practice to enable only those protocols that are needed. For example, if TCP/IP is sufficient, there is no need to enable the Named pipes protocol. Dynamics AX does not make use of Named pipes protocol.

Instant File Initialization

In SQL Server, data files can be initialized instantaneously. This allows for fast execution of Auto growth operations. Instant file initialization is only available if the SQL Server (MSSQLSERVER) service account has been granted to SE_MANAGE_VOLUME_NAME (Perform volume maintenance tasks).

This can be checked from 'gpedit.msc', Local Computer Policy, Computer Configuration, Windows Settings, Security Settings, Local Policies, User Right Assignment, Perform volume maintenance tasks.

More information can be found in http://msdn.microsoft.com/en-us/library/ms175935.aspx

- Perform volume maintenance tasks have been granted only to local Administrators, which does include the SQL Server account. This is following not the best practice. The right must be granted directly to the SQL Server execution account and remove its membership from Local Administrators group.

More information can be found in http://msdn.microsoft.com/en-us/library/ms175935.aspx

Lock Pages in memory

- Lock pages in memory is currently not set to the SQL Server account that has permission to run the Sqlservr.exe, which is not the best practice. It is an important setting as it can reduce paging of buffer pool memory.

Please read the following KB article for more details on this: “How to reduce paging of buffer pool memory in the 64-bit version of SQL Server” http://support.microsoft.com/kb/918483

More information can be found here:
http://msdn.microsoft.com/en-us/library/ms190730(SQL.90).aspx

SQL Server Trace Flags

Please note that these trace flags are recommended to improve Dynamics AX performance under certain specific conditions. If there are used inappropriately they can degrade general performance.

Trace flag 4136 (Not recommended by default)

Trace flag 4136 can significantly improve the performance, or your Dynamics AX implementation if the composition of your AX data is prone to parameter sniffing issues.

When trace flag 4136 is enabled, the default "parameter sniffing" behavior is changed so that a more average estimate of selectivity (based on density statistics) is used by the optimizer instead of the default parameter-specific estimates (based on the histogram).

The Dynamics AX Performance Team Blog has a good explanation of how this trace flag works, and provides some common scenarios where it might improve performance:

http://blogs.msdn.com/b/axperf/archive/2010/05/07/important-sql-server-change-parameter-sniffing-and-plan-caching.aspx

Below is a link to a post from the SQL Server Optimization Team. They do nice job of explaining parameter sniffing, how it helps performance, and when it may cause issues.
http://blogs.msdn.com/b/queryoptteam/archive/2006/03/31/565991.aspx

Be sure to do performance tests with this trace flag enabled before using it in your production environment.
Trace Flag KB Article: http://support.microsoft.com/kb/980653/

Trace flag 4199 (Recommended by default)

Trace flag 4199 is a trace flag that activates query optimizer fixes from a number of different hotfixes. The SQL Server query processor team has policy that any hotfix that could potentially affect the execution plan of a query must be controlled by a trace flag. Because of this policy, even if you are running with the latest hotfix or cumulative update installed, you are not necessarily running SQL Server with all the latest query processor fixes enabled. Some of the fixes enabled by trace flag 4199 directly address issues that affect Dynamics AX performance.

For more information on this you can refer to
http://blogs.msdn.com/b/axinthefield/archive/2010/11/04/sql-server-trace-flags-for-dynamics-ax.aspx

Note: Before applying a trace flag in production it is crucial to test and validate the effects of the flag first, in test and pre-production environment.

For a list of optimizer fixes that were previously enabled with individual trace flags but are now controlled by trace flag 4199, go here http://support.microsoft.com/kb/974006. Many of these optimizer fixes may help improve Dynamics AX performance. Two that stand out are listed below:

- Fast Forward Cursor Performance http://support.microsoft.com/kb/926024/
- FORWARD_ONLY Cursor Performance http://support.microsoft.com/kb/946793/

Trace flag 2371 (Not recommended by default)

In Service Pack 1 of SQL 2008 R2, a new feature got introduced which changes the algorithm used to determine when to update statistics. The new algorithm uses a sliding scale as the table grows to reduce the percentage of records that must change before an update occurs.

As the table grows, the percentage of records drops and keeps fairly consistent to what you might expect. This feature can be enabled through Trace Flag 2371 if you are running SQL 2008 R2 SP1 or greater.

You can find all trace Flags which are recommended for Dynamics AX here:
http://blogs.msdn.com/b/axinthefield/archive/2010/11/04/sql-server-trace-flags-for-dynamics-ax.aspx

Please note that these trace flags are recommended to improve Dynamics AX performance under certain specific conditions. If there are used inappropriately they can degrade it.

Database Configuration

SQL Server DB Settings	Best Practice	Actual
Recovery Model	Full	SIMPLE
Compatibility Level	Same as version of SQL Server	100
Read Committed Snapshot	Enabled	1
Collation	Same as TempDB Case Insensitive, Accent Sensitive for Dynamics AX	Not the same one as TempDB.
Auto Close	Disabled	Disabled
Auto Shrink	Disabled	Disabled
Auto Create Stats	Enabled	Enabled
Auto Update Stats	Enabled	Enabled
Auto Update Stats Async	Disabled	Disabled
Page verify	Checksum	Checksum
Allow snapshot isolation	Allow snapshot isolation should be set OFF in the AX database. Enabling this option is different than enabling Read Committed Snapshot Isolation (RCSI) which should be ON.	OFF

Database File Configuration (SOLERPALAU_AX2012/MicrosoftDynamicsAX)

SQL Database Files	Best Practice	Actual
Data and Log File Placement	Data and Log files on separate drives	Yes, different volumes. Data: T; Log: L
Data File Auto Growth Increment	Avoid auto growth by sizing the files large enough to start with. 200MB to 500MB	200 MB
Log File Auto Growth Increment	Avoid auto growth by sizing the files large enough to start with. 200MB to 500MB	100 MB
Data file Free space	Space should be periodically reviewed and adjusted when necessary based or Auto Growth should be set. It is a better strategy to pre-allocate the Database data file to a size which accounts for the expected growth some time ahead. You can still set Auto Growth to avoid any issue before the next pre-allocation.	1% / 8%

DATABASE_NAME	FILE_ID	FILE_NAME	PHYSICAL_NAME	FILE_TYPE	DB_SIZE(MB)	DB_FREE(MB)	FREE_SPACE_%	GROWTH_UNITS
MicrosoftDynamicsAX	1	DAX_DVLP	T:\AX2012\MSSQL10_50.MSSQLSERVER\MSSQL\DATA\MicrosoftDynamicsAX.mdf	Data	6564	478	8	200Mb
MicrosoftDynamicsAX	2	DAX_DVLP_log	L:\SQLLOGS\MicrosoftDynamicsAX_log.LDF	Log	200	196	98	100Mb
SOLERPALAU_AX2012	1	DAX_DVLP	T:\AX2012\MSSQL10_50.MSSQLSERVER\MSSQL\DATA\SOLERPALAU_AX2012.mdf	Data	11665	90	1	200Mb
SOLERPALAU_AX2012	2	DAX_DVLP_log	L:\SQLLOGS\SOLERPALAU_AX2012.LDF	Log	100	100	100	100Mb

Database File Configuration (TempDB)

SQL Database Files	Best Practice	Actual
Data and Log File Placement	Not on same drive as AX data and transaction log	All in T. Like AX data file. T:
Data File Auto Growth Increment	Avoid auto growth by sizing the files large enough to start with. 200MB to 500MB but can be smaller if multiple TempDB files	10%
Log File Auto Growth Increment	200MB to 500MB	10%
TempDB Data File Count	1 data file per logical processor	1 file only.
TempDB Data Files Initial Size	TempDB data files should have the same initial size and the same auto grow	8MB
TempDB Data File Size	20-25% of AX database or just large enough to avoid file auto growth.	1MB
TempDB Log File Size	Large enough to avoid file auto growth.	**79 MB**

DATABASE_NAME	FILE_ID	FILE_NAME	PHYSICAL_NAME	FILE_TYPE	DB_SIZE(MB)	DB_FREE(MB)	FREE_SPACE_%
tempdb	1	tempdev	T:\AX2012\MSSQL10_50.MSSQLSERVER\MSSQL\DATA\tempdb.mdf	Data	305	104	35
tempdb	2	templog	T:\AX2012\MSSQL10_50.MSSQLSERVER\MSSQL\DATA\templog.ldf	Log	74	36	49

Operations Scorecard

Operating Environment

Checklist Item	Best Practice	Actual
Development, test, and production environments	Separate servers for development, test, and production environments.	3 Environments 1 DEV/ TEST / PRO (Pre-Go-Live)
Change control procedures	Structured change control procedures documented and used with appropriate segregation of duties in place.	Not available for the Customer.
Business continuity / disaster recovery	BC/DR procedures documented and practiced.	Not documented / project milestone is postponed.
SLA	Partner /End users	N/A

Pre-Go live

High availability

First of all, we need to mention the High Availability options supported by Dynamics AX 2012.

High availability configuration	Support status
Windows Server Failover Clustering (WSFC)	Supported
Log shipping	Supported
Transactional replication	Supported. Requires KB 2765281.
Snapshot replication	Supported
Database mirroring	Supported
Merge replication	Not supported, because complex resolution is required to guarantee data integrity
SQL Server 2012 AlwaysOn Availability groups	Supported. Both synchronous and asynchronous secondary configurations are supported.

- If you are running SQL Server 2012, we recommend that you deploy AlwaysOn Availability Groups.
- If you are running SQL Server 2008, we recommend that you deploy a Windows Server Failover Cluster with one active node and one inactive node.
- Availability groups and failover clusters do not require a restart of the Application Object Server (AOS) service.

Fine entire details at “SQL Server topology [AX 2012]”: http://technet.microsoft.com/en-us/library/dd362068.aspx

- We recommend that you deploy an active/passive failover cluster, because a failover cluster does not require a restart of the Application Object Server (AOS) service.

Note: When you use SQL Server failover clustering, note the following behavior:

- The failover is transparent to AOS, and the service typically does not require a restart.
- In-process transactions are rolled back, and the user may have to reenter data that was being entered at the time of failure.

- Please note that SQL Server Reporting Services and Analysis Services are not supported in a failover cluster.

Disaster Recovery

Setting up a recovery plan that can be executed in a disaster situation requires detailed planning, extensive step-by-step documentation, and most of all practice. The information below is not a comprehensive guide, but rather a starting point to assist you in your recovery planning.

The Service Level Agreement (SLA) is the definition of the Disaster Recovery process. All the action required and their ownership need to be approved by the customer, the partner and all the third parties involved in the infrastructure, like the SAN vendor. The SLA plan includes the worst case scenario where the previous backup file is corrupted and cannot be used.

The SLA will define the total time required to restore the database from the disaster to the recovery (Recovery Time Objective) and the amount of data that can be lost (Recovery Point Objective).

Code Maintenance

The layers definition are:

Layer	Description
USR	The user layer is for user modifications, such as reports.
CUS	The customer layer is for modifications that are specific to a company.
VAR	Value Added Resellers (VAR) can make modifications or new developments to the VAR layer as specified by the customers or as a strategy of creating an industry specific solution.
ISV	When an Independent Software Vendor (ISV) creates their own solution, their modifications are saved in the ISV layer.
SLN	The solution layer is used by distributors to implement vertical partner solutions.
FPK	The FPK layer is an application object patch layer reserved by Microsoft for future patching or other updates. For more information, see Patch Layers.
GLS	When the application is modified to match country or region specific legal demands, these modifications are saved in the GLS layer.
SYS	The standard application is implemented at the lowest level, the SYS layer. The application objects in the standard application can never be deleted.

Note: the patching layers are defined with the suffix P. For example, the patching layer for the GLS is GLP

Layers: http://technet.microsoft.com/en-us/library/hh335184.aspx

Code Promotion:

The strategy to take new development into production should be to use Model export/import to go from development to test/acceptance environment. Going from test/acceptance environment to live environment is preferably done by deploying the whole precompiled Model Store from test to live environment.

Source Environment

- Compile, Generate CIL
- Export Model Store metadata

Target Environment

- Prepare Target for Deployment
  - Drain users, reject new clients
  - Close active sessions
  - Stop all AOS instances
- Deployment
  - Import Model Store metadata
  - Start single AOS
  - Synchronize database
- Publish to Servers
  - Publish cubes
  - Create Role Centers from AOT
  - Publish EP content
  - Publish reports
- Hydrate System
  - Clean up old model schema (if applicable)
  - Allow multiuser on AOS
  - Start all AOS instances

By following this approach we can avoid long production downtime due to compilation task. Also we make sure that no single code line is missing which can happen in an exceptional situation during xpo file export/import.

- The procedure described above can be further extended by using temp schemas for the modelsote to do the import and reduce the maintenance window required to apply the schema with the imported modelstore.

Scenario	Recommended installation method
Distributing a solution to customers	Model files
Deploying a solution in a development or test environment	Model files or XPO files
Deploying a solution to a production environment	Modelstore files

For further details review “White paper ‘Deploying Customizations across Dynamics AX 2012 Environments” http://technet.microsoft.com/en-us/library/hh292604.aspx

To drain users from the AOS please read the following article: http://technet.microsoft.com/en-us/library/hh433538.aspx

Monitoring and Maintenance

Task	Best Practice	Actual
Monitoring for application availability, performance, and error conditions	Proactive monitoring for application availability, performance, and error conditions.	Zenoss is enabled to send alerts. Disks, network, CPU, Memory and services availability
Index maintenance on the AX database	Regular index and statistics maintenance performed on the AX database. This can be based on Fragmentation See "Rebuild and Reorganize Indexes" note below for details	Once per week
Statistics maintenance on the AX database	Update Statistics every day With full scan See "Statistics" note below for details	None.
Database Integrity Checks	Run Database Integrity Checks regularly. Every week or every 2 weeks for instance. See "Database Integrity Checks" note below for details	Weekly
Full Backups	Every day Compressed Verify backup integrity Verify restore procedure and validity regularly	Daily DPM, no compression required, but it can use HW compression to tape.
Differential backups	Informational. This can be used to speed up recovery, if there are many transaction log backups	None
Log Backups	Note: Possibility lose up to 1 hour of transactions.	None, simple recovery model.
AX standard AX cleanup jobs	Regularly execute AX standard cleanup jobs (batch, parm, etc.).	None

System Center Operations Manager (SCOM)

http://www.microsoft.com/en-us/download/details.aspx?id=26934

The management pack guide is found at:
http://download.microsoft.com/download/A/C/F/ACF342E1-FE01-444E-8110-A316F1F7B0CA/MP%20Guide%20for%20Microsoft%20Dynamics%20AX%202012.doc

The Monitoring Pack for Microsoft Dynamics AX 2012 includes the following files:

- Microsoft.Dynamics.AX6.ManagementPack.AIF.Monitoring.mp
- Microsoft.Dynamics.AX6.ManagementPack.AOS.Discovery.mp
- Microsoft.Dynamics.AX6.ManagementPack.AOS.Monitoring.mp

- Microsoft.Dynamics.AX6.ManagementPack.ClassLibrary.mp
- Microsoft.Dynamics.AX6.ManagementPack.EP.Monitoring.mp
- Microsoft.Dynamics.AX6.ManagementPack.SSRS.Monitoring.mp

Recommended Additional Management Packs

To perform complete service-oriented monitoring of Microsoft Dynamics AX servers, you may want to download the most recent versions of the following additional management packs from the SYSTEM CENTER MARKETPLACE:

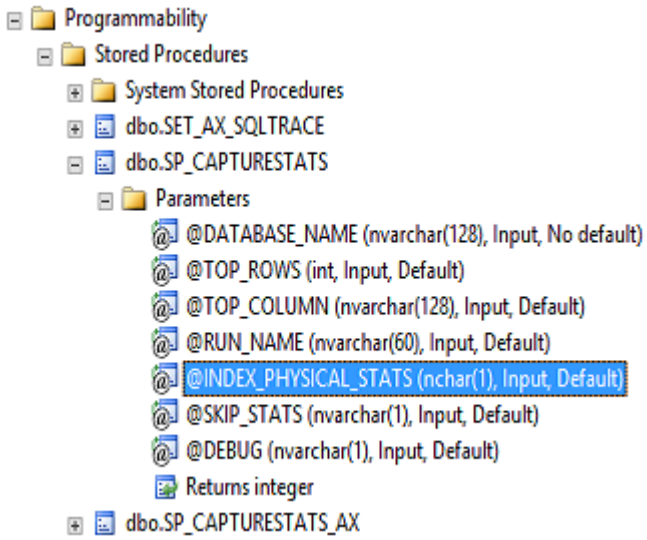
- Windows Server Operating System Monitoring Management Pack
- Microsoft SQL Server Management Pack
- Microsoft SharePoint 2010 Products Management Pack
- Windows Server Internet Information Services Management Pack

Index fragmentation

Indexes have a fragmentation percentage higher than 30%:

	Number of indexes (with more the 1000 pages)
Fragmentation < 10%	N/A
10% <= Fragmentation < 30%	N/A
Fragmentation >= 30%	N/A

In order to capture fragmentation status with DynamicsPerf the SQL Server Stored Procedure needs to be run with the parameter @INDEX_PHYSICAL_STATS='Y'



After running the job, we can find the index fragmentation in DynamicsPerf, higher than 30% and with a number of pages > 1000, with the following query.

```
SELECT b.TABLE_NAME as [Table Name],
               b.INDEX_NAME as [Index Name],
               b.INDEX_KEYS as [Index Keys],
```

```
        STR(ROUND(AVG_FRAGMENTATION_IN_PERCENT,2),5,2) as [Percent Fragmentation],
        PAGE_COUNT as [Page Count],
        ROW_COUNT as [Row Count]
FROM INDEX_PHYSICAL_STATS a
JOIN INDEX_DETAIL AS b
       ON a.object_id = b.object_id and a.INDEX_ID = b.index_id
       where
       a.STATS_TIME = ( select max(stats_time) from INDEX_PHYSICAL_STATS)
       and a.STATS_TIME = b.stats_time
       and AVG_FRAGMENTATION_IN_PERCENT >= 30.0
       and b.PAGE_COUNT > 1000
       and INDEX_TYPE_DESC <> 'HEAP'
ORDER BY [Page Count] DESC , [Percent Fragmentation] DESC
```

Use the 1000 amount of pages to locate bigger or smaller indexes.

Guidance

- The following maintenance is recommended for the AX database and should be scheduled for instance on a weekly basis.
  - Reorganize indexes that are larger than 1000 pages and are between 10% and 30% fragmented.
  - Rebuild indexes that are larger than 1000 pages and more than 30% fragmented using a fill factor between 85% and 95% depending on the frequency of the job execution. (On some indexes this could be as low as 70%)

  On a big database, implementing this maintenance will minimize the number of indexes that are touched by the maintenance plan by only addressing those indexes that require attention. This minimizes the maintenance window. If time allows you could of course simply rebuild all indexes.

  We should note though, that many indexes defined in the AX schema do not necessarily cause any performance degradation even if fragmentation levels are very high. As a rule of thumb, we can postpone rebuilding AX indexes that are used exclusively for locating a single row.

Statistics maintenance on the AX database: Update statistics

Please see the following article for complete details on the maintenance strategy on index:

http://blogs.msdn.com/b/axinthefield/archive/2012/08/01/database-maintenance-strategies-for-dynamics-ax.aspx

Because Dynamics AX indexes uses DataareaID as first column, it is often critical that SQL Server has accurate statistics on other columns of the index. Normally SQL Server creates automatically such statistics, and updates them due to the autoupdatestats option.

These statistics, based on a sample of 5% of the rows can sometime be inaccurate when the distribution of values is skewed.

This is why it is recommended to update regularly statistics with FULL SCAN, or with at least a 50% sample

This is recommended:

- Reorganize Index task
- Update statistics task

Do an update statistics first to optimize the Index reorganize action. See the recommendations and scripts in the previous paragraph.

Please see the following article for complete details on the maintenance strategy on index:

http://blogs.msdn.com/b/axinthefield/archive/2012/08/01/database-maintenance-strategies-for-dynamics-ax.aspx

AX cleanup jobs

At this time the biggest tables are system tables, or troubleshooting tables.

TABLE NAME	ROW COUNT	TOTAL SIZE MB
SYSTRACETABLESQL	6670892	6194
ModelElementData	581475	1377
SYSTRACETABLESQLTABREF	6670803	877
ModelElementLabel	2689116	554
SYSXPPASSEMBLY	2002	467
Sources	267665	375
ModelElement	567438	253
CITPESIMPORTLINESITEMS	299677	228
CITPESINTERFACEITEMS	345789	208
SYSIMAGETABLE	2697	112
ModelSecurityPermission	140893	92
ECORESPRODUCT	120938	58
BATCHHISTORY	51589	50
EVENTINBOX	48983	35
ECORESPRODUCTTRANSLATION	120933	30
AVA_ECORESPRODUCTLOOKUP	158250	23
SYSOLD2NEWRECID	316603	21
BATCHJOBHISTORY	51557	20
ECORESPRODUCTVARIANTDIMENSIONVALUE	159368	20
LOGISTICSADDRESSZIPCODE	58071	14

EVENTINBOXDATA	48983	12
SYSLASTVALUE	10359	12
SQLDICTIONARY	58553	11
ModelSecurityCommon	49470	10
LOGISTICSADDRESSSCITY	63981	8

This script checks for the largest tables in the AX database by row count:

```
SELECT TOP 25
       IND.TABLE_NAME AS [TABLE NAME], IND.ROW_COUNT AS [ROW COUNT]
       , TOT.TOTAL_TABLE_AND_INDEX_SIZE_MB AS [TOTAL SIZE MB]
       -- , TOT.TOTAL_INDEX_AND_DATA_PAGES AS [TOTAL PAGES]
FROM INDEX_STATS_CURR_VW IND
JOIN
(SELECT TABLE_NAME, SUM(PAGE_COUNT) AS TOTAL_INDEX_AND_DATA_PAGES,
       ((SUM(PAGE_COUNT) * 8)/1024) AS TOTAL_TABLE_AND_INDEX_SIZE_MB
       FROM INDEX_STATS_CURR_VW
       GROUP BY TABLE_NAME
       ) TOT
ON IND.TABLE_NAME = TOT.TABLE_NAME
WHERE (IND.INDEX_DESCRIPTION LIKE 'CLUSTERED%' OR IND.INDEX_DESCRIPTION LIKE 'HEAP%')
--ORDER BY ROW_COUNT DESC
 ORDER BY TOT.TOTAL_TABLE_AND_INDEX_SIZE_MB DESC
```

Similar values are returned as previous query, no additional information so far, keep on monitoring.

This script also checks for the largest tables in the AX database by row count:

```
SELECT TOP 25 TABLE_NAME, ROW_COUNT, INDEX_DESCRIPTION, INDEX_KEYS
FROM INDEX_STATS_CURR_VW
WHERE (INDEX_DESCRIPTION LIKE 'CLUSTERED%' OR INDEX_DESCRIPTION LIKE 'HEAP%')
ORDER BY ROW_COUNT DESC
```

This script checks for the largest tables in the AX database by table size:

```
SELECT TOP 25
       TABLE_NAME,
       SUM(PAGE_COUNT) AS TOTAL_INDEX_AND_DATA_PAGES,
       ((SUM(PAGE_COUNT) * 8)/1024) AS TOTAL_TABLE_AND_INDEX_SIZE_MB
FROM INDEX_STATS_CURR_VW
GROUP BY TABLE_NAME
ORDER BY TOTAL_INDEX_AND_DATA_PAGES DESC
```

Here are some specific tables to be also watched:

```
SELECT TABLE_NAME, ROW_COUNT
FROM INDEX_STATS_CURR_VW
WHERE
       (INDEX_DESCRIPTION LIKE 'CLUSTERED%' OR
        INDEX_DESCRIPTION LIKE 'HEAP%') AND
        TABLE_NAME IN
             (  'EVENTCUD' --alerts
              , 'SYSTRACETABLESQL' --tracing
              , 'INVENTSUMLOGTTS'
              , 'INVENTSETTLEMENT'
         , 'BATCH'
         , 'BATCHHISTORY'
         , 'SYSTRACETABLESQL'
         , 'SYSDATABASELOG'
         , 'SYSEXCEPTIONTABLE'
)
ORDER BY TABLE_NAME
```

TABLE_NAME	ROW_COUNT
BATCH	45
BATCHHISTORY	51589
EVENTCUD	432
INVENTSETTLEMENT	3
INVENTSUMLOGTTS	0
SYSDATABASELOG	0
SYSEXCEPTIONTABLE	223
SYSTRACETABLESQL	6670892

SYSTRACETABLESQL
The SYSTRACETABLESQL table is the table that gets populated when long duration query tracing is enabled. If long duration tracing is enabled, a couple of best practices should be followed:

1. Monitor the growth of the table and periodically purge unnecessary records. This type of trace data is usually not beneficial if it's more than a month old.
2. When enabling tracing for long periods of time, be sure the threshold is set no lower than 1000 milliseconds. A lower setting may increase logging enough to have a negative performance impact on the system.

Administration > Users > User options button > SQL tab.

You can also find a job in DynamicsPerf to cleanup this table at Administration | Inquiries | Database | SQL Statement Trace Log | Functions | Clear log**:** it deletes all the SQL statement traces and query plans saved.

EVENTCUD

This table stores alerts waiting to be sent and will continue to grow until the batch job that delivers them executes. When lots of records are queued in the system it usually indicates the batch job that delivers the messages is not running or scheduled.

1. If the alerts queued in the system are not critical, the EVENTCUD table can be truncated. This will prevent a flood of old alerts from being delivered when the batch job is scheduled and runs.
2. Review the alert rules currently setup in the system to make sure they are all necessary.
3. If it is determined that alerts will be used going forward, then schedule the alerts batch job to run periodically so they actually get delivered as expected.

SYSDATABASELOG

If the SYSDATABASELOG table is large, it usually indicates it has either not been purged or transaction tables are being logged. Due to its performance and storage impact, the best practice is to only log activity that is absolutely necessary either for legal compliance or to meet other business requirements. It is recommended to review all logging parameters with special consideration for highly active tables such as transactional and master planning tables

You can find the clean up form for SysDatabaseLog in Administration | Inquiries | Database log | Clean up log: Use the “Database log clean up” process to delete information in the Database log.

You could also breakdown SYSDATABASELOG by log type (Insert, Update, Delete, Rename Key) with the following query:

```
       SELECT top 25         SD.NAME AS TABLE_NAME    , LOG_TYPE =       CASE SDL.LOGTYPE
         WHEN 0 THEN 'Insert'
         WHEN 1 THEN 'Delete'
         WHEN 2 THEN 'Update'
         WHEN 3 THEN 'Rename Key'
         ELSE 'Other'      END
       , COUNT(SDL.LOGTYPE) AS LOG_COUNT
FROM SYSDATABASELOG SDL    INNER JOIN SQLDICTIONARY SD ON SDL.TABLE_ = SD.TABLEID
WHERE SD.FIELDTYPE = 0 AND SD.FIELDID = 0
GROUP BY SD.NAME, SDL.LOGTYPE ORDER BY LOG_COUNT DESC, SD.NAME, SDL.LOGTYPE
```

BATCH & BATCHHISTORY

You can find the clean up form in Basic | Inquiries| Batch jobs | Functions | Delete

Use the “Delete” process within the Function button to set up criteria for deleting a group of batch jobs. You can delete batches by Hold, Waiting, Executing, Error, or Finished status

You can also find a clean up form in Basic | Inquiries | Batch job history | Delete

Use the “Batch clean up” process to clean up batches with a status of Ended

AOS Event Log

Event Logs (Errors only, limited to the past 2 weeks)

In order to use the queries presented in this section ¡, the AOSANALYSIS.CMD script needs to be run. During the data capture the script failed because previous non-existing AOS instances where registered within the database.

- This script will count the Dynamics AX event codes by server:

```
SELECT SERVER_NAME, EVENT_TYPE , COUNT (EVENT_TYPE) AS EVENT_COUNT
FROM AOS_EVENTLOG
WHERE SOURCE_NAME LIKE 'Dynamics%'
       AND TIME_WRITTEN >
(select dateadd(week,-1,MAX(run_name)) from stats_collection_summary) -- or enter time
rang :'2008-11-01 00:00:00.000'
GROUP BY SERVER_NAME, EVENT_TYPE
ORDER BY SERVER_NAME, EVENT_TYPE
```

- This script will count all the Dynamics AX event codes across all AOS server:

```
SELECT EVENT_CODE , COUNT (EVENT_CODE) AS EVENT_COUNT
FROM AOS_EVENTLOG
WHERE SOURCE_NAME LIKE 'Dynamics%'
GROUP BY EVENT_CODE ORDER BY EVENT_CODE
```

Here are some events found in the AOS event log:

Event ID	Event Description / Notes	Severity
110	Log Name: Application Source: Dynamics Server 01 Date: 1/13/2014 4:13:37 AM Event ID: 110 Task Category: None Level: Error Keywords: Classic User: N/A Computer: SV00052.corp.solerpalau.com Description: Object Server 01: MaxMemLoad (75) has been reached. No more connection will be accepted. Current availabe physical memory: -1766572032 bytes. Event Xml: <Event xmlns="http://schemas.microsoft.com/win/2004/08/events/event"> <System> <Provider Name="Dynamics Server 01" /> <EventID Qualifiers="0">110</EventID> <Level>2</Level> <Task>0</Task> <Keywords>0x80000000000000</Keywords> <TimeCreated SystemTime="2014-01-13T12:13:37.000000000Z" />	High

	<EventRecordID>5876946</EventRecordID> <Channel>Application</Channel> <Computer>SV00052.corp.solerpalau.com</Computer> <Security /> </System> <EventData> <Data>Object Server 01: </Data> <**Data>MaxMemLoad (75) has been reached. No more connection will be accepted. Current availabe physical memory: -1766572032 bytes.** **</Data>** </EventData> </Event> **Cause: AOS instance is configured with startup parameter to limits to 75% of total server memory.**	
110	Log Name: Application Source: Dynamics Server 01 Date: 12/9/2013 4:07:20 AM Event ID: 110 Task Category: None Level: Error Keywords: Classic User: N/A Computer: SV00052.corp.solerpalau.com Description: Object Server 01: Dialog issued for client-less session 1: Cannot select a record in System cache flush (SysCacheFlush). Error accessing database connection. Event Xml: <Event xmlns="http://schemas.microsoft.com/win/2004/08/events/event"> <System> <Provider Name="Dynamics Server 01" /> <EventID Qualifiers="0">110</EventID> <Level>2</Level> <Task>0</Task> <Keywords>0x80000000000000</Keywords> <TimeCreated SystemTime="2013-12-09T12:07:20.000000000Z" /> <EventRecordID>5849392</EventRecordID> <Channel>Application</Channel> <Computer>SV00052.corp.solerpalau.com</Computer> <Security /> </System> <EventData> <Data>Object Server 01: </Data> <Data>Dialog issued for client-less session 1: Cannot select a record in System cache flush (SysCacheFlush). Error accessing database connection.</Data> </EventData> </Event> **Cause: This may be related to database connectivity issues.**	Medium
117	Log Name: Application Source: Dynamics Server 01	Medium

	Date: 12/23/2013 12:07:19 AM Event ID: 117 Task Category: None Level: Error Keywords: Classic User: N/A Computer: SV00052.corp.solerpalau.com Description: Object Server 01: The database reported (session 1 (-AOS-)): [Microsoft][SQL Server Native Client 10.0][SQL Server]Cannot drop the table 'tempdb.DBO.t65460_4EC91BC8EF55460E8E83F527B35A51C9', because it does not exist or you do not have permission.. The SQL statement was: "DROP TABLE tempdb."DBO".t65460_4EC91BC8EF55460E8E83F527B35A51C9 " Event Xml: <Event xmlns="http://schemas.microsoft.com/win/2004/08/events/event"> <System> <Provider Name="Dynamics Server 01" /> <EventID Qualifiers="0">117</EventID> <Level>2</Level> <Task>0</Task> <Keywords>0x80000000000000</Keywords> <TimeCreated SystemTime="2013-12-23T08:07:19.000000000Z" /> <EventRecordID>5857413</EventRecordID> <Channel>Application</Channel> <Computer>SV00052.corp.solerpalau.com</Computer> <Security /> </System> <EventData> <Data>Object Server 01: </Data> <Data>[Microsoft][SQL Server Native Client 10.0][SQL Server]Cannot drop the table 'tempdb.DBO.t65460_4EC91BC8EF55460E8E83F527B35A51C9', because it does not exist or you do not have permission.</Data> <Data>DROP TABLE tempdb."DBO".t65460_4EC91BC8EF55460E8E83F527B35A51C9 </Data> <Data>session 1 (-AOS-)</Data> </EventData> </Event> **Cause: This event could have happened if SQL Server instance was restarted and an attempt to delete a temporary table that is not present in TempDB anymore. Keep on monitoring to confirm database accessibility and permissions required are set.**	
140	Log Name: Application Source: Dynamics Server 01 Date: 12/9/2013 4:09:55 AM Event ID: 140 Task Category: None Level: Error Keywords: Classic User: N/A Computer: SV00052.corp.solerpalau.com Description: Object Server 01: Fatal SQL condition during login. Error message: "[Microsoft][SQL Server Native Client 10.0]Login timeout expired" Event Xml: <Event xmlns="http://schemas.microsoft.com/win/2004/08/events/event"> <System>	Low

	<Provider Name="Dynamics Server 01" /> <EventID Qualifiers="0">140</EventID> <Level>2</Level> <Task>0</Task> <Keywords>0x80000000000000</Keywords> <TimeCreated SystemTime="2013-12-09T12:09:55.000000000Z" /> <EventRecordID>5849476</EventRecordID> <Channel>Application</Channel> <Computer>SV00052.corp.solerpalau.com</Computer> <Security /> </System> <EventData> <Data>Object Server 01: </Data> **<Data>[Microsoft][SQL Server Native Client 10.0]Login timeout expired</Data>** </EventData> </Event> **SQL Server was not available for connection. The AOS will attempt to reconnect SQL Server automatically. No action needed but monitoring. Always shut down the AOS before restarting SQL Server.**	
149	Log Name: Application Source: Dynamics Server 01 Date: 1/22/2014 5:35:30 AM Event ID: 149 Task Category: None Level: Information Keywords: Classic User: N/A Computer: SV00052.corp.solerpalau.com Description: Object Server 01: Ready for operation. System Info: OS: WINSRV2008 PID: 10132 Executable: f:\Program Files\Microsoft Dynamics AX\60\Server\MicrosoftDynamicsAX\Bin\Ax32Serv.exe Kernel build: **1108.4316** Configuration: **01** System directory: f:\Program Files\Microsoft Dynamics AX\60\Server\MicrosoftDynamicsAX\bin\Application\ Application: Standard RPC listener: Server listening on port **2712** X++ debugging: **Enabled** **Model store: CL00008-SQL\MicrosoftDynamicsAX** Event Xml: <Event xmlns="http://schemas.microsoft.com/win/2004/08/events/event"> <System> <Provider Name="Dynamics Server 01" /> <EventID Qualifiers="0">149</EventID> <Level>4</Level> <Task>0</Task> <Keywords>0x80000000000000</Keywords> <TimeCreated SystemTime="2014-01-22T13:35:30.000000000Z" /> <EventRecordID>5887466</EventRecordID> <Channel>Application</Channel>	INFO

	<Computer>SV00052.corp.solerpalau.com</Computer> <Security /> </System> <EventData> <Data>Object Server 01: </Data> <Data>f:\Program Files\Microsoft Dynamics AX\60\Server\MicrosoftDynamicsAX\Bin\Ax32Serv.exe</Data> <Data>1108.4316</Data> <Data>01</Data> <Data>f:\Program Files\Microsoft Dynamics AX\60\Server\MicrosoftDynamicsAX\bin\Application\</Data> <Data>Standard</Data> <Data>10132</Data> <Data>Server listening on port 2712</Data> <Data>Enabled</Data> <Data>WINSRV2008</Data> **<Data>CL00008-SQL\MicrosoftDynamicsAX**</Data> </EventData> </Event> **Cause: AOS Startup message**	
163	Object Server 01: SQL diagnostics: [Microsoft][SQL Server Native Client 10.0]Login timeout expired. Connect information was: Userid = [], Database = [MicrosoftDynAX2012R2], Server = [SQL05], DSN = [], Other = [] **SQL Server was not available for connection. The AOS will attempt to reconnect SQL Server automatically. No action needed.** **Always shut down the AOS before restarting SQL Server.**	Low
180	Object Server 01: RPC error: RPC exception 1726 occurred in session 7 process is Ax32Serv.exe thread is 19196(User: avanade0, ClientType: GUI) **This error message indicates that the AOS server was running and that a Microsoft Dynamics AX client was active. Then, the AOS server was either restarted or crashed. After the AOS server was restarted, the Microsoft Dynamics AX client that was running when the crash occurred tried to communicate with the AOS server. Because the AOS server was restarted, it does not recognize the existing client connection or the session that the client is trying to use.** **To resolve this problem, you have to shut down the Microsoft Dynamics AX client, and then restart it. This will create a new connection to the AOS server that will have a new session number.**	Low
193	Log Name: Application Source: Dynamics Server 01 Date: 2/6/2014 2:08:39 AM Event ID: 193 Task Category: None **Level: Information** Keywords: Classic User: N/A Computer: SV00052.corp.solerpalau.com Description:	Medium

	Object Server 01: Could not load assembly 'Microsoft.Dynamics.AX.Framework.Analytics, Version=6.0.0.0, Culture=neutral, PublicKeyToken=31bf3856ad364e35' or one of its dependencies. Event Xml: <Event xmlns="http://schemas.microsoft.com/win/2004/08/events/event"> <System> <Provider Name="Dynamics Server 01" /> <EventID Qualifiers="0">193</EventID> <Level>4</Level> <Task>0</Task> <Keywords>0x80000000000000</Keywords> <TimeCreated SystemTime="2014-02-06T10:08:39.000000000Z" /> <EventRecordID>5891271</EventRecordID> <Channel>Application</Channel> <Computer>SV00052.corp.solerpalau.com</Computer> <Security /> </System> <EventData> <Data>Object Server 01: </Data> <**Data>Could not load assembly 'Microsoft.Dynamics.AX.Framework.Analytics, Version=6.0.0.0, Culture=neutral, PublicKeyToken=31bf3856ad364e35' or one of its dependencies.</Data>** </EventData> </Event> **Confirm all required assemblies are correctly installed. Keep on monitoring to identify if this messages appeared only during installation of any of the components.**	
2000	Log Name: Application Source: Dynamics Server 01 Date: 1/23/2014 1:12:13 PM Event ID: 2000 Task Category: None Level: Information Keywords: Classic User: N/A Computer: SV00052.corp.solerpalau.com Description: Object Server 01: The model store has been successfully validated and is ready for use. The model schema version is 1.9. **The model store is CL00008-SQL\MicrosoftDynamicsAX.** Event Xml: <Event xmlns="http://schemas.microsoft.com/win/2004/08/events/event"> <System> <Provider Name="Dynamics Server 01" /> <EventID Qualifiers="0">2000</EventID> <Level>4</Level> <Task>0</Task>	INFO

<Keywords>0x80000000000000</Keywords>
<TimeCreated SystemTime="2014-01-23T21:12:13.000000000Z" />
<EventRecordID>5889353</EventRecordID>
<Channel>Application</Channel>
<Computer>SV00052.corp.solerpalau.com</Computer>
<Security />
</System>
<EventData>
<Data>Object Server 01: </Data>
<Data>1.9</Data>
<Data>CL00008-SQL</Data>
<Data>MicrosoftDynamicsAX</Data>
</EventData>
</Event>

Security Scorecard

Dynamics AX Security

Checklist Item	Best Practice	Actual
AX admin group membership	Limited number of users. Access to this group reviewed regularly. System Admin > Common > User groups	Few users listed. Security model is under definition/design.
Business Connector Proxy account	Dedicated domain account used. Account is not associated with an AX user ID. This account will be used to connect to the AOS on behalf of a Microsoft Dynamics AX user, without granting that user excessive privileges in the system.	Dedicated account.
Workflow execution account		N/A
AOS service account	Dedicated domain account used for AOS services. It is strongly recommend that you use a domain account in a production environment. You should use the Network Service account only in development and testing environments.	Dedicated account.
SQL Server account	Dedicated account	Dedicated account
Database logging	AX database logging configured to track changes to sensitive data. Log reviewed periodically.	0
Alerts	Org Admin – Setup – Alert – Alerts rules Table EventCUD	Alerts are being sent and table size is under control. Less than 500.
Firewall	Exclude the TCP/IP port used by the AOS (2712 by default) Exclude the services WSDL port used by the AOS (8101 by default) Exclude the services endpoint port used by the AOS (8201 by default)	Enabled.

Firewall settings

- Exclude the TCP/IP port used by the AOS (2712 by default): Setup automatically creates the inbound rule "Dynamics AX 6.0 -MicrosoftDynamicsAX (RPC)" for the TCP/IP port.

- Exclude the services WSDL port used by the AOS (8101 by default): Setup automatically creates the inbound rule "Dynamics AX 6.0 -MicrosoftDynamicsAX (WSDL)" for the WSDL port.

- Exclude the services endpoint port used by the AOS (8201 by default): Setup automatically creates the inbound rule "Dynamics AX 6.0 -MicrosoftDynamicsAX (NetTCP)" for the services endpoint port.

Note: Windows Firewall must be enabled on the computer. Each AOS instance must use a different port number. By default, each time you install an additional AOS instance on a computer, the TCP/IP port number and the Services endpoint port numbers increment by one. For example, the second AOS instance on a computer would be assigned to TCP/IP port 2713 by default.

Database logging

Setup > Database > Database log setup.

The database logging functionality available in Dynamics can be useful in providing an audit trail for data changes. A review of your business and legal compliance requirements is recommended. If data change audit trails are not required, the current settings are appropriate. If an audit trail is necessary to meet those requirements you may want to implement database logging.

The following script will help you to count the number of log per month on the prodution database:

```
SELECT
         DATEPART(year, CREATEDDATETIME) AS LOG_DATE_YEAR
       , DATEPART(month,CREATEDDATETIME) AS LOG_DATE_MONTH
       , COUNT (RECID) AS LOG_COUNT
FROM SYSDATABASELOG (NOLOCK)
GROUP BY DATEPART(year, CREATEDDATETIME), DATEPART(month,CREATEDDATETIME)
ORDER BY DATEPART(year, CREATEDDATETIME), DATEPART(month,CREATEDDATETIME)
```

- The best practice here is to keep logs only from limited amount of months.

What are the most actively logged tables with percent of total. Tables that are frequently updated should not be in the database logging to avoid any performance contenttion during database operations:

```
SELECT
         SD.NAME
       , SDL.TABLE_ AS TABLE_ID
       , COUNT (SDL.TABLE_) AS ROW_COUNT
       , (CONVERT(NUMERIC(18,2),COUNT(SDL.TABLE_))/(SELECT
CONVERT(NUMERIC(18,2),COUNT(TABLE_)) FROM SYSDATABASELOG)) * 100 AS PERCENT_OF_TOTAL_LOG
FROM SYSDATABASELOG SDL (NOLOCK)
       INNER JOIN SQLDICTIONARY SD (NOLOCK)
              ON SDL.TABLE_ = SD.TABLEID
                     AND SD.FIELDID = 0
GROUP BY SD.NAME, TABLE_
ORDER BY PERCENT_OF_TOTAL_LOG DESC
```

SQL/Database Security

Checklist Item	Best Practice	Actual
AOS service account access to AX database	AOS service account access should be restricted to database roles: • db_datareader • db_datawriter • db_ddladmin Granted execute permissions to stored procedures.	Too much privileges.
User access to AX database	Users should not have direct access to the AX database.	Not granted.
SQL Server Database Engine Account	Dedicated SQL Server account used for SQL Services. The domain account the SQL Server (MSSQLSERVER) Windows service will run as.	SOLERPALAU\Services This account is used for more services not only SQL.
SQL Server Reporting Services Account	The domain account the SQL Server Reporting Services (MSSQLSERVER) Windows service will run as.	N/A
SQL Services Analysis Services Account	The domain account the SQL Server Analysis Services (MSSQLSERVER) Windows service will run as. *IMPORTANT: The .NET Business Connector account must have read access to the Microsoft Dynamics AX online transaction processing (OLTP) database*	N/A

Performance Score Card

AOS Server Utilization

SV00052

Log Time Range: 24/02/2014 12:05:48 - 25/02/2014 17:50:34

Processor					
Object	Counter	Min	Average	Max	Notes
Processor	% Processor Time	0	3	35	
Processor	% Privileged Time	0	0	12	

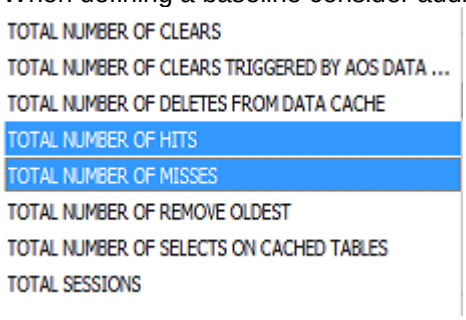
Memory					
Object	Counter	Min	Average	Max	Notes
Memory	Available Mbytes (GB)	3,845	5,910	7,061	
Paging File	% Usage	0	1	1	
Process	Working Set (ax32serv) in GB	0,06	0,83	1,77	
Process	Virtual Bytes (ax32serv) in GB	5,28	6,55	7,36	

Disk					
Object	Counter	Min	Average	Max	Notes
Logical Disk (C) OS	Avg. Disk Sec/Read (ms)	0	1	389	
Logical Disk (C) OS	Avg. Disk Sec/Write (ms)	0	10	1966	
Logical Disk (C) OS	%Idle time	45	99	100	
LogicalDisk (F) Ax32serv	Avg. Disk Sec/Read (ms)	0	0	198	
LogicalDisk (F) Ax32serv	Avg. Disk Sec/Write (ms)	0	1	319	
LogicalDisk (F) Ax32serv	%Idle time	91	100	100	

Network Capacity	Metric	Min	Average	Max	Notes
All cards	Output Queue Length	0	0	0	
	% Network Utilization	0	0	0	

AOS					
Object	Counter	Min	Average	Max	Notes
Microsoft Dynamics AX Object Server	Active Sessions	1	8	30	

<table>
<tr><th colspan="2">AOS Server Utilization Notes</th></tr>
<tr><td>Processor</td><td>No issues.</td></tr>
<tr><td>Memory</td><td>No issues.
Remove the AOS startup command parameter to limit memory usage. Is not currently needed and there are events in the Application Event Log registering dropped connections because of the setting.</td></tr>
<tr><td>Disk</td><td>Several high peaks.
General guidance for disk performance counters :
Avg disk sec/read & Avg disk sec/write

<table><tr><th>Status</th><th>Scale</th></tr><tr><td>Ok</td><td>0 to 10 ms</td></tr><tr><td>Warning</td><td>11 to 24 ms</td></tr><tr><td>I/O Bottleneck</td><td>25 + ms</td></tr></table>
Review disks access patters and isolate resources and grant high priority to AOS servers’ resources wherever possible.</td></tr>
<tr><td>Network</td><td>No issues.</td></tr>
<tr><td>AOS</td><td>No issues:
When defining a baseline consider adding additional AOS counters.
 

I.e. the ratio between misses and hits from cache could give an estimation on how the cache settings are behaving.</td></tr>
</table>

SQL Server Utilization

SV00008-1

System Information	
OS Name	Microsoft® Windows® Server 2008 R2 SP1 Standard x64
System Model	IBM eServer BladeCenter HS21 -[8853G7G]-
System Type	X64 BIOS Version/Date IBM -[BCE149AUS-1.22]-, 11/06/2012
Processors	2 x Processor Intel(R) Xeon(R) CPU X5460 @ 3.16GHz, 3166 Mhz, 4 Core(s), 4 Logical Processor(s)
Total Physical Memory	16 GB
Total Virtual Memory	32 GB
Page File:	E:
SQL SERVER Service INFO	SQL Server (MSSQLSERVER) **MSSQLSERVER Running** Manual Own Process "c:\program files\microsoft sql server\mssql10_50.mssqlserver\mssql\binn\sqlservr.exe" –smssqlserver Normal sol****\s****** 0 SQL Server (SQLAXPROD) ***MSSQL$SQLAXPROD* Stopped** Manual Own Process "c:\program files\microsoft sql server\mssql10_50.sqlaxprod\mssql\binn\sqlservr.exe" –ssqlaxprod Normal SQL****\s******* 0

Below are represented, the number of I/Os for the databases' files.

For the Data files we see that:

- Most reads operations are on MicrosoftDynamicsAX with 51% and SOLERPALAU_AX2012 43%.
- The writings on TempDB data represent about 60% and writing to MicrosoftDynamicsAX 38%.

For the Log files we can see that:

- Most log write operations on log files happened on MicrosoftDynamicsAX, near 70% and TempDB about 28%.
- Reading MicrosoftDynamicsAX represents 85% of all log reading activity.

This can be verified with the queries below:

Database I/O Access for data files

```
select distinct D.DATABASE_NAME, sum(num_of_bytes_read) OVER(PARTITION BY DATABASE_ID) /1024 /
1024  as [# MB READ],
             STR( ROUND (1.0 * sum(num_of_bytes_read) OVER(PARTITION BY DATABASE_ID)/
sum(num_of_bytes_read) over() * 100.0, 2), 5, 2)  as [PerCent READ],
       sum(num_of_bytes_written)  OVER(PARTITION BY DATABASE_ID)  /1024 / 1024 as [# MB
WRITTEN],
```

```
        STR(ROUND (1.0 * sum(num_of_bytes_written)  OVER(PARTITION BY D.DATABASE_NAME) /
sum(NUM_OF_BYTES_WRITTEN) over() * 100, 2), 5, 2)  as [Percent WRITTEN]
from PERF_DISKSTATS D
INNER JOIN SQL_DATABASEFILES F
                ON D.DATABASE_NAME = F.[Database_Name]
                    AND D.FILE_ID = F.file_id
and F.[PHYSICAL_NAME]  not like '%.ldf'
and D.DATABASE_NAME <> 'DynamicsPerf'
where D.STATS_TIME =
(select MAX(stats_time) from PERF_DISKSTATS)
ORDER BY [PerCent READ] DESC
```

DATABASE_NAME	# MB READ	PerCent READ	# MB WRITTEN	Percent WRITTEN
MicrosoftDynamicsAX	68893	**51.31**	4458	**38.68**
SOLERPALAU_AX2012	58803	**43.79**	125	1.09
tempdb	6373	4.75	6823	**59.20**
msdb	132	0.10	64	0.56
MicrosoftDynamicsAXBaseline	34	0.03	25	0.22
master	19	0.01	3	0.03
model	17	0.01	24	0.22

Database I/O Access for log files

```
select distinct D.DATABASE_NAME, sum(num_of_bytes_read) OVER(PARTITION BY DATABASE_ID) /1024 /
1024  as [# MB READ],
                STR( ROUND (1.0 * sum(num_of_bytes_read) OVER(PARTITION BY DATABASE_ID)/
sum(num_of_bytes_read) over() * 100.0, 2), 5, 2)  as [PerCent READ],
        sum(num_of_bytes_written)  OVER(PARTITION BY DATABASE_ID)  /1024 / 1024 as [# MB
WRITTEN],
        STR(ROUND (1.0 * sum(num_of_bytes_written)  OVER(PARTITION BY D.DATABASE_NAME) /
sum(NUM_OF_BYTES_WRITTEN) over() * 100, 2), 5, 2)  as [Percent WRITTEN]
from PERF_DISKSTATS D
INNER JOIN SQL_DATABASEFILES F
                ON D.DATABASE_NAME = F.[Database_Name]
                    AND D.FILE_ID = F.file_id
and F.[PHYSICAL_NAME]  like '%.mdf'
and D.DATABASE_NAME <> 'DynamicsPerf'
where D.STATS_TIME = (select MAX(stats_time) from PERF_DISKSTATS)
ORDER BY [Percent WRITTEN] DESC
```

DATABASE_NAME	# MB READ	PerCent READ	# MB WRITTEN	Percent WRITTEN
MicrosoftDynamicsAX	70	**84.56**	4834	**69.02**
msdb	3	4.39	29	0.42
tempdb	2	3.20	1989	**28.41**
SOLERPALAU_AX2012	1	2.34	99	1.43
model	1	2.30	24	0.35
master	1	2.06	2	0.03
MicrosoftDynamicsAXBaseline	0	1.13	24	0.35

Date range = 24/02/2014 12:00:40 - 24/02/2014 13:11:55

Processor					
Object	Counter	Min	Average	Max	Notes
Processor	% Processor Time	1	3	14	
	% Privileged Time	0	1	2	
System	Processor Queue Length	0	0	0	
System	Context Switches /sec	2,356	3,563	7,123	
SQL Server: SQL Statistics	Batch Requests/sec	1	234	1,085	

Memory					
Object	Counter	Min	Average	Max	Notes
Memory	Available Mbytes (GB)	384	439	480	
Paging File	% Usage	0	0	0	
SQL Server: Buffer Manager	Buffer Cache Hit Ratio	100	100	100	
	Page life expectancy	128,780	130,917	133,054	
	Lazy writes / sec	0	0	0	

Disk					
Object	Counter	Min	Average	Max	Notes
LogicalDisk (C) OS	Avg. Disk Sec/Read (ms)	0	3	84	
LogicalDisk (C) OS	Avg. Disk Sec/Write (ms)	8	10	31	
LogicalDisk (C) OS	%Idle time	91	98	100	
LogicalDisk (E) Pagefile.sys	Avg. Disk Sec/Read (ms)	0	0	7	
LogicalDisk (E) Pagefile.sys	Avg. Disk Sec/Write (ms)	0	1	26	
LogicalDisk (E) Pagefile.sys	%Idle time	99	100	100	
LogicalDisk (T) Data file and TempDB	Avg. Disk Sec/Read (ms)	0	3	46	
LogicalDisk (T) Data file and TempDB	Avg. Disk Sec/Write (ms)	0	4	42	
LogicalDisk (T) AX Data file and TempDB	%Idle time	96	100	100	
LogicalDisk (L) AX log file	Avg. Disk Sec/Read (ms)	0	0	2	
LogicalDisk (L) AX log file	Avg. Disk Sec/Write (ms)	0	6	39	
LogicalDisk (L) AX log file	%Idle time	87	98	100	

Network Capacity	Metric	Min	Average	Max	Notes
Broadcom BCM5708S NetXtreme II GigE [NDIS VBD Client] _x2	Output Queue Length	0	0	0	
	% Utilization	0	0	1	

SQL Server Utilization Notes	
Processor:	No issue.
Memory:	Notes: 2 SQL Server instances are installed. One is stopped and set to start manually. There current usage of memory by SQL Server instance is fine and there are always RAM with free available MB even if low. Consider that current workload is not representative. Further monitoring is needed in tests environment. Initially and without any other further data, the values as available MB could be low compared to high workload times. SQL Server always had free pages and when needed checkpoint pages were created and lazy writer was never searching for free pages. This behavior is expected to change under heavy workload scenario. In order to help allocate the growing trend of usage be sure that proper Indexes' optimization is done. You can use this counter to monitor a health ratio, Index Searches To Full Scans Ratio Percentage. A ratio of more than 1 SQL Full Scan for every 1000 Index Searches SV00008-1 Min: 0 Avg:1.083 Max:12
Disk:	General guidance for disk performance counters : Avg disk sec/read & Avg disk sec/write **Status** / **Scale** Ok / 0 to 10 ms Warning / 11 to 24 ms I/O Bottleneck / 25 + ms There are several disks already suffering some bottlenecks. Recommendation is to implement the remediation plan and keep monitoring. Consider that the performance of this could be affected by several factors, like disks cluster size, fragmentation, RAID configuration (1+0 recommended for AX), better indexes or with compression, database file configuration, the storage engine settings among other factors. You can use tools like SQLio to simulate SQL workload with the storage system and optimize the storage system configuration for your particular needs. You may find it here: SQLIO Disk Subsystem Benchmark Tool http://www.microsoft.com/en-us/download/details.aspx?id=20163
Network:	No issues.

Query Performance

Expensive queries

Using DynamicsPerf database we can also have a look at the expensive queries (Total elapsed time) from a SQL Server DMV perspective.

```
SELECT TOP 20
         SQL_TEXT as [Query], QUERY_PLAN,
         cast (TOTAL_ELAPSED_TIME as INT) as [Total Duration (ms)],
         cast (AVG_ELAPSED_TIME as INT) as [Average Duration (ms)],
         AVG_LOGICAL_READS as [Average reads] , EXECUTION_COUNT as [Execution Count]
FROM QUERY_STATS_CURR_VW
WHERE SQL_TEXT not like 'FETCH%'
ORDER BY TOTAL_ELAPSED_TIME DESC
```

The tables listed are system queries or DyanmicsPerf queries we run to gather or analyze data. Keep using it to detect potential problematic functional areas.

We could have ordered the most expensive queries by average elapsed time (AVG_ELAPSED_TIME DESC) instead:

```
SELECT TOP 10
         SQL_TEXT as [Query], QUERY_PLAN,
         cast (TOTAL_ELAPSED_TIME as INT) as [Total Duration (ms)],
         cast (AVG_ELAPSED_TIME as INT) as [Average Duration (ms)],
         AVG_LOGICAL_READS as [Average reads] , EXECUTION_COUNT as [Execution Count]
FROM QUERY_STATS_CURR_VW
WHERE SQL_TEXT not like 'FETCH%'
ORDER BY AVG_ELAPSED_TIME DESC
```

The tables listed are system queries or DynamicsPerf queries we run to gather or analyze data. Keep using it to detect potential problematic functional areas.

AX long running queries

Using DynamicsPerf database we can do an analysis of the Dynamics AX SQL statement log for long running queries (> 1000 ms or 2000 ms for instance). Th AX loggins also allows to identify the Dynamics AX X++ code which generated the queries, by making use of the AX stack trace reference. It also indicates which AX users executed the queries.

If we want to have an overview of the AX long running queries by date and time we can run a query like this:

```
SELECT    CONVERT(nvarchar,CREATED_DATETIME,101) AS [CREATED DATE]
            , DATEPART (hh, CREATED_DATETIME) AS [HOUR OF DAY]
            , COUNT (CREATED_DATETIME) AS [EXECUTION COUNT]
            , SUM (SQL_DURATION) AS [TOTAL DURATION (milliseconds)]
```

```
            , AVG (SQL_DURATION) AS [AVERAGE DURATION (milliseconds)]

FROM AX_SQLTRACE_VW
WHERE
SQL_DURATION > 1000
-- AND CREATED_DATETIME > = '20120604'
GROUP BY CONVERT(nvarchar,CREATED_DATETIME,101), DATEPART (hh, CREATED_DATETIME)
ORDER BY [CREATED DATE],[HOUR OF DAY]
```

No data was gathered during the captured time. Keep using it to detect potential problematic functional areas.

Missing clustered indexes

As a general practice all tables in an OLTP database should have clustered indexes, even those whose contents are temporary (lasting for the duration of a transaction or batch process). The following whitepaper is available on the Microsoft site, and provides background behind this recommendation:

http://www.microsoft.com/technet/prodtechnol/sql/bestpractice/clusivsh.mspx

You might consider the following criteria when prioritizing which tables need a clustered index the most:

- Highly active tables
- Tables frequently involved in blocking or deadlock situations.
- Tables that frequently incur the overhead of forwarded rows.
- Indexes that maximize the benefit of clustering are those which are frequently used to return a range of rows.
- The clustered index key should not include columns which are updated.
- Consider the key length when choosing a clustered index. A long clustered key can inflate the size of non-clustered indexes on the same table. This is because every non-clustered index 'embeds' the clustering key as the mechanism to find the path back to the actual data row.

To find tables without a clustered index, we ran the following query on the DynamicsPerf database:

```
SELECT TABLE_NAME as [Table Name],
(USER_SCANS + USER_LOOKUPS) as [Lookup_or_Scan Count],
ROW_COUNT as [Row Count],
PAGE_COUNT as [Page Count]
FROM INDEX_STATS_CURR_VW
WHERE
INDEX_DESCRIPTION LIKE 'HEAP%'
AND (USER_SCANS + USER_LOOKUPS) > 0
AND PAGE_COUNT > 64
AND ROW_COUNT > 1000
ORDER BY (USER_SCANS + USER_LOOKUPS) DESC
```

This returns table names:

The tables listed are not significant nowadays but keep using it to detect potential problematic areas.

Table Name	Lookup_or_Scan Count	Row Count	Page Count
CITPESOPERATINGKEYS	0	309	7
existingPaths	0	1124	21
MODELSECPOLRUNTIMEEX System table	0	385	278

- A very strong recommendation here is to create a clustered index for each table (starting with the ones with highest lookup or scan count).

  As a hint: for heaps having only one non-clustered index which is correctly used; make this index clustered. For heaps with multiple non-clustered indexes some more investigation is needed to decide which clustered index would be the best candidate.

Forwarded Records

As mentioned above, tables which have forwarded rows are good candidates to have a clustered index, because of the loss of performance they generate.

A forwarded row occurs in a heap (table without a clustered index) when a row grows in length such that it will no longer fit in the same page.
The row is then migrated to another page, and in its original location a pointer row is retained which contains the new location of the row. Thus, a lookup operation for the row will actually involve two lookups.

The number of times this double lookup event occurs can be observed through one of the dynamic management views (DMVs) in SQL Server 2008 (sys.dm_db_index_operational_stats).

By querying the forwarded_fetch_count column in this view, we can determine the number of times that access to a row in a heap table was degraded. Based on early analysis the following tables have a high volume of forwarded fetch counts, and should be analyzed for a suitable clustered index:

```
SELECT TABLE_NAME as [Table Name],
       FORWARDED_FETCH_COUNT as [Forwarded Fetch Count]
FROM INDEX_STATS_CURR_VW
WHERE FORWARDED_FETCH_COUNT > 0
ORDER BY FORWARDED_FETCH_COUNT DESC
```

No forwards were detected during the monitoring period. Keep using the query to detect risks.

Memo Fields

All these fields can have a negative impact on performance; for example memo fields on tables that are selected frequently (While select InvoiceTxt….) will slow down the process. The reason is that the BLOB data is stored in separate locations on the disk and that the data is fetched in a “second” cursor in SQL server. Memo fields on key AX tables should be changed to string max 1000.

To help analyze the usage of Memo fields, you can see below the maximum size of each Memo field stored in the database as NTEXT.

You can get this information from the DynamicsPerf.dbo.MemoFields table, by running the query:

```
use AX DATABASENAMEPROD
declare
@SQL varchar(255),
@ColumnName varchar(255),
@TableName varchar(255)

set quoted_identifier off

create table #foo
(
      tableName varchar(100),
      columnName varchar(100),
      maxLength int

)

declare     tableCursor CURSOR for

select tablename = t.name, columnname = c.name
from sys.columns c join sys.tables t
on c.object_id = t.object_id
where c.system_type_id = 231 and max_length = -1
order by t.name

OPEN tableCursor

FETCH TableCursor into @TableName, @ColumnName
WHILE @@Fetch_Status = 0
      BEGIN
            set @SQL = 'insert into #foo select "' + @TableName + '", "'+@ColumnName+'",
maxlength = isnull(max(datalength(' + @ColumnName + ')),0)/2 from ' + @TableName
            exec(@SQL)
            FETCH TableCursor into @TableName, @ColumnName
      END
select * into dynamicsPerf..MemoFields from #foo
select * from #foo
order by maxLength desc
drop table #foo
CLOSE TableCursor
DEALLOCATE TableCursor
RETURN
```

Using the query above, we stored the memo field information in a DynamicsPerf table called Memo fields.

To determine the maximum size for each memo field you can run the following query:

```
SELECT M.tableName as [Table Name]
      ,M.[columnName] as [Column Name]
      ,M.[maxLength] as [Max Length]
```

```
      ,I.ROW_COUNT as [Row Count]
      ,T.APPLICATION_LAYER as [Application Layer]
FROM   Memofields M
JOIN  INDEX_STATS_CURR_VW I
         ON M.TABLENAME = I.TABLE_NAME
JOIN   AX_TABLE_DETAIL_CURR_VW T
ON T.DATABASE_NAME = I.DATABASE_NAME AND T.TABLE_NAME = I.TABLE_NAME
WHERE (I.INDEX_DESCRIPTION LIKE 'CLUSTERED%' OR I.INDEX_DESCRIPTION LIKE 'HEAP%')
       AND I.ROW_COUNT > 0
       and T.APPLICATION_LAYER NOT IN ('sys', 'syp', 'gls', 'glp')
ORDER BY T.APPLICATION_LAYER, I.ROW_COUNT DESC
```

This returns the following rows.

tableName	columnName	maxLength
LACREPORT	TRANSFORMSTYLESHEET	87916
SYSTASKRECORDERSAVEDTASKS	SCRIPTTEXT	39150
LACREPORT	SORTSTYLESHEET	35635
SYSTRACETABLESQL	STATEMENT	9242
SYSINETCSS	TEXT	5542
AIFSCHEMASTORE	SCHEMAXML	2825
WORKFLOWELEMENTVIEWSTATE	XML	1105
SYSTRACETABLESQL	CALLSTACK	955
LACREPORTELEMENT	VALUESTR	641
CUSTTABLE	MEMO	504
DMFCUSTOMERENTITY	MEMO	504
SYSEXCEPTIONTABLE	DESCRIPTION	465
PURCHPURCHASEORDERHEADER	FORMLETTERREMARKSTXT	446
FORMLETTERREMARKS	TXT	446
EVENTINBOX	MESSAGE	306
SYSTRACETABLESQL	TEXT	305
OUTLOOKUSERSETUP	OUTLOOKCALENDAROUTLOOKSTOREID	240
OUTLOOKUSERSETUP	OUTLOOKCONTACTFOLDERSTOREID	240
OUTLOOKUSERSETUP	OUTLOOKTASKOUTLOOKSTOREID	240
WORKFLOWVERSIONTABLENOTES	NOTES	202
SYSTRACETABLESQL	TEXTDETAILS	190
LACREPORTELEMENT	VALUECODE	173
SMMACTIVITIES	EXTERNALMEMO	118
LACREPORT	MAPORDERID	117
LACREPORT	MAPDOCID	117

The recommendation is to limit the amount of this memo type to as less as possible to avoid performance degradation. Review the attached document “SolerPalau_AX_HC_Additional_Info.xlsx” for further details.

For example if memo fields don’t contain data or are small strings, it could probably be replaced by Strings (varchar). For these which has a reason to be memo field type, value should be changed to the maximum fixed reasonable value for the fields’ purposes.

Change max length value of some tables for the faster execution of the query plan:
- fix the max length of tables which has today value of 0 to the fixed value of 100
- fix the max length of tables which has today value less than 1000 max length to 1000.

Hints and advice to find clustered index columns

If you want to know if you have heaps (tables without a clustered index) with only one non-clustered index you can run a query like this:

```
SELECT TABLE_NAME AS [TABLE NAME],
      (USER_SCANS + USER_LOOKUPS) AS [LOOKUP OR SCAN COUNT],
       ROW_COUNT AS [ROW COUNT], PAGE_COUNT AS [PAGE COUNT]
FROM INDEX_STATS_CURR_VW O
WHERE
INDEX_DESCRIPTION LIKE 'HEAP%'
AND (USER_SCANS + USER_LOOKUPS) > 0
AND PAGE_COUNT > 64
AND ROW_COUNT > 1000
AND 2 =
(
       SELECT COUNT(*) FROM INDEX_STATS_VW I
       WHERE O.RUN_NAME = I.RUN_NAME
       AND O.TABLE_NAME = I.TABLE_NAME
)
ORDER BY (USER_SCANS + USER_LOOKUPS) DESC
```

No tables were detected during the monitoring period. Keep using the query to detect future risks.

Script to identify potential clustered indexes based on user activity

For heaps with multiple non-clustered indexes, you can automate the methodology described above and use the following script to identify a good clustered index based uniquely on user activity.

```
select A.ROW_COUNT as [Row_count],
             A.TABLE_NAME as [Table Name],
             A.Index_to_Cluster as [Index to Cluster]
FROM (select T.ROW_COUNT,T.TABLE_NAME,
       (select dbo.fn_getnonclusteredindexes(T.DATABASE_NAME, T.TABLE_NAME)) as
Index_to_Cluster
from INDEX_STATS_CURR_VW T
       WHERE   T.INDEX_DESCRIPTION LIKE 'HEAP%'
               and T.ROW_COUNT> 1000)
               A
               where A.Index_to_Cluster is not NULL
               order by A.ROW_COUNT DESC
```

No tables were detected during the monitoring period. Keep using the query to detect future risks.

Missing indexes

We can run a query that identifies the queries in DynamicsPerf logging database that the SQL Server Optimizer suspects can be optimized by new or changed indexes:

```
SELECT  TOP 100 INDEX_IMPACT AS [Index Impact],
SQL_TEXT AS [Query Text],
QUERY_PLAN AS [Query Plan],
TABLE_NAME AS [Table Name],
EQUALITY_COLUMNS AS [Equality Columns],
INEQUALITY_COLUMNS AS [Inequality Columns],
EXECUTION_COUNT AS [Execution Count],
STR(ROUND(TOTAL_ELAPSED_TIME,0), datalength(cast(TOTAL_ELAPSED_TIME AS VARCHAR(32))) - 3,
0) AS [Total Time],
ROUND(AVG_ELAPSED_TIME,2)AS [Average Time]
FROM MISSING_INDEXES_CURR_VW
--WHERE INCLUDED_COLUMNS = ''
ORDER BY TOTAL_LOGICAL_READS DESC
```

The activity generated in the environment is not significant for any analysis as crossed databases where tracked.
In the query above, I select the Missing Indexes with no Included fields to check for lighter indexes. Comment out this line to see all the indexes suggested.

You should analyze these findings and maybe consolidate the indexes with existing ones: making a bigger index from 2 smaller indexes, removing an index with the same columns if tests show that one is no longer necessary, not add some of these hints from the Query Analyzer at all because there is not much benefit for the queries you use etc…

You can also use the SQL Server Data Tuning advisor on the queries above, or on a profiler trace which would be representative of your workload.

Keep in mind that we always should create indexes via Dynamics AX MorphX development environment and not directly in SQL Server.

Maintaining duplicate indexes in the database wastes system resources. Additional disk space is required to store the duplicate information and additional IO operations are required to keep them updated. Duplicate indexes should be disabled in the AOT.

The only time an index which is a left key subset of another index may be necessary is if it needs to enforce a unique constraint. This is not the case for the indexes listed above. It is recommended to remove the indexes listed above to avoid the unnecessary overhead involved in maintaining a duplicate index.

Left key subset indexes

A way to eliminate the amount of unnecessary indexes is to search for indexes that are a left key subset of another index on the same table. Unless the subset key is unique, its usefulness is subsumed of the superset key. If we run the following query:

```
SELECT TABLE_NAME, INDEX_NAME, INDEX_DESCRIPTION, INDEX_KEYS
FROM INDEX_STATS_CURR_VW O
WHERE INDEX_DESCRIPTION NOT LIKE '%UNIQUE%'
AND EXISTS
       (
       SELECT * FROM INDEX_STATS_VW I
       WHERE I.RUN_NAME = O.RUN_NAME
       AND I.TABLE_NAME = O.TABLE_NAME
       AND I.INDEX_KEYS <> O.INDEX_KEYS
       AND I.INDEX_KEYS LIKE O.INDEX_KEYS + ',%'
       )
ORDER BY TABLE_NAME, INDEX_KEYS
```

This returns several indexes, some of them for system tables:

TABLE_NAME	INDEX_NAME	INDEX_DESCRIPTION	INDEX_KEYS
AIFDOCUMENTSETFILTERELEMENT	I_100014AIFDOCUMENSETFILTERIDX	NONCLUSTERED	DOCUMENTSETFILTER
CITPESEXCHANGERATEXML	I_101251VALIDFROMIDX	NONCLUSTERED	DATAAREAID, VALIDFROM
CITPESINTERFACECONVERTFIELDS	I_101327REFRECIDIDX	NONCLUSTERED	DATAAREAID, REFRECID
CITPESINVENTSUBFAMILY	I_101249CITPESINVENTDIVISIONIDX	NONCLUSTERED	DATAAREAID, INVENTDIVISIONID
ECORESCATEGORY	I_2665MODIFIEDDATETIMEIDX	NONCLUSTERED	DATAAREAID, CATEGORYHIERARCHY
ModelSecurityPolicy	I_ModelSecurityPolicy_ElementHandle	NONCLUSTERED	ElementHandle
ModelSecurityPolicyConstraint	I_ModelSecurityPolicy_ElementHandle	NONCLUSTERED	ElementHandle
ModelSecurityPolicyTable	I_ModelSecurityPolicy_POLICYHANDLE	NONCLUSTERED	OWNERHANDLE
ModelSecuritySubRole	I_ModelSecuritySubRole_ROLE	CLUSTERED	ROLEHANDLE
PURCHTABLE	I_345ORDERACCCREATEDDATETIMEIDX	NONCLUSTERED	DATAAREAID, ORDERACCOUNT
SALESTABLE	I_366CUSTCREATEDDATEIDX	NONCLUSTERED	DATAAREAID, CUSTACCOUNT
TRVPOLICYVIOLATIONSCACHE	I_2371HCMWORKERIDX	NONCLUSTERED	WORKER
WRKCTRRESOURCEGROUPRESOURCE	I_3038RESOURCEIDX	NONCLUSTERED	DATAAREAID, WRKCTRID

To check how the indexes of a table have been behaving we can use the following query:

```
SELECT *
  FROM [INDEX_STATS_CURR_VW]
  where TABLE_NAME ='salestable'
```

TABLE_NAME	INDEX_NAME	INDEX DESCRIPTION	DATA COMPRESSION	INDEX KEYS	INCLUDED COLUMNS
SALESTABLE	I_366CUSTCREATEDDATEIDX	NONCLUSTERED	0	DATAAREAID, CUSTACCOUNT	NULL
SALESTABLE	I_366CUSTIDX	NONCLUSTERED, UNIQUE	0	DATAAREAID, CUSTACCOUNT, SALESID	NULL

Hidden clustered index scans

Using the DYNAMICSPERF database we can identify also queries that use clustered index seek to filter data however these seeks are just hidden scans as only DataareaID field is used to filter the result set. We use this query to determine the hidden clustered index scans:

```
SELECT TOP 100 *
FROM HIDDEN_SCANS_CURR_VW
ORDER BY TOTAL_ELAPSED_TIME DESC
```

You can review the execution plan for each query where you can see SQL Server Query Optimizer recommendation on missing index creation.

Unused indexes

Use this query to identify not used indexes:

```
SELECT TABLE_NAME,
       INDEX_NAME,
       INDEX_KEYS,
       SUM(USER_UPDATES) AS USER_UPDATES
FROM INDEX_STATS_VW
WHERE INDEX_DESCRIPTION NOT LIKE '%UNIQUE%'
      AND INDEX_DESCRIPTION != 'HEAP'
GROUP BY TABLE_NAME, INDEX_NAME, INDEX_DESCRIPTION, INDEX_KEYS, INCLUDED_COLUMNS
HAVING SUM(USER_SEEKS) = 0
AND SUM(USER_SCANS) = 0
AND SUM(USER_LOOKUPS) = 0
ORDER BY USER_UPDATES DESC
```

This returns 582 unused indexes. Which is not meaningful because of current environment's usage.

However the logging period was too short to conclude if these indexes are really not used at all. Some indexes can maybe only be used once a month. A longer logging is needed to make a conclusion about indexes that are not being used.

- Recommendation is to run all business processes in test environment and use DynamicsPerf to isolate what indexes are really going to be used and which ones won't.

Blocking analysis

Definition

Blocks occur when two users try to access the same records with incompatible lock types. Information about lock compatibility can be found here http://msdn.microsoft.com/en-us/library/ms186396.aspx.
There are many reasons for blocks but the top 3 are users are updating the same records at the same time, queries scanning tables thus locking records not expected to be locked, and long running transactions.

Users locking the same records is a natural activity in a database. This is a natural activity in an ERP system that occurs all the time without the users even knowing that it occurs. Where this can become a problem is when there is a natural set of data based upon the business needs that will cause more of this activity than expected. Some business examples of this are where you may do 80% of your sales on 5 inventory items, or 90% of your purchase orders are from 3 vendors, or 70% of your sales are to 1 customer. In all of these situations, there will be a lot of natural database blocking occurring because of the business needs.

Queries scanning tables is a second major source of blocking that occurs in a database. An example of this is where a user might be requesting the information on a single sales order but the way the query is written is causing SQL to scan through all of the sales orders thus leaving record locks on the other sales orders blocking other users. With Performance Analyzer, we can do query analysis and find those situations relatively quickly. In the execution plan of the query we will have an index scan.

The third situation that occurs frequently is what we call long running transactions. This situation looks as follows in the database:

User 1	User 2
Begin Transaction	
Update Table A	
Select Table B	
Update Table C	Select Table A
Commit Transaction	

In this case, User 2 would get blocked because user 1 has not yet committed the transaction to the database. This is the hardest situation to determine root cause of with any blocking tools or scripts. The reason for this is because SQL Server will only show the currently executing SQL statement for User 1 which in this case is the Update to Table C. All of the tools will show the update to Table C blocking the Select from Table A. If you have this condition where the 2 SQL statements are not accessing the same tables, this is the tell-tale sign that the root cause is a long running transaction. The longer the transaction is the harder it is to find the root cause.

Analysis

Next to the analysis of DynamicsPerf using SQL Server Dynamic Management Views (DMV) and AX SQL Statement log we also ran a very light SQL Profiler trace from Monday until Wednesday. One of the most important events we monitored in this trace was Event 137; blocked process report. This event is fired every time a query is blocked by another one for more than 5 seconds. This setting is configurable in SQL server by using this statement:

```
sp_configure 'blocked process threshold', 5
reconfigure
```

With DynamicsPerf to get detailed information on blocking, you can run a select on the view BLOCKED_PROCESS_VW in DynamicsPerf to shred the tracing files.

Before you run this view you must change the path to where your trace files are located, or ensure the traces are copied in the default path (c:\sqltrace)

The expected name for the trace is DYNAMICS_DEFAULT.trc (in case of trace rollovers, give the last name) and by default is expected to be found in folder C:\ SQLTRACE\
To create Traces, you can use the stored procedure SP_SQLTRACE in DynamicsPerf. This creates minimal traces, mainly catching blocking reports.

During the onsite Dynamics AX Health Check we did a blocking analysis. Every query that is blocked for longer than 5 seconds has been logged:

```
SELECT top 10 * FROM BLOCKED_PROCESS_VW
ORDER BY [WAIT_TIME(MS)] DESC
```

- No blocking was detected during the monitoring period.

Events

Use the DEFAUT_TRC_VW view to look at the any of the events that were recorded by the SP_SQLTRACE stored procedure.

```
SELECT [NAME]        ,[ApplicationName] ,      [EventClass]
    , COUNT(*) as 'count'
        FROM [DEFAULT_TRC_VW]
 -- where DatabaseName = ''
  group by EventClass, NAME, ApplicationName
  Order by EventClass,NAME, ApplicationName
```

The count per event is:

Count	NAME	Notes
941	Audit Backup/Restore Event	Review backup policy. Change database recovery mode from SIMPLE to FULL and set a periodic log file backup action to use in the Recovery Policy.
608	FT:Crawl Started	Several execution per minute in different time intervals. Total execution time Avg. Less than 3 seconds.
608	FT:Crawl Stopped	
39	Missing Join Predicate	http://technet.microsoft.com/en-us/library/ms175146.aspx The Missing Join Predicate event class indicates that a query is being executed that has no join predicate. This could result in a long-running query. For more information on join predicates, see Predicates (Transact-SQL).
10	Hash Warning	http://technet.microsoft.com/en-us/library/ms190736.aspx Hash recursion and hash bailout cause reduced performance in your server. To eliminate or reduce the frequency of hash recursion and bailouts, do one of the following: •Make sure that statistics exist on the columns that are being joined or grouped. •If statistics exist on the columns, update them. •Use a different type of join. For example, use a MERGE or LOOP join instead, if appropriate. •Increase available memory on the computer. Hash recursion or bailout occurs when there is not enough memory to process queries in place and they need to spill to disk.

		Creating or updating the statistics on the column involved in the join is the most effective way to reduce the number of hash recursion or bailouts that occur.
4	Lock:Escalation	The 4 lock escalation detected were caused most probably by doing bulk data imports in the database:

Lock Escalations:

UPDATE [MicrosoftDynamicsAX].[dbo].[DMFCUSTOMERENTITY] SET [MODIFIEDDATETIME] = DEFAULT,[MODIFIEDBY] = DEFAULT,[CREATEDDATETIME] = DEFAULT

insert bulk DMFBANKGROUPENTITY ([BANKCONTRACTACCOUNT] NVarChar(11) COLLATE Modern_Spanish_CI_AS, [BANKGROUPID] NVarChar(10) COLLATE Modern_Spanish_CI_AS, [BANKSUFFIX] NVarChar(3) COLLATE Modern_Spanish_CI_AS, [BANKTRANSFERCODE] NVarChar(15) COLLATE Modern_Spanish_CI_AS, [CELLULARPHONE] NVarChar(20) COLLATE Modern_Spanish_CI_AS, [COMPANYPAYMID] NVarChar(35) COLLATE Modern_Spanish_CI_AS, [CONTACTPERSON] NVarChar(60) COLLATE Modern_Spanish_CI_AS, [CURRENCYCODE] NVarChar(3) COLLATE Modern_Spanish_CI_AS, [DISCNOTICEDELAYDAYS] Int, [EMAIL] NVarChar(80) COLLATE Modern_Spanish_CI_AS, [NAME] NVarChar(60) COLLATE Modern_Spanish_CI_AS, [PAGER] NVarChar(20) COLLATE Modern_Spanish_CI_AS, [PHONE] NVarChar(20) COLLATE Modern_Spanish_CI_AS, [PHONELOCAL] NVarChar(10) COLLATE Modern_Spanish_CI_AS, [REGISTRATIONNUM] NVarChar(10) COLLATE Modern_Spanish_CI_AS, [SMS] NVarChar(80) COLLATE Modern_Spanish_CI_AS, [TELEFAX] NVarChar(45) COLLATE Modern_Spanish_CI_AS, [TELEX] NVarChar(20) COLLATE Modern_Spanish_CI_AS, [URL] NVarChar(255) COLLATE Modern_Spanish_CI_AS, [DEFINITIONGROUP] NVarChar(60) COLLATE Modern_Spanish_CI_AS, [ISSELECTED] Int, [TRANSFERSTATUS] Int, [EXECUTIONID] NVarChar(70) COLLATE Modern_Spanish_CI_AS, [BANKCODETYPE] NVarChar(9) COLLATE Modern_Spanish_CI_AS, [RECVERSION] Int, [RECID] BigInt, [ADDRESSNAME] NVarChar(60) COLLATE Modern_Spanish_CI_AS, [COUNTRYREGIONID] NVarChar(10) COLLATE Modern_Spanish_CI_AS, [ZIPCODEID] NVarChar(10) COLLATE Modern_Spanish_CI_AS, [STREET] NVarChar(250) COLLATE Modern_Spanish_CI_AS, [CITY] NVarChar(60) COLLATE Modern_Spanish_CI_AS, [COUNTYID] NVarChar(10) COLLATE Modern_Spanish_CI_AS, [STREETNUMBER] NVarChar(20) COLLATE Modern_Spanish_CI_AS, [STATEID] NVarChar(10) COLLATE Modern_Spanish_CI_AS)

INSERT INTO tempdb."DBO".t101787_810C2D03692E423E8E114F698AABAB0D (STAGINGRECORDRECID,DATAAREAID,RECVERSION) SELECT T1.RECID,N'017',1 FROM DMFBANKGROUPENTITY T1 WHERE ((DEFINITIONGROUP=N'BankGroup') AND (EXECUTIONID=N'BankGroup-12')) ORDER BY T1.RECID

INSERT INTO tempdb."DBO".t101787_C732FD3BAC5A4D10A22B73F3BBE44D01 (STAGINGRECORDRECID,DATAAREAID,RECVERSION) SELECT T1.RECID,N'017',1 FROM DMFBANKGROUPENTITY T1 WHERE ((DEFINITIONGROUP=N'BankGroup') AND (EXECUTIONID=N'BankGroup-12')) ORDER BY T1.RECID

- It will be important to excute the same query to monitor the future Events in Production, especially:
  - Deadlocks
  - Lock Escalations
  - Block Process Report
  - Data and Log Auto Growth

Appendix

1. Monitoring Tools installed and run during the Health Check

Here are the action items executed during the onsite:

Install DynamicsPerf version 1.16

Performance Analyzer 1.16 for Microsoft Dynamics helps you to analyze the performance of Dynamics products, Dynamics AX in particular.

You can download this tool from http://code.msdn.microsoft.com/DynamicsPerf.
In the download you will find also PDF file which describes the installation and use of the tool.

Reports for DynamicsPerf
To facilitate the monitoring of the performance counters captured in the tool DynamicsPerf, new SSRS reports have been shared by the PFE team.

- In AOS: Import XPO

Once the XPO is imported you can see the 3 tables and run the class AOTExport to populate the 3 tables:

- Start the SQLTRACE on SQL Server:
- Execute CaptureStats job every 3, 8 or 12 hours.
- Enable AX Trace for all users above 2000 ms.
- Perfmon on C:\PerfLogs on both servers. For the AOS Server add all AOS counters available.
- AOS Tracing: Add Event Trace Providers with Microsoft Dynamics AX Tracing for specific scenarios.
  - Before leaving customer, all jobs were disabled.
  - And tracing was disabled too.

Important Notice to Customers

We recommend that you contact your Microsoft Dynamics Partner before installing service packs or hot fixes. It is important to verify that your environment is compatible with the service pack(s), hotfix (es), or

download(s) being installed. A service pack, hotfix, or download may cause interoperability issues with customizations, and third-party products that work with your Microsoft Dynamics solution.

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2. Creating a Base Line

Every month; or alternatively down to every two weeks; you should spent time to do Performance measuring, testing and if needed some tuning or adjustments. Please find below some information about tools and counters that can be useful for this purpose:

Memory

- Available bytes
  - Any value less than 4 MB is an issue, very short time periods (10sec) not fewer than 2.5 MB are usually acceptable but still need to be investigated. Extended periods fewer than 4 MB generally mean that the system is out of physical memory. Extended periods less than 2.5MB certainly means that the system is out of physical memory. Frankly, a proper operating server will at least 15 MB free or about 5% whichever is greater, if the server is not experiencing any memory pressure.
  - Memory cannot be blindly added as a solution. Further investigation is needed to determine what is consuming physical memory. You might add memory and the original issue will consume it as well.
  - Remember that extensive paging will occur at this point and the system will slow down. Paging is the result of low physical memory, not the cause of this activity.
  - The trouble-shooter will need to next investigate the Cache Bytes, Paged Pool Bytes, Non-paged Pool Bytes and then the memory counters for each process.
- Pages faults/second
  - It is important not to confuse this counter with the following counter. This is a soft fault counter, high counts are not an issue with the system. Soft faults are only memory references to another page existing in memory. Usually these requests are only requests for new memory pages for applications to use, which can be confirmed by looking at the Demand Zero pages /sec.
  - These memory references are quite fast and do not result in any performance penalty. Remember, high numbers need to be investigated but usually do not mean anything unless the Pages /second or Pages input /sec are high. Page faults can range all over the spectrum with normal application behavior; values from 0 to 5000 per second can be normal. This is where a normal baseline is essential to determine the expected behavior. The event logs are also useful.
  - Look at context switches /second for supporting behavior. If this counter is high, look for a specific process to demonstrate high CPU or other unusual behavior.
  - This counter will impacted by changing the memory allocator used by a process generating large number page faults, if that is an option for that application.
- Pages/second
  - Investigate if over 100 pages per second on a system with a slow disk, usually even 500 pages per second on a system with a fast disk subsystem may not be an issue. Please note that the values of >20 pages that appear in many other sources of documentation are out of date.

        - Always break up this counter in pages output and pages input, separately, if the counter is above 100 /second.
        - Pages /sec is the number of pages read from the disk or written to the disk to resolve memory references to pages that were not in memory at the time of the reference. This is the sum of Pages Input/sec and Pages Output/sec. This counter includes paging traffic on behalf of the system Cache to access file data for applications.
        - This is the primary counter to observe if you are concerned about excessive memory pressure and the excessive paging that may result because of this.

    - Pool Nonpaged bytes
        - Here, the trouble-shooter is looking for two separate behaviors. First, memory leaking behaviors, i.e. increasing non-paged pool usage. The assumption is that nonpaged pool memory should reach a stabilizing value after some operating time, generally two or three hours. Generally this is true but not always. For example, adding many new users on a file server will generate an increase in nonpaged pool usage but this is cyclic behavior and we would expect this memory usage to drop as the users log off.
        - Be very suspicious of any deltas (sudden changes or spikes) in either pool counters. This could be normal behavior but usually it is not. Try to find any process or thread from the system process that increases CPU when these deltas occur.
        - Also, compare the deltas against process memory usage, IO usage and handle usage.
        - Excessive pool usage needs to be investigated if much higher than 60 MB. A typical pool usage would be 60-90 MB except for terminal server or streaming video or audio. The use of high bandwidth SAN interconnect devices will easily double this expected value.
        - If usage is excessive, look at drivers, services, and then the system process as sources of the problem. Search the Knowledge Base for the term “PoolTagging”
        - Since you may have software that uses pools it is difficult to determine what you would expect but if the pool usage is greater than 80% you do not have enough overhead to cover pool usage during changes in operation.
        - Limit is 256 MB, Period.
        - /3GB limit non-paged pool to 128 MB.
        - Very busy file server will hit the limit of the x86 OS resource allocation and will exhaust all of page pool. Rather than use the register setting above you may wish to change the use of memory by the server service. Search the Knowledge Base using the key words “work items”, registry, and “SizReqBuf” to understand the options when reducing the default from 16644 to 8452 bytes in order to free up paged pool memory.
    - Pool Paged bytes
        - Looking for the same behaviors as above but remember that applications as well as services and drivers use paged pool.
        - The maximum amount of paged pool is approximately 360MB with default settings.
            - You can maximize the page pool to about approximately 520MB by using the registry settings below:
                - [HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Session Manager\Memory Management]
                - "LargeSystemCache"=dword: 00000001
                - "NonPagedPoolSize"=dword: 00000000
                - "PagedPoolSize"=dword: 0xFFFFFFFF

        - "SystemPages"=dword: 00000000
    - It is important to keep some free space available in paged pool as it is expected to see very large swings in page pool usage as the server throughput or workload changes.
    - If these swings become very large you can control them with the following registry setting but your throughput may be affected.
        - [HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Session Manager\Memory Management]
        - "PoolUsageMaximum"=dword: 60 (decimal)
            - OR
        - "PoolUsageMaximum"=dword: 40 (decimal)
    - 163 MB Maximum on /3 GB.
    - The prime users of page pool are file servers, especially when serving out profiles. Also, terminal servers with many connections and print servers with 10's of thousands of print jobs pending are major users of system pool. Printer queues use little space; it is the printing that take the space.
    - Expect to see 60 MB used plus whatever is needed for the above tasks.
    - Since you may have software that uses pools it is difficult to determine what you would expect but if the pool usage is greater than 70% you do not have enough overhead to cover pool usage during changes in operation

Processor (Check for EACH processor and overall)

- % Interrupt Time
    - Very important counter, this counter, along with the counter below, shows the amount of time sustained doing I/O.
    - Time required to setup an I/O request.
    - This counter is rolled up in the system counter but will not show up in any of the system's thread counters. So look for confirmation there (system process CPU vs. system threads CPU).
    - Look for variations in this counter; sometimes a hardware device will get blocked yielding a delta increase in this counter.
    - Threshold is 10%.
- % DPC Time
    - Very important counter. This counter, along with the counter below, shows the amount of time sustained doing I/O.
    - Time required to complete an I/O.
    - This counter is rolled up in the system counter but will not show up in any of the system's thread counters. So look for confirmation there (system process CPU vs. system threads CPU), the difference will be the sum of interrupt and DPC time.
    - Look for variations in this counter; sometimes a hardware device will get blocked yielding a delta increase in this counter.
    - The values observed here are quite wide so a baseline is essential. Normally any value of 25% is something that needs to be investigated.
    - These is an issue with the OS that will show up in this counter from time to time. The way W2K3 works is that only one DPC is processed from a NIC and both the interrupt and DPC are assigned to only one processor. So you can easily have high values, only on one processor. Other than user settings for the driver there is little you can do to address this. The work around is to use NIC teaming in Link Aggregate Mode and use a utility that controls process affinity to assign each NIC to a separate processor for inbound traffic and use TCP processing offloading on the NIC for outbound traffic.

- % Privileged Time
  - The time the operating system kernel is doing work.
  - Usually the threshold is less than 30% for application/WEB servers
  - Usually >60% is a better value for pure print and file servers.

- % Processor Time
  - The overall processor time can go over 100%. The limit is 100% times the number of processors in the box.
  - Some systems are by nature CPU bound. CPU bound systems are not necessarily a bad thing, you need to understand what the expected load is form the type of applications on the box.
  - You need to consider any sustained CPU time over 90% to be the same as 100%.
- % User Time
  - The time the system is doing useful work on behalf of a process or a user.
  - 80% is good; 60% is only fair on application/WEB servers but little user time is used on file/print servers.

Network Interface or other NIC stack counters

- Bytes total /sec (100BaseT = 100Mbips = 12.5Mb/sec)
  - Sanity check to verify if the system is under any load and if the load changes with observed memory or CPU behavior.
- Current Bandwidth (Often static max theoretical value like 10Mbits or 100Mbits)
  - Check for saturation, 37% for random I/O especially SMB but can get to 70% for dedicated Winsock applications.
- Packets received discarded
  - Sanity check: Hardware problems
- Packets received errors
  - Sanity check: Hardware problems
  - We tend to cache everything. So on a server with many megabytes of free memory, Free memory

Physical Disk (For Each Disk)

- Avg Disk Queue Length
  - Again, on these two counters, there are a lot of outdated values in existing documentation.
  - Again RAID “write caches” require the trouble-shooter to evaluate read and writes separately.
  - Less than 2 plus the number of spindles is an excellent value.
  - Less than double the number of spindles is a good value.
    - This requires further investigation of the disk transfer time in order to see whether disk queue length would actually impact the system.
  - Less than triple the number of spindles is a fair value.
    - Generally not an issue if seen for period of 5-10 seconds
- Current Queue Length
  - Again, on these two counters, there are a lot of outdated values in existing documentation.
  - Again RAID “write caches” require the trouble-shooter to evaluate read and writes separately but this counter does not allow the trouble-shooter to split

writes from reads so the counter is used to support conclusions determined from the other counters.

- This counter is an instantaneous counter, not an average one. Due to the way it is captured it is NOT reliable. If you suspect issues due to high values here, investigate by using average queue length with a data gathering sample time of 2 seconds in order to obtain accurate data.
- Less than 2 plus the number of spindles is an excellent value.
- Less than double the number of spindles is a good value.
  - This requires further investigation of the disk transfer time in order to see whether disk queue length would actually impact the system.
- Less than triple the number of spindles is a fair value.
  - Generally not an issue if seen for period of 5-10 seconds

- Avg Disk Sec/Transfer (Avg time for an I/O transaction)
  - This is perhaps the most important counter because it is what the application actually sees.
  - Caching controllers require evaluation of reads separately from writes.
  - Disk Transfer Times are rule of thumb.
    - Reads or non-cached Writes
      - Excellent < 08 ms (.008 seconds)
      - Good < 12 ms (.012 seconds)
      - Fair < 20 ms (.020 seconds)
      - Poor > 20 ms (.020 seconds)
    - Cached Writes Only
      - Excellent < 01 ms (.001 seconds)
      - Good < 02 ms (.002 seconds)
      - Fair < 04 ms (.004 seconds)
      - Poor > 04 ms (.004 seconds)
  - Also remember that throughput is an important consideration when evaluating expected disk performance. Also remember that the Raid Setup is very important; Raid 5 introduces a 100% over head on writes as explained later. A SAN running 40MB/SEC of random I/O would be rated excellent if experienced “fair” performance above due to the massive data flow.

Process Counter

- Handle count
  - References to objects used by a process. A VERY important counter to use to correlate with memory for all memory issues. A baseline with expected values is important but normally any values over 10,000 would be an issue.
  - Correlation with pool leaks is very helpful. Major increases in pool usage are commonly caused by handle leaks.
- Page Faults/sec
  - For performance issues, one needs to look at pages input/second but these counters are not available on a per process level so we have correlate the process page fault counter with the overall page fault counter and make an educated guess concerning the process pages input and output by looking at the overall pages input and output.
- Private bytes
  - Private bytes are not related to pool bytes in any way but very commonly code paths within an application that leak private bytes may leak pool bytes as well. This counter is a key in looking for the source of pool leaks.

        - Remember that this is a virtual byte counter and does not directly relate to the actual physical memory used by the application. This is memory allocated and written to by an application so this counter does not directly indicate to the trouble-shooter any physical memory stress. You should use the working set counter for physical memory stress but will need to look at private bytes in order to determine whether physical memory stress is expected behavior. For example, if private bytes hold steady and working set goes up the conclusion is that the application is not requesting more memory, the application is just touching more memory. This is not a memory leak; the working set is going up simply because the application is getting busier. You can confirm this by looking at the CPU utilization for that application.
    - Virtual bytes
        - Memory reserved by the application to be used. ALWAYS review this. Understand when and how virtual bytes go up and then determine whether this is a “leak” or not. Understanding the expected behavior is essential here.
    - Working set bytes
        - The portion of private bytes resident in physical memory that is owned by one application.
        - Will go up and down in normal usage, the secret is determining why. You can only do this with additional application information, problem description, etc.
    - Pool Nonpaged bytes
        - This may correlate with system pool usage, if it does, then you have found the process that is leaking memory. If no process correlates to the overall system pool usage; that does not mean that one of the applications is not causing the problem.
    - Pool Paged bytes
        - This may correlate with system pool usage, if it does, then you have found the process that is leaking memory. If no process correlates to the overall system pool usage; that does not mean that one of the applications is not causing the problem.
    - % processor Time CPU counters
        - Remember the thresholds mentioned earlier for the processor CPU counters.

System

- Context Switches/sec
    - A context switch occurs when a processor switches from running one thread to another thread.
    - Do not forget to divide by number of processors!
    - 1500 – 3000 per processor is the range from excellent to fair.
    - 6000 or greater is considered poor. Upper limit is about 40,000 at 90 % CPU per CPU.
    - 3000 – 6,000 per processor for Citrix Server is allowed due to blocking that naturally occurs when dealing with keyboard driven applications.
    - Abnormal high rates can be caused by page cache faults due to memory starvation.
    - Abnormally high rates are usually caused by an application memory issue around heap memory allocations or another resource is being blocked. Further determination of the cause of the issue requires a good base line to compare against.
- Processes

        - Sanity checks to determine number of processes to determine if it is increasing or decreasing.
    - Processor queue length
        - Only one queue for all processors.
        - On standard servers with long quantum's:
            - 4 or less per CPU is excellent
            - < 8 per CPU is good
            - < 12 per CPU is fair
        - On terminal servers which have short quantum:
            - 10 or less per CPU is excellent
            - < 15 per CPU is good
            - < 20 per CPU is fair
    - Threads
        - Sanity checks to determine number of threads, especially to determine if it is increasing or decreasing.

3. Performance Analysis of Logs

The PAL (Performance Analysis of Logs) tool is a new and powerful tool that reads in a performance monitor counter log (any known format) and analyzes it using complex, but known thresholds (provided). The tool generates an HTML based report which graphically charts important performance counters and throws alerts when thresholds are exceeded. The thresholds are originally based on thresholds defined by the Microsoft product teams and members of Microsoft support, but continue to be expanded by this ongoing project. This tool is not a replacement of traditional performance analysis, but it automates the analysis of performance counter logs enough to save you time. This is a VBScript and requires Microsoft LogParser (free download).

PAL is an open source tool that was developed by some engineers within PFE. The tool has 2 main purposes:

- Help you to gather the most important performance counters.
- Provides a number of different performance counter templates that can be imported and scheduled for easy data capture.
- Help you to analyze the data once it has been captured.
- Provides analysis logic in the form or "threshold" files for a number of different applications such as SQL, IIS, and MOSS.
- Outputs an easy to read report in html or xml format.
- New thresholds can be created and existing ones can be modified to meet your specific needs.

PAL can be downloaded from the following location: HTTP://WWW.CODEPLEX.COM/PAL

4. Trace parser 2012

The Event Trace Parser for Microsoft Dynamics® AX is a user interface and data analyzer built on top of the Event Tracing for Windows (ETW) framework. The ETW framework allows an administrator to conduct tracing with an overhead of approximately 4%. This low overhead allows administrators to diagnose performance problems in live environments as opposed to development environments.

The Trace Parser is built on top of Microsoft SQL Server. It enables rapid analysis of traces to find the longest running code, longest running SQL query, highest call count and other metrics useful in debugging a performance problem. In addition, it provides a call tree of the code that was executed,

giving the developer insight into the code, and the power to quickly become familiar with the flow of an unfamiliar piece of code. It also provides the ability to jump from the searching feature to the call tree, so that the person analyzing the trace can determine how the problematic code was called.

Trace Parser 2012 is the latest version of Trace Parser that is shipped with Microsoft Dynamics AX 2012 product.

Compared to its previous releases, Trace Parser 2012 has many new features with significant improvement in performance and stability:

HTTPS://MBS.MICROSOFT.COM/CUSTOMERSOURCE/DOWNLOADS/SERVICEPACKS/AX_TRACEPARSER.HTM?PRINTPAGE=FALSE&SID=2FKLR4KOYLCM21OODYXNBNMB&STEXT=TRACE%20PARSER

5. Microsoft blog related to Dynamics AX

Dynamics AX Sustained Engineering blog: HTTP://BLOGS.TECHNET.COM/DYNAMICSAXSE/

Dynamics AX Performance Team Blog: HTTP://BLOGS.MSDN.COM/B/AXPERF/

Microsoft Dynamics AX UK Blog: HTTP://BLOGS.MSDN.COM/B/UKAX/

EMEA Dynamics AX Blog: HTTP://BLOGS.MSDN.COM/B/EMEADAXSUPPORT/

Microsoft Dynamics Ax Community: HTTPS://COMMUNITY.DYNAMICS.COM/PRODUCT/AX/F/33.ASPX

Dynamics AX in the Field: HTTP://BLOGS.MSDN.COM/B/AXINTHEFIELD/

Supply Chain Management in Dynamics AX: HTTP://BLOGS.MSDN.COM/B/DYNAMICSAXSCM/

All recent news around Dynamics ERP:
HTTPS://COMMUNITY.DYNAMICS.COM/B/THEEDGE/DEFAULT.ASPX

Microsoft SQL Server Team Blog: HTTP://BLOGS.TECHNET.COM/B/DATAPLATFORMINSIDER/

BLOGTALKRADIO FROM PFE: HTTP://WWW.BLOGTALKRADIO.COM/PFEDYNAMICS

6. Microsoft sites related to Dynamics AX

Partner Source: HTTPS://MBS.MICROSOFT.COM/PARTNERSOURCE

Customer Source: HTTPS://MBS.MICROSOFT.COM/PARTNERSOURCE

System Requirements for Dynamics AX 2012 Microsoft Knowledge Base:
HTTPS://MBS.MICROSOFT.COM/KNOWLEDGEBASE/SEARCH.ASPX

Server Virtualization Validation Program:
HTTP://WINDOWSSERVERCATALOG.COM/SVVP.ASPX?SVVPPAGE=SVVP.HTM

DAY IN THE LIFE 2012

https://mbs.microsoft.com/customersource/documentation/whitepapers/ax2012_benchmarkpapers.htm?printpage=false&sid=lycvn5jvkjctbz5xbb15bfh0&stext=day in the life

7. Microsoft Dynamics AX documentation

Microsoft TechNet : HTTP://TECHNET.MICROSOFT.COM/EN-US/LIBRARY/DD362025.ASPX

MSDN : HTTP://MSDN.MICROSOFT.COM/EN-US/DYNAMICS/AX/DEFAULT.ASPX

Microsoft Learning : HTTP://WWW.MICROSOFT.COM/LEARNING/EN/US/DEFAULT.ASPX

8. Lifecycle Services for Microsoft Dynamics User Guide (LCS) [AX 2012]

http://technet.microsoft.com/en-us/library/dn268616.aspx

Microsoft Dynamics Lifecycle Services provides a cloud-based collaborative workspace that customers and their partners can use to manage Microsoft Dynamics AX projects from pre-sales to implementation and operations. Based on the phase of your project and the industry you are working in, the site provides checklists and tools that help you manage the project. It also provides a dashboard so that you have a single place to get up-to-date project information.

Lifecycle Services is available to customers and partners as part of their support plans. You can access it with your CustomerSource or PartnerSource credentials. Go to Lifecycle Services.

Tools

Project home page: Project home page (Lifecycle Services, LCS)

Business process modeler: Business process modeler (Lifecycle Services, LCS)

Usage profiler: Usage profiler (Lifecycle Services, LCS)

License sizing estimator: License sizing estimator (Lifecycle Services, LCS)

Customization analysis: Customization analysis (Lifecycle Services, LCS)

Microsoft Lifecycle services (LCS) customization analysis [AX 2012]

Microsoft Dynamics Lifecycle Services provides a cloud-based collaborative workspace that customers and their partners can use to manage Microsoft Dynamics AX projects from pre-sales to implementation and operations. Based on the phase of your project and the industry you are working in, the site provides checklists and tools that help you manage the project. It also provides a dashboard so that you have a single place to get up-to-date project information. Lifecycle Services is available to customers and partners as part of their support plans. You can access it with your Customer Source or Partner Source credentials.
CUSTOMIZATION ANALYSIS SERVICE (LIFECYCLE SERVICES) offers Microsoft Dynamics AX 2012 customers an automated tool that validates the customer's model files against Microsoft Dynamics AX best-practice rules for tables, classes, forms, and enums. It then generates reports, including a summary report display on the site, a detailed Microsoft Excel report that lists all issues, and a developer report that the developer can load in the Microsoft Dynamics AX development environment.
HTTP://MSDN.MICROSOFT.COM/EN-US/LIBRARY/DN458949.ASPX

Upgrade analysis: Upgrade analysis (Lifecycle Services, LCS)

Issue search: Issue search (Lifecycle Services, LCS)

System diagnostic service: System diagnostic service (Lifecycle Services, LCS)

RFP responses: RFP responses (Lifecycle Services, LCS)