Spring 3-2-2018

# BEST PRACTICE FOR COMPUTER IMAGING AND MAINTAINING A DATABASE

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Recommended Citation

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Senior project

CSIS 49x

Best Practice for Imaging computer labs and Maintaining A Databases

A. Best practice for Computer lab imaging

Thesis: Computer labs provide users a possible means to learn and keep up to date with technologies and other things they might be interested in learning

- Abstract
- Introduction; what is Lab imaging
    - Purpose and Definition
- Background research
    - How imaging is done
    - Work that was done
    - What was learned
- Types/ways of upgrading lab image
    - Ghosting
    - Virtual machine
    - Microsoft SCCM
        - Microsoft toolkit
        - Sysprep (System preparation tool)
- Challenges

B. Best practice for maintaining a database
- Introduction
    - What is a Database
    - Database concepts and terminology

- Background research
    - Database maintenance procedures/routines
    - Work that was done
    - What was learned

- Challenges
- Future work
- Conclusion

**Abstract**

For my field experience class CSIS494 I did an internship where I mostly learned about computer lab imaging and worked on researching the best practice for database updates/maintenance. This paper documents all the work was done during my internship as well as the number of hours spent on my project. I worked on this project for a total hour of approximately 280hours, i.e., about 25 hours, each week for 14 weeks, which was during the fall semester of 2017.

This paper gives an introduction of both topics I have worked on, and the technology I have learned about which is computer imaging and database maintenance and upgrades as well as the advantages of using imaging software to build and deploy images to a large number of computers, usually in a lab setting.

**Introduction**

Computer labs provide users a possible means to learn and keep up to date with technologies and other resources they might be interested in learning. Unfortunately, providing a well-furnished computer lab can be very expensive. The hardware is essential to provide a regular system, but Imaging can help reduce the cost and time required to run a computer lab. This procedure will simplify the installation of software and configuration of multiple machines/computers. Computer imaging is a proficient, automated technique that uses a client-server connection, which then allows the client to download and install all the necessary software and security updates by choosing an image file that exists on a server.

This is pretty much the act of copying or cloning preconfigured operating systems and other optional, software applications to a destination computer. There are several mechanisms needed to be in place to image a computer; one of which is a dynamic host configuration protocol (DHCP). This dynamic host configuration manager runs a connection between the client and the image server by assigning a dynamic IP address to each computer. In addition to a unique IP address, it is essential for each client to have a single hostname, which then merges into the image for each client using a security identifier generator also known as a SID Generator. Next, the operating system software, application software, and data files are downloaded to the clients.

This method of computer imaging helps to retain a stable computer lab atmosphere on campus or across an organization. Students or users depend on the computers in the lab to learn, get their homework/schoolwork done and because the computer systems in the lab are not individual properties, students or users are most likely not going to handle these computers with care as they would if it were their personal computers. Computers can be unknowingly exposed to security threats, viruses, malware, and more without the user even being aware. Also, users anticipate getting the same experience regardless of what computer they log on to across campus, which makes it the responsibility of the IT department to provide users/students the consistent computing experience they require on an ongoing basis.

The computer lab will need the most up to date applications and updates for everything on each computer. There are different ways used to accomplish this based on the environment. To get started with the imaging process one would have to choose or decide on a solution that best meets the needs of the organization, based on financial plans, team resources, and task timelines, etc. There are a number of good options mostly with little or no licensing costs. One approach to take in the process of imaging is virtualization.

However, in the case where the financial plan, resources, licensing, endpoint performance, and other factors are not a good fit for VDI, there are many other options including third-party sellers that make software to do what a snapshot does for a virtual machine (VM), only for a physical device. A few common options include Deep Freeze from Faronics. And Microsoft Deployment Toolkit (MDT). MDT is a free Microsoft tool that is ready for use, but the IT administrator will need to have enough skill to know what needs to happen and when it needs to happen for imaging.

My first few weeks of the internship, I learned several technical skills that I was not aware of before getting this internship. Through the first three weeks, i.e., 50 to 75 hours, I learned the different model types of computer stations as well as how to correctly disassemble and reassemble a computer along with several other skills needed in the IT field. Some of the skills I learned are how to diagnose and resolve unique problems related to application software and operating systems, configure, deploy, maintain, troubleshoot and support computer workstations, laptops, printers, mobile devices. In addition to learning different techniques, that I was not very familiar with, I began working on reimaging computer labs.

The first thing I learned about computer imaging was the fact that it reduces the stress and time consumption of having to install multiple pieces of software on a large number of computers. I also had the opportunity to work on updating the image for few of our labs. Currently, I am doing some research to find out other different ways to go about imaging in comparison to other possible ways that imaging can be done. I chose the imaging project mostly because I have always come across the term computer imaging but I never really knew how it worked, and upon learning about the process of carrying out the work, it appeared to be nothing I thought it was which got me even more interested in working on it. I am excited to be learning more about this aspect of technology.

I have worked on this project for about 6 hours every day of the week for two weeks now; so far I have gained more knowledge on this topic. One of the things I have learned so far is that the IT Systems support team at Olivet uses SCCM for imaging. SCCM is Microsoft System Center Configuration Manager. This Windows product enables administrators to manage the deployment and security of devices and applications across an enterprise environment.

The way I have learned to go about pc or computer imaging is to create a customized operating system image, you build a reference computer with the desired operating system, and install apps, configure settings, and everything you want to be on the image/lab, etc. Then, you capture the operating system image from the reference computer to create the WIM file. A WIM file is a disk image format that is specific to Windows. It is file-based; so it is not a direct copy but is a copy. It is used to help deploy Windows systems. In a way, it is a backup of the reference machine. The WIM file is referenced in a Windows install to put in place all of the applications and settings that were made on the reference machine. You can build the reference computer manually or use a task sequence to automate some or all of the build steps. This process will require a system preparation tool also known as Sysprep.

The System Preparation tool is a technology used along with other deployment tools to install Microsoft Windows operating systems with minimal intervention by a technician. This tool is typically used during large-scale deployment that can be slow and expensive for a technician to install the operating system on individual computers manually. Sysprep is used to strip out machine specific items from an Operating System so that it can be used on other computers regardless of the model. These items include licenses and drivers. It is used in small and large computer environments and also useful for transferring an OS for personal computers. The disk-imaging program creates the disk image of the master installation. After copying the disk image onto a destination computer, turning on the destination computer, a summarized form of the Windows Setup program runs which creates only user and system specific settings, such as computer name,

domain membership, and regional options. All of this is possible because technology permits computers to capture, display and to improve usability.

Computer hardware has made it possible to run imaging programs on personal computers, substantially reducing the cost and the time it takes to set up a lab. Improvements in computer software have made the technology easier to use and created new applications and ways to better image a lab. Before the deployment of these imaging tools, the department has had to go back and forth through a multiple DVDs trying to figure out operating systems, applications, updates or driver disks for each computer as well as the difficulties involved in the process of capturing, storing, and maintaining separate images for each computer labs. That means that automated imaging also increases accuracy as the manual methods leave much more room for mistake. I must say that the way this technique is done today has drastically changed in the sense that it is now more efficient and is not time-consuming. Especially with a virtual machine.

I have concluded that educational setting or an organizational environment such as Olivet Nazarene University where multiple computers are provided to meet the needs of students, staffs, and faculty, the computer imaging process is used to overcome the challenges of installing and configuring several software applications on multiple computer stations. Here at Olivet Nazarene University, the IT Department is in charge of assessing, testing, connecting, upholding, and documenting all software and operating systems that are set up on campus, i.e., the school's computer labs, classrooms, offices and IT loaner or temporary laptops. The IT Department at Olivet Nazarene University has a set of primary software that is installed in all Windows operating system computer labs. This software includes;

- Microsoft Windows 7 professional
- Adobe Flash Player
- Adobe Reader
- Internet Explorer
- Java
- Microsoft Office
    - Access
    - PowerPoint
    - Word
    - Excel
- Skype/Skype for business
- Microsoft Endpoint
- In addition, specialized software such as MathLab and few others are requested by Faculty and/or Staff. Which can be for computer labs, individual workstations, and/or an entire department's workstations.

The imaging technique here at Olivet Nazarene University is very much in compliance with the industry standards that I have reviewed while doing my research. The imaging processes or steps, of course, includes choosing a reference computer, figuring out how update works with your imaging software, i.e., using a virtual machine for your reference computer means allows you save an additional copy to make updates to it without having to rebuild it. The system preparation

can be used in this step, however, to avoid having to rebuild an update after every few times. You can also look for an imaging solution that can handle the system preparation. Also, the imaging software that is used should permit the use of drivers without having to go to every producer's website to download the required drivers as well as embedding them in the image with hardware specific images, using disk cloning techniques.

Always make sure that the chosen imaging solution works for your environment now and can handle changes in the future especially knowing that manufacturers change models so often. Also, flexibility should be something to consider during the imaging process. Software such as SmartDeploy and Microsoft Deployment Toolkit, use the industry standard WIM file type. This file type makes your image much more flexible. Giving you the ability to use it with several other products, including Microsoft SCCM and WDS. Furthermore, you can service and manipulate WIM files while other proprietary formats are locked down and require you to always return to the vendor to make any updates.

Furthermore, considering deployment time is essential to make sure that you are not spending too much time when not needed. Finally, make sure the imaging software is easy to use and support; by easy to use I am mostly referring to not having to go through multiple steps of support just to get the solution to a problem. There are other known for their ease of use, such as, Altiris and Norton Ghost. Altiris delivers excellent results for the configuration and deployment of multiple computers.

Particularly, Altiris Deployment Server remotely images or run scripted installed packages for all types of computers across a network or lab environment, and the daily tasks can be performed from a central console eliminating the need to go to each computer. While Norton Ghost uses the replicating process that generates an image file containing all a computer disk configuration and hidden data. This information is used to restore a computer to its original state. Altiris and Norton Ghost imaging software have some advantage and similar benefits such as a complete creation and restoration of a computer's configuration in minimal time. For instance, Norton Ghost can create an image file or clone. Altiris provides similar performance when creating an image or restoring a computer's configuration, although not quite as quickly as Norton Ghost.

Altiris, on the other hand, needs additional time if several partitions are on the disk that needs to be copied. However, one difference between the Norton and the Altiris products involves their abilities to clone a computer's configuration across multiple systems. Altiris allows a laidback method; it can manage an entire lab from a single workspace. Norton Ghost, there is no need to go to each station separately to change every computer name and IP address or inserting a disk to point the computer to a network share after cloning the disks.

In conclusion, imaging and deployment should be simple, fast, and reliable. Before spending hours trying to configure an imaging software to work the way you need it to, evaluate your options. Spending a couple of hours trying a few solutions may save you hours of pain down the road. More importantly, having an imaging process will ultimately keep devices performing at their best and reducing potential security vulnerabilities since you'll be consistently deploying the most up to date images across the organization.

For the second portion of my project, I was tasked with finding the industry best practices for performing database updates and maintenance. For this part of my project, I did the work on one of the IT department's SQL database servers called Scar. Before going right into this part of my project, I will define the term database; this is a group or collection of information that is organized to be easily accessed, managed and updated. In a database, data are organized into rows, columns, and tables, and indexed to make it easier to locate relevant information. The data is updated, expanded and deleted as new information are added. A database management system (DBMS) is a group of programs that manage the database arrangement and controls access to the data stored in the database.

The database management system serves as an intercessor between the user and the database. Therefore, the database structure itself is kept as a group of files, that can only be accessed through the database management system. The DBMS lets you create, edit, and delete databases. The picture below shows the difference between a database and database management system. The picture shows a visual difference between a database and a database management system
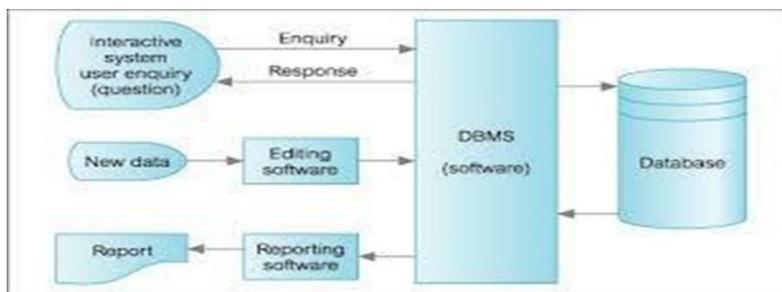


At the very beginning of this project, I started the work by having a meeting with my supervisor and getting all the information needed to get work started on the database. After this meeting the first thing I did was try to familiarize myself with the database I was required to work with. Initially, I had some difficulties working on this project, but I was able to figure it out with the help of my supervisor.

I started out by looking up some repeated errors I had found in the database. I did this manually by researching what each error message meant. I found that this was very time consuming so I brought it up in one my class meetings and a student suggested that I sort the data I am working with. Sorting is a process of organizing data into meaningful order so that you can analyze it more efficiently. In this case, I sorted the data based on the most repeated error I found in the database. After working on sorting the errors, I went ahead to look up the meaning of the errors and how to resolve the issues. I found this very time consuming, but it was beneficial as it has helped improve my knowledge of databases. I learned a lot from doing this search. The sorting and searching process of my project took me about 50 hours to complete I say this because I worked on it for 5 hours each day for two about weeks which sums up to the hours reported above.

Following this, I began to research the best ways to maintain a database. Some things I found relevant in this part of my project is that if a database is left unattended it can give rise to

glitches and ultimately lead to downtime and data loss. Maintaining a database, like maintaining anything requires a great deal of time and energy. This is also true in the case of a database; it requires maintenance as to keep it free from threats, improve performance, reliability, and availability to users when needed. With SQL Server there are quite a few options that can be used to accomplish database maintenance tasks. One of which is the Database Maintenance Plans. This is a simple way to certify that maintenance routines are being done on the databases.

Also, keep in mind that the regular data recovery and backups are essential parts of any database process, database maintenance plans make backups very easy to setup and monitor. A disaster recovery strategy will differ from one environment to another. The primary backup and recovery process are to ensure the readiness and reliability of provided or available data, having a reliable disaster recovery process is essential because it is impossible to predict all likely disaster situations. Backup is necessary for maintaining a database. Backup is the process of copying data from the database to the standby device. The backup device can return the database to its previous state of when the backup was generated.

Recovery is another process that needs to be done to maintain a database correctly; this is the ability of the SQL server database to run the transactions after a system failure. Without a backup and recovery plan, the system and user errors can make the database inoperable and useless. Also, the backup strategy must be developed with recovery time objectives in mind, so that data is not unavailable for extended periods when problems inevitably occur. In addition to the necessary backup and recovery procedures that are essential to maintaining a database properly. There are other routines such as Index Defragmentation, Log File Maintenance, File/Data Compaction; and Integrity checks that needs to be run regularly.

First, Index defragmentation is a part of Microsoft SQL Server maintenance that is done by maintenance tasks that can be run on a constant basis to ensure that the SQL statements are running as competently as possible. Maintenance tasks do not take many levels of effort to do but could provide significant results if done correctly. Microsoft SQL Server keeps indexes of all the insert, update and delete operations performed on databases. Over time, these indexes can turn out to be fragmented or disordered on the server's disks which leaves the disk space wasted and can slow down database access operations. The indexes are defragmented by rearranging an index. Defragmentation ensures that all entries in an index are connected for quick and efficient access as opposed to multiple disks and partitions.

Log File Maintenance is another routine for maintaining a database SQL Databases contain a 'Log File' that monitors all transaction that occurs in the database. Using these log files, you can restore a database to the state it was at any point in time. Therefore, if an unexpected or unplanned situation such as data corruption occurs in the database, it can regain the data to its initial state before the corruption, or unforeseen circumstance occurred which is why the Log files are significant parts of the system and require special care as well. Log files grow as you add more data to the database and every time the file increases, it creates a 'Virtual Log File that it uses to retain data. The problem in this is that if there are several VLFs, it will take a longer time to insert data into the log file, which harms performance.

Part of our maintenance routine is to scan these VLFs and see if they are hurting performance. If the maintenance routine determines that they are, then we adjust several factors of the log file, including how large each 'increment' is when the log file grows. We can then compact these VLFs together to regain our lost performance (and without losing any log data). In addition to the maintenance routine is the Integrity Check. Over time, your database will go through numerous changes which include data being added and removed as well as tables been added, improved, and removed allowing the overall plan of the database to change. Also, indexes will be added, rebuilt, deleted, and re-created. Data columns will be added, modified, and removed.

The database will go through numerous changes just as a natural course of its lifespan. But each change, no matter how small, has the potential to introduce corruption into the database. Indexes can have corrupt pages; the table can have bad records; the schema can contain inaccurate references. These different types of corruption can cause anything from simple performance issues to complete schema failure and terrible data loss, and that is where the Integrity Check comes into play. The Database Integrity Check examines and analyzes the entire database and can detect and repair any corruption it comes across. The database integrity check should be run on a regular, reoccurring, weekly schedule.

Although, properly maintaining a database eliminates most or all of the issue that might arise. There are still some challenges to maintaining a database. Some of this challenges are; increased data volume and cost, keeping it current, regular upgrades, data security and management complexity. Therefore, maintaining an accurate database requires a supported process to manage all interactions within the database as well as

**Future work**

While working on this project, I came across a lot of information that I found overwhelming; some work such as experiments, and trials with real data have been left for the future due to lack of time. Other than there not being enough time to experiment with real data mainly on the database portion of my project, I was relatively limited in carrying out some actions. However, if I had more time or have the opportunity to work on this project at a later time I will look into more experimentation of the information I came across during my research in order to fulfill my curiosity.

**Conclusion**

In this paper, I have addressed some the ways I found that is best to maintain a database and image a computer lab as well as some of the challenges and why I chose these topics. After working on this project for 6 hours 5 days a week for 14 weeks; this sums up to over 160 hours throughout the semester/ my internship period I have gained a considerable amount of knowledge and about a technology I had little understanding of before working on this project. Other than learning about new technologies, while on my internship I learned some life lessons that have changed the way I perceive things in the IT field as well as the workplace in general. Also, throughout my internship, I was able to come to a decision in regards to the IT field I would most likely be pursuing in my career.

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