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Comparative study of restoration tools by cloning using LSP method

Colaboración

José Luis Lira Turriza; Yaqueline Pech Huh; Jose Manuel Lira Turriza; Ariana Abigail Chi-Dzib; Miguel Angel Cohuo Avila, Instituto Tecnológico Superior de Calkini, Campeche

RESUMEN: Las herramientas de restauración en un laboratorio de cómputo se utilizan para el mantenimiento de los equipos que en él se encuentran. Una técnica utilizada es la de clonación de imágenes, que consiste en generar una imagen del sistema en un momento dado y sobre la que será restablecido. En este documento se han revisado tres herramientas como las mencionadas, usando la metodología de Puntuación Lógica de Preferencias (LSP) evaluando su Instalación, Usabilidad, Desempeño y Mantenibilidad, en los laboratorios del Instituto Tecnológico Superior de Calkiní. Se pudo observar que el sistema llamado Clonezilla obtuvo 75 puntos porcentuales siendo el mayor de los tres.

PALABRAS CLAVE: Aplicaciones de Linux, Clonezilla, Laboratorios de computación, Restauración de software de equipos, Sistemas de clonación.

ABSTRACT: The restoration tools in a computer lab are used to maintain the equipment that is in it. One technique used is image cloning, which consists in generating an image of the system at a given time and on which it will be restored. In this document we have reviewed three tools such as those mentioned using the methodology of Logical Scoring of Preference(LSP) evaluating its Installation, Usability, Performance and Maintainability in the Instituto Tecnologico Superior de Calkini laboratories. It was observed that the tool named Clonezilla got 75 percentage points being the higher.

KEYWORDS: Clonezilla, cloning systems, Equipments Software Restoration, Computer labs, linux applications.

INTRODUCTION

Computers into computer labs are used to process and optimize activities of the end-users, this is one reason why are useful and essential for organizations and institutions, they generate competitive advantages that are reflected in the increased efficiency, learning and business growth.

Organizations commonly acquire computer equipment from the same vendor because it generates higher profits and better relationships with them, helping the technical service to reduce the type of parts of the equipment purchased since they have the same features in terms of hardware, so the software installation can be performed in a standardized manner.

In the ITESCAM, there is a policy of restoration for the computer labs where the stable initial configuration of all the needed programs is returned.

Currently, there are authors like Pressman that establish criteria for measure of software quality. In this document we present the compilation and classification of this information divided in three criteria: ease to install, ease to use, performance and maintainability, integrated through LSP methodology for, in a quantitative manner, compare two or more software's and determine the better, using the established indicators; in addition, we show the results of use it with three restoring and cloning tools for the equipment of ITESCAM computer center.

State of the art
The dedicated area for its required maintenance to protect needed programs of providing services either for poor performance, virus or organization policies, in order to maintain service levels [1]

Taking the advantages of the computer lab, the managers can use features of different programs to make a massive installation of the full content of hard disks, no matter if you have installed two operating systems (in some disks) or if you have installed some programs.

If a manager does not implement any of the programs that we will evaluate, to perform this work can be tedious and inefficient and it would take too long to finish the activity, because it would imply that the restoration of operating systems (one or more), drivers and applications installation that are used is going to be made computer by computer.

In the current market there are tools of software (copyright or copyleft) that offer disaster restoration, disk cloning and backup that are ideal to apply on computer labs or in connected computers by net for an efficient maintenance in the computers.

We name disk clone or Disk Image, as an exact copy of computer hard disk drive. The copy includes all the partition information, boot sectors, the file allocation table, operating system installation and software application. It saves the entire data from the disk, including the file structure and all the files and folders from the disk, in a single file [2]

Evaluate a system means establishing criteria based on properties that are expected to have, it can be made using oriented methods for economic effects, trying to express criteria in terms of financial indicators, from the perspective of quality with the classic works of [3] and [4], through metrical standards of software quality established in [5] and [6]., nevertheless metrics quality standards are standardized, evaluation methods that operate over these are different as can

be shown in [7], and usually are always focused on aspects of software design and development. One of the quantitative methods is Logical Score Preference (LSP). It is used to evaluate, compare, and select software and hardware, and is a generalization and extension of several techniques of qualify [8] and [9] . LSP does not specify a criterion, but it gives us a method to get a list to evaluate quantitatively criteria for comparing as is showed in [10].

The chosen tools are: Acronis, Clonezilla SE and Symantec Ghost Solution Suite that permit creating and cloning an image.

MATERIALS AND METHODS
Methodology
An experiment was made using Installation Labs of the institute with thirty-five computers for the massive deployment of a disk image from a hard disk of 500Gb containing 80 GB of information and with two operating systems: Windows 7© and Linux Ubuntu 14.04.

At the beginning of the test we followed next steps:
i. Review Connectivity
ii. Operating System Installation as a server
iii. Preparation of a client computer to install required operating systems and applications in the computer lab.
iv. Installation of cloning software on the server
v. Saving the disk image on the client from server.
vi. Cloning target computers of the computer lab.

Software Description
The characteristics of the three tools to be used to accomplish the target are presented below:
Clonezilla SE. It is a free software used for restoration management of hard disk to different clients, it is a tool that permits to start the operating system in the net machines, without having an operating system installation in the locally, with Clonezilla (included) we can clone several computers simultaneously. It is a program that works over Linux distributions and permits to clone the hard disk. It is important to mention that is an open software, available for all users.

Symantec Ghost Solution Suite. It is a commercial software that is used for the creation of disk images of systems; and it is compatible with Windows, although it can install in other operating systems using another tools.

Acronis It provides security copies and restoration solutions after disasters and let us access to security data through a security software giving us access to security data in physical servers, virtual servers, and the cloud. It includes a feature called Universal Restore that permits to restore security copies simultaneously on any computer, independently of the platform.

Hardware Description
The tests were made on connected computers in a switch 3COM Ethernet with the next features:

Server:
i. Brand: DELL
ii. Model: DCSLF
iii. Operating Systems: Ubuntu 14.0.4 LTS, Windows 7 Professional ©
iv. Processor: Intel Core Duo
v. Memory RAM: 512 Mb
vi. CPU Speed: 2.8 GHz
vii. BUS CPU Speed: 800 MHz
viii. Hard-disk Capacity: 80 Gb
Client:
i. Brand: IBM
ii. Model: 8215G1S
iii. Operative Systems: Windows 7 Ultimate 32 bits Xubuntu 14.04
iv. Processor: Intel Core Duo
v. RAM Memory: 512 Mb
vi. CPU Speed: 2.8 GHz
vii. BUS CPU Speed: 800 MHz
viii. Hard-Disk Capacity: 80 Gb

An overview of the lsp method
Software systems can be evaluated from different criteria; it depends of the evaluator's point of view. For instance, the users expect that the system can satisfy their requirements without considering the features described by the product. The LSP method can be defined by three steps:

Creating a System Atribute Tree
First, define the components to evaluate, these components can be systematically identified using a system requirement tree described [8].. For instance, for the first component in our case we identify the Installation. We could follow the next decomposition structure:
Installation
i. Environment
ii. Configurable Options: A) Path selection and B) Customize applications

The decomposition process ends when the components cannot be further decomposed and can be measured and evaluated. This last level of the requirement tree is named performance variables.

Defining elementary criteria
For each measured component   (performance variable), elementary criteria function will be determined. This function represents the level of satisfaction for each component value. The interval of these values is and it represents the degree of truth in the measured component. For instance, if   denotes Response time, we can determine the maximum and minimum time to respond. In this case, while we wait more time to respond, it will be less acceptable for the user.

The function that computes the elementary criteria E as a function of   can be defined as a decreasing function with the equation (1).

$$E = 100 \min \left\{ 1, \max \left[0, (t_{max} - t)/(t_{max} - t_{min}) \right] \right\} \quad 0 \le E \qquad \text{Ec.(1)}$$

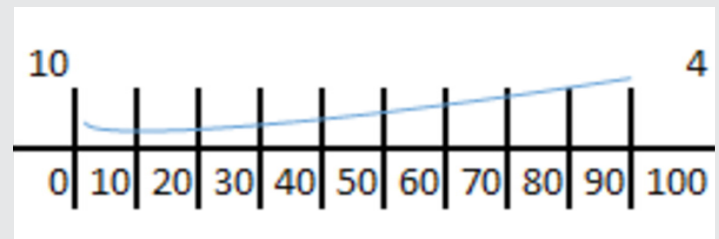This mapping can be conveniently expressed using the preference scale shown in figure. 1.

Figure. 1. An example of elementary criterion tomado de (J. Dujmović and Bai 2006).

Similar elementary criteria can be defined for all n performance variables, and from these criteria we get a group of elementary preferences: $E_1,....E_n$ With these elementary preferences we can compute the global value that reflects the total satisfaction of all requirements.

Development of preference agregation structure
It consists of superposition of appropriate aggregation operators. In this document we define four main components with different priorities and all of these components with its own priority or importance degree. Is for that LSP consider preference aggregators with adjustable weights; an aggregator that has   input preferences generates the output preference like shown in using the equation (2).

$$e_0 = \left(w_1 e_1^r + .. + w_k e_k^r \right)^{1/r}$$
$$0 < w_i < 1, w_1 + .. + w_k = 1 \qquad \text{Ec(2)}$$
$$0 \le e_i \le 1, i = 0,1,...k$$

Weights reflect relative importance of the input and the exponent   reflect the properties of the aggregators.

In the Figure. 2 presents seventeen aggregators with symbolic names and its values of exponent . If we aggregate preferences   and   then, the aggregator value will be between   and, approximately.
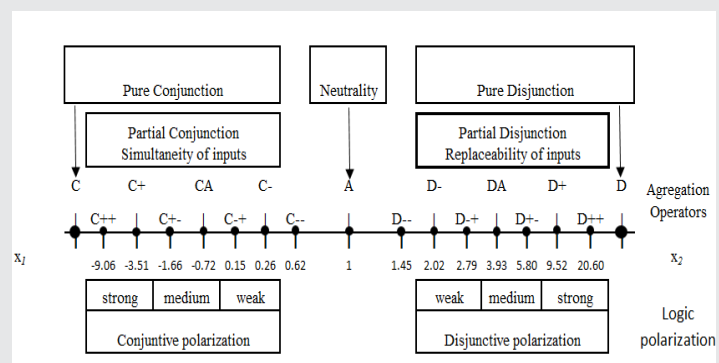

Figure 2. Preference aggregator from and to or.

We can calculate the global preference that reflects the global satisfaction of the evaluator's requirements [11]. with equation (3)

$$E0 = L(E1,..En) = L(g1(x1),..gn(xn)) = G(x1,..xn) \quad Ec(3)$$

The aggregation function   is created using logic aggregation of preferences like [8], [12]   and [9] and shown in Figure. 3.
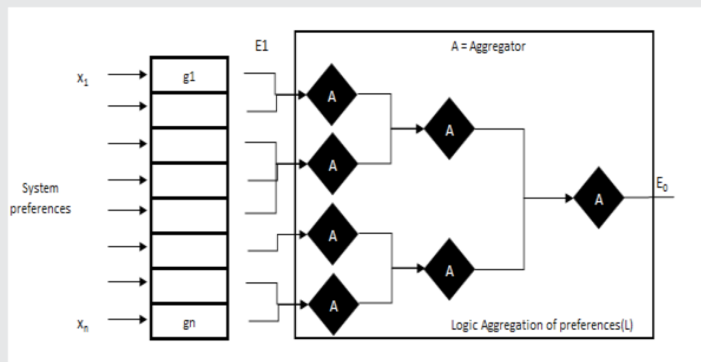

Figure 3. Complex criterion model using LSP.

2. D: R34 Speed for create image. This evaluates using a relative criterion. Times average to create the image   times, that is to say, for each times to   the time is calculated by the with equation (4). The correspondent criteria is showed in figure. 5.

$$E0 = L(E1,..En) = L(g1(x1),..gn(xn)) = G(x1,..xn) \quad Ec(4)$$

3. ID: R10. Installation manual. It is evaluate using a binary criterion: 1 (100%) denotes existence and 0 denotes its absence of this manual.

Figure. 5. An example of relative score.

COMPARISON CRITERIA

Our interpretation of the evaluation methods, we based it on a qualitative and quantitative method in accordance of the features of the tools that it described each tool Clonezilla [13], Ghost Symantec [14], Acronis [15] and also use the knowledge of experts in each of the platforms. We consider the evaluate systems and those who use it, the user needs and the degrees in that this evaluate systems satisfy the requirements. For that the users of the platforms are managers, responsible of technical support or users that have the needed of made a massive restoration of the cloning image(disk-image).

For each variable we define a form to measure. The next steps are examples of three types of measurements that we use in this paper.

1. ID: R8 Architecture: It evaluates the compatibility of the different architectures and the distinct processors that exists in the market assigning from point to point for each handled architecture.
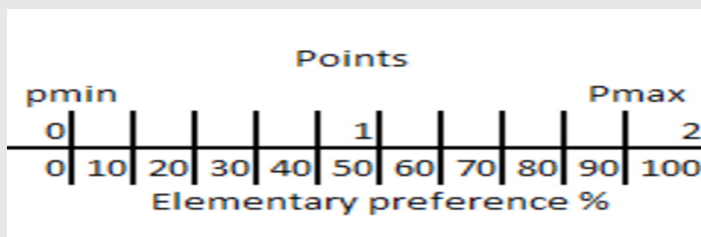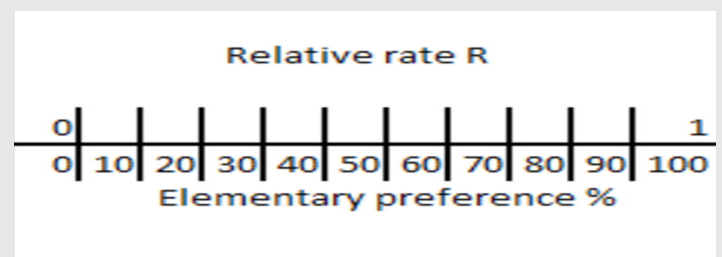

Figure. 4. An example of direct score.

With that and the use of the LSP Method we establish the criteria of comparison. We identify fourteen relevant components (performance variables) group by four main areas: Installation, Usability, Performance and Maintainability, each of them is assigned to identify named   to . Speed in the creation of image. This evaluates using a relative criterion. The mean of the times in the generation of an image n times, ie for the times   the time is calculated calculated by the with equation (5)

$$Ri = \min(t1,t2....,tm)/ti, 0 < Ri \leq 1 \quad Ec.(5)$$

The corresponding criteria is: it is assigned to an identification named   until ; this is for the purpose of avoid wrong results by misinterpretation of the qualitative factors assigned. Each one we assign a weight for criterion. This criterion was assigned according to importance in reference to the finality of the tools (where it holds that the sum of the measures in each block must be 100), also it is assigned to each block a corresponding symbol to andness and orness value. With all information we generate a structure that we present in the tables 1, 2, and 3. They represents the mechanisms that will use to measure each tool in this study. The main component aggregation structure of the global score is showed in the table 4.

Points that reflects the capacity of the tool for install in distinct architectures allowing a mayor compatibility.

Table 1 Installation Component

Id	Elementary Criteria	Operator	Blok ID	Operator
R1	Environment: Friendliness			17
R2	Path Selection for installation.	30	Configurable Options	16
R3	Customize applications or packages.	40	DA	
R4	Language Selection	30		
R5	Speed	50	A	Performance	16
R6	Resource consumption	50		
R7	Number of OS permitted	30	CA	Compatibility	34
R8	Architecture(x86, x64, etc.	40		
R9	Compatibility with other applications	30		
R10	Online Help	20		
R11	Installation Manual	20		
R12	Help tutorials	20	D++	Help	17
R13	FAQs(Frequently Asked Questions)	20		
R14	Troubleshooting	20		

(with D+- spanning Compatibility/Help area)

Table 2 Usability Component

Id	Elementary Criteria	Operator	Blok ID	Operator
R1	Environment: Friendliness			17
R2	Path Selection for installation.	30	Configurable Options	16
R3	Customize applications or packages.	40	DA	
R4	Language Selection	30		
R5	Speed	50	A	Performance	16
R6	Resource consumption	50		
R7	Number of OS permitted	30	CA	Compatibility	34
R8	Architecture(x86, x64, etc.	40		
R9	Compatibility with other applications	30		
R10	Online Help	20		
R11	Installation Manual	20		
R12	Help tutorials	20	D++	Help	17
R13	FAQs(Frequently Asked Questions)	20		
R14	Troubleshooting	20		

(with D+- spanning Compatibility/Help area)

Table 3 Performance and Mantenibility Component

Id	Elementary Criteria	Operator	Block ID
R34	Disk image generation Speed	25	C++	Performance
R35	Disk image restoration Speed	25		
R36	Disk Image Size	25		
R37	Fault tolerance	15		
R38	Scalability	10		
R39	Changes	50	A	Maintainability
R40	Versioning	50		

Table 4 Global Score

Id	Components	Operator	Block Id
1	Installation	25	
2	Usability	25	A
3	Performance	40	Global Score
4	Maintainability	10	

Clonezilla SE.

Clonezilla SE. Installation process does not present a graphical environment. It was made with command line. It was the same for configuration options. All options present a description in text mode. In the program configuration it presents different options and the most of them was difficult to understand and deduce at moment to choose one. Configuration options and installation itself present an environment poor for people that does not have experience in the area. Even for people with some previous knowledge, it could be difficult to handle. As shown in Table 5

Table 5 Global Score for Software

Name	Global Score value				
	Installation	Usability	Performance	Maintainability	Total
Clonezilla	11.60%	24.10%	39.92%	0%	75.63%
Norton Ghost	13.50%	23.85%	10%	5%	52.36%
Acronis	13.10%	23.9%	24%	10%	70.54%

Symantec Ghost Solution Suite

This program results ease to install, it presents a graphical environment where is only necessary to click in the option that we need, and the program will do the rest. As its name suggest it presents a suite to choose options that we want to install, there is a good documentation about each part of the suite, but we use GhostCast Server (cloning disk and partition through net) ad Ghost Boot Wizard (build boot disks and partitions of Ghost). Installation options are clear and easy to understand so an inexperienced user in the area could use this program. However, is a copyright software and has a cost for its use. As shown in Table 6

Table 6 Clonezilla results

Clonezilla SE					
Block ID	Input	Operator		R	Score
		Weight	Symbol		
Installation	46.41	25		11.6025	
Usability	96.42	25	A	24.105	75.628
Performance	99.80	40		39.92	
Maintanability	0	10		0	

Acronis

For this program, the installation presents a graphical environment where is only necessary follow the guide steps. To install this program was necessary to activate a service from Acronis. We had some problems at the moment to operate the program, for instance when we tried to share a file through the net, it failed. Another problem

was at the moment to restore a computer, although the disk image was cloning correctly, at the moment of restoring, it marked an error at the end of the process. The installation an operational experience for both software was easy to handle. As shown in Table 7

Table 7 Acronis results

Acronis					
Block ID	**Input**	**Operator**		**R**	**Score**
		Weight	**Symbol**		
Installation	52.4	25		13.10	
.5Usability	95.6	25	A	23.9	70.54
Performance	59	40		23.54	
Maintainability	100	10		10	

CONCLUSIONS AND FUTURE WORKS.

Clonezilla SE is a software that does not present an attractive environment for users. Even though its interface is not graphical the command line describes a group of instructions that each option that represent. This indicates that it is not a good choice for users that are used to graphical environments. However, its process of disk cloning and computer restoration connected to an intranet of organization where the number of computers is significantly in a short time and efficiently supporting different operative systems sticks out over Acronis and Ghost.

Acronis has almost features that we need in a computer lab, inclusive it supports both operative systems Windows© and Linux, and it has support for mac solutions. One disadvantage of this tool is the compatibility, in some cases we have problems with other programs installed in the target machine.

Symantec Ghost Solution Suite on the other hand is a good solution for persons who needs clone his disks only for backup its data. The main disadvantage is that only permit clone and restore Windows© Operative System.

Although the cost is not part of our study and it is not affect the performance of the tool, we consider the cost at the moment to choose one of them.

In conclusion, when you need to make a disk cloning with one or two operating systems, indeed, Clonezilla SE it is the best option. Nevertheless, both Acronis and Ghost are very good tools especially for those that like graphical environment and, as mentioned at the beginning of the document, the decision of getting a software depends of the type of end-user and the possibilities of the organizations.

In future works we will compare software at different work environments using the indicators and criteria established in this document to observe behavior.

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