

## User's perception of Windows operating systems: A comparative analysis

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### ABSTRACT

Windows operating system (WOS) introduced flexibility and user-friendliness into operating systems. This makes the computer easier to use when compared with the old non-windows based operating system like MS-DOS, UNIX, OS/2, XENIX. Upgrades for windows operating system are numerous. This can often lead to confusion and cause a problem of choice to consumers who have to bother about usability, cost, maintainability, stability, availability and other attributes of windows operating systems. This study seeks to make a comparative study of nine popular windows operating system from the perspective of users. Data were collected using interviews, direct observation and questionnaire. Factor Analysis by principal components was adopted in the data analysis. The results show that most users prefer the use of Windows '98 (Second Edition) because it ranks high in the factors extracted from the principal components analysis using Kaiser criterion. The general performance of WOS is mainly determined by the four extracted factors, namely; processor speed, booting speed, cost and ease of installation. The findings also show that each successive WOS is an improvement over the previous one. The latest version often compromises stability and efficiency for effectiveness and robustness..

### RÉSUMÉ

Grâce au système d'exploitation Windows, les concepts de flexibilité et convivialité des systèmes d'exploitation sont devenu une réalité. Avec les systèmes d'exploitation Windows, il est plus facile d'utiliser l'ordinateur par rapport aux anciens systèmes d'exploitation tels que MS - DOS, nouvelle version du système d'exploitation Windows. La convivialité, le coût, la maintenabilité, la stabilité, la disponibilité et bien d'autres aspects relatifs à chacune de ces versions ayant une influence sur le choix de l'utilisateur, une telle diversité de version, lui pose souvent des difficultés. La présente article a pour objectif de faire une analyse comparée de neuf systèmes d'exploitation Windows du point de vu d'utilisateur. Les informations ont été recueillies par biais des interviews, des questionnaires et des observations sur le terrain. La méthode d'analyse de donnée adoptée est l'analyse factorielle par composantes principales. Les résultats prouvent que la plupart des utilisateurs préfèrent travailler avec Windows '98 (deuxième édition), car celui-ci se situe à un niveau élevé parmi les facteur extraits de l'analyse des composantes principales selon le critère de Kaiser. Le fonctionne générale du systèmes d'exploitation Windows dépend essentiellement des quatre facteur considéré, dont : vitesse de processeur, vitesse de démarrage, coût et facilité d'installation. L'étude révèle également que toute nouvelle version du système d'exploitation Windows est une révolution de celle qui la précède. Mais au regard de la convivialité et de la robustesse, la stabilité et l'efficacité diminuent au fur et à mesure que l'on passe des anciennes aux nouvelles versions.

## 1.0 INTRODUCTION

Advances in Information Technology exert a primary influence on the lives and activities of individuals and corporate bodies all over the world. The computer industry occupies a very strategic position in information management and technology. The development of computers and microchip technology has brought about increased productivity in virtually every facet of human endeavour. The ease of use of computers today has been traced to the evolution of user-friendly operating systems [Satzinger and Lorne, 1998].

A computer is valuable only to the extent that it can help users solve problems more economically than by other means [The Diebold Group, 1977]. Recognition of the valuable contribution of the computer led to evolutions of operating systems from a haphazard collection of programs and subprograms to a vital and integral part of computer systems. While computer hardware has changed through technology from tubes to transistors to integrated circuits, software has primarily evolved through management and control [Laudon and Laudon, 2000]. In the early days of computing, when command driven operating systems such as Microsoft Disk Operating System (MS-DOS) were paramount, the user needed to memorize all command jargons associated with each operating system. This was both tedious and stressful, causing many people to develop cold feet at the sight of a computer. The introduction of the windows operating system by Microsoft Corporation in the mid 90's has paved the way for wide use of computers in business, management, communication and other aspects of human endeavour. Today, hundreds of millions of people all over the world are hooked onto the Internet freely without the stress of initial literacy in command processing language. Connecting computers in a network can now be achieved even at home by mere click of buttons on the control panel thanks to WOS. No doubt, the computer is now an exciting companion.

The first version of WOS, tagged Windows '95, was released in 1995. Windows '95 uses File Allocation Table 16 (FAT16) file system format. After the release of windows '95, excitement, expectation and desire to satisfy users brought about deeper research that led to the release of the second version, named Windows '97 (popularly known as Windows '95 Second Edition). Several users thus upgraded to the new version, expecting better satisfaction in terms of efficiency and effectiveness. Unfortunately, Windows '97 did not stand the test of time. This was attributed to inherent bugs.

Windows '97 was then upgraded to windows '98 which greeted the shelves in early 1999 [Nee, 1999]. Windows '98 was also a quick response to advances in hardware development in the area of disk drives, which now had FAT32 instead of FAT16. Thus Windows '98 was the first of the Windows Operating System to run on FAT32 disks.

Before the middle of 1999, Microsoft Corporation had begun advertising another version of Windows, named Windows 2000. At the time of its introduction, Microsoft Corporation claimed that Windows 2000 was "the commercial world's replacement for Windows '95". Since then, other versions like Windows Millennium Edition (ME) and Windows Extra Performance (XP), have greeted the market, each with its perceived strengths and inherent weaknesses. Despite the introduction of new versions of Windows Operating Systems, some users still prefer the earlier versions - Windows '95 and Windows '98. The big question is: "What does a user want in an operating system?". The users have formed their views about the various Windows Operating Systems. Their choice is largely affected by factors such as perceived turnaround time, purchase price, maintainability, ease of installation and use, stability, graphic support, time sharing ability, upgradability and virtual storage. Operating systems acceptability can be examined from the points of view of the following categories of users: computer operators, data processing managers, programmers, system analysts and general users [Schonberg *et al*, 1992; Sheetz *et al*, 1997; Elusade, 2002].

The development of operating systems poses significant problems to the manufacturers of computing equipment. One of such problems is the simple decision regarding the content of the operating system and the hardware requirements. It is equally easy to recognize that almost all customers have requirements that are unique to their own installation. The manufacturer is then faced with the dilemma of user satisfaction in the development of computer hardware and software. Since the operating system is an open-ended one, that is always in a constant state of change. The task of achieving stability while accommodating change is the manufacturer's paradoxical situation. The most significant problem for the user and manufacturer is the problem of reliability [The Diebold Group, 1977].

Release levels of operating systems are proofs of imperfect reliability as each new release attest to the inefficiencies of prior release. Such new release levels con-

tain corrections to previous release levels, and additional functional levels. User groups provide the feedback to manufacturers in specifying and requesting additions and modifications to operating systems. In some developing countries like Nigeria, strong user groups are rare. It therefore, becomes important to study the user's aggregate view of the operating system from the individual user's perspective. This study addresses such as a means of assisting users in the choice of operating system and manufacturers in the design of new operating systems. The study does not consider hardware factors that affect the performance of operating systems. This is because most users, especially non-experts are not conversant with hardware metrics and how they affect the performance of their software. Only Widows Operating Systems are considered in this study because most computer users world wide utilize Windows Operating Systems. Other operating systems are sparingly used, except some specialized process control operating systems.

**2.0 MATERIALS AND METHODS**

Data for this study was generated through fieldwork involving questionnaire, interviewing and direct observation. Seventy structured questionnaires were distributed to computer users (industrial, commercial and academic) in five states in Nigeria, namely; Lagos, Ondo, Rivers, Kaduna and the Federal Capital Territory. It is noted that these states consist of a high cluster of computer users in Nigeria, considering their metropolitan nature. In the distribution, three clusters of users were identified, expert users, end users and casual users. Fifty-six of the questionnaires were properly completed and used for the data analysis.

The experimental variables considered in comparing the performance of nine Windows operating systems include: processor speed requirements, ease of installation, ease of use, hardware compatibility, software compatibility, security facilities, booting speed, shut down speed, performance, stability, purchase and maintenance costs, upgradability and graphics support. The following Windows operating system were considered: Windows '95, Windows '98 (Second Edition and Full Version - SE and FV), Windows '2000, Windows ME, Windows CE (Customized Edition), Windows XP (Home Edition and Professional Edition - HE and PE) and Windows NT (New Technology).

Factor Analysis was applied to the experimental variables. Factor analysis is a statistical technique used to identify a relatively small number of factors that can be used to represent relationships among sets of many

interrelated variables [Hamburg, 1979]. The linear multivariate model of factor analysis was adopted for this research. It is given as.

$$X_i = A_{i1}F_1 + A_{i2}F_2 + \dots + A_{ik}F_k + U_i$$

Where  $X_i$  is the  $i$ th variable,  $F_1, F_2, \dots, F_k$  are common factors,  $A$ 's are the constants used to combine the  $k$ -factors.  $U$  represents the unique factors (unexplained factors), which are assumed to be uncorrelated with each other and with the common factors. The general expression for the estimate of the  $j$ th factor is given as:

$$F_j = \sum_{i=1}^p W_{ji}X_i = W_{j1}X_1 + W_{j2}X_2 + \dots + W_{jp}X_p$$

Where  $W_i$ 's are known as factor score coefficients, and  $P$  the number of variables. The factor score coefficients for this study are represented by a likert scale weighting of 1-4 (Low =1, Moderate = 2, High = 3, Very High = 4). The correlation matrices, communalities, eigenvalues and component matrices were extracted for each operating system by method of principal Component Analysis, using SPSS. In the next section, the result is presented and some discussions carried out on the findings.

**3.0 RESULT AND DISCUSSIONS**

Table 3.1 shows the responses concerning users' preference for the various versions of Windows Operating System and their associated levels of reasons for such preferences. The administered questionnaire allows for multiple preferences, since it is possible that the aggregate preference for two or more operating systems could be the same, with variations in factor reasonings.

From Table 3.1, it could be seen that the highest number of users (31) are found using Windows '98 (SE), followed by Windows '95 (25), Windows ME (22), Windows '2000 (18), Windows '98 FV (13), Windows NT (10), Windows XP, PE (08), Windows XP, HE (03) and the least being windows CE (02). Windows XP is yet to gain popularity among users despite its advanced features, probably because of the seemingly poor publicity given to it. Windows '98 (FV) is less commonly used because of the perceived existence of bugs, poor reliability and weak driver base. People prefer windows '95 and '98 mainly because of processor speed requirements and booting speed. This goes to suggest that while users care for effectiveness, robustness and flexibility of the operating system, they seem more concerned about speed and efficiency. Table 3.2 shows the results obtained from Factor Analysis, using Kaiser criterion, which discards factors with eigenvalues less than 1.

Table 3.1: Users Preference Responses

S/N	Windows O/S Features	'95 Score & Freq.  (25)	'98 (SE) Score & Freq.  (31)	'98 (FV) Score & Freq.  (13)	2000 Score & Freq.  (18)	ME Score & Freq.  (22)	XP (HE) Score & Freq.  (03)	XP (PE) Score & Freq.  (08)	NT Score & Freq.  (10)	CE Score & Freq.  (02)
1.	Processor Speed	1=2 2=9 3=0 4=14	1=0 2=1 3=1 4=29	1=0 2=1 3=0 4=12	1=0 2=2 3=0 4=16	1=1 2=1 3=1 4=19	1=0 2=0 3=0 4=3	1=0 2=2 3=0 4=6	1=0 2=0 3=0 4=10	1=0 2=0 3=0 4=2
2.	Ease of installation	1=0 2=2 3=0 4=23	1=0 2=1 3=1 4=29	1=1 2=1 3=1 4=10	1=6 2=2 3=5 4=5	1=0 2=2 3=1 4=19	1=0 2=0 3=1 4=2	1=0 2=1 3=1 4=6	1=0 2=5 3=1 4=4	1=0 2=1 3=0 4=1
3.	Ease of use	1=0 2=2 3=2 4=21	1=2 2=1 3=2 4=10	1=0 2=1 3=2 4=10	1=1 2=1 3=9 4=7	1=0 2=2 3=0 4=20	1=0 2=0 3=0 4=3	1=0 2=0 3=3 4=5	1=0 2=2 3=3 4=5	1=0 2=0 3=0 4=2
4.	Hardware Compatibility	1=0 2=0 3=3 4=22	1=0 2=0 3=1 4=30	1=0 2=0 3=2 4=11	1=1 2=1 3=1 4=15	1=2 2=0 3=1 4=19	1=0 2=0 3=0 4=3	1=0 2=1 3=0 4=7	1=0 2=0 3=0 4=10	1=0 2=0 3=0 4=2
5.	Software Compatibility	1=1 2=1 3=12 4=11	1=0 2=0 3=5 4=26	1=0 2=0 3=3 4=10	1=0 2=1 3=1 4=16	1=0 2=1 3=3 4=18	1=0 2=0 3=1 4=2	1=0 2=1 3=0 4=7	1=0 2=0 3=0 4=10	1=0 2=0 3=1 4=1
6.	Security facility available	1=1 2=22 3=1 4=1	1=0 2=24 3=4 4=3	1=0 2=8 3=3 4=2	1=0 2=1 3=1 4=16	1=0 2=18 3=2 4=2	1=0 2=0 3=3 4=0	1=0 2=0 3=2 4=6	1=0 2=0 3=1 4=9	1=0 2=0 3=2 4=0
7.	Booting Speed	1=1 2=2 3=3 4=19	1=1 2=2 3=3 4=25	1=0 2=2 3=1 4=10	1=0 2=2 3=6 4=10	1=0 2=1 3=1 4=20	1=0 2=0 3=1 4=2	1=0 2=2 3=1 4=6	1=0 2=2 3=2 4=6	1=0 2=0 3=0 4=2
8.	Shut down Speed	1=1 2=2 3=6 4=16	1=1 2=0 3=2 4=28	1=0 2=3 3=1 4=9	1=0 2=2 3=2 4=14	1=0 2=1 3=1 4=20	1=0 2=0 3=0 4=3	1=0 2=0 3=1 4=7	1=0 2=2 3=0 4=8	1=0 2=0 3=0 4=2
9.	Performance	1=2 2=2 3=14 4=7	1=0 2=1 3=10 4=20	1=1 2=0 3=5 4=7	1=0 2=0 3=0 4=18	1=0 2=4 3=7 4=11	1=0 2=0 3=1 4=2	1=0 2=0 3=0 4=8	1=0 2=0 3=1 4=9	1=0 2=0 3=1 4=1
10.	Stability	1=2 2=10 3=2 4=11	1=0 2=10 3=5 4=16	1=2 2=3 3=2 4=6	1=1 2=2 3=0 4=15	1=0 2=14 3=5 4=3	1=0 2=0 3=1 4=2	1=0 2=0 3=0 4=8	1=0 2=0 3=1 4=9	1=0 2=0 3=1 4=1
11.	Upgradability	1=0 2=4 3=2 4=19	1=4 2=1 3=3 4=23	1=1 2=2 3=1 4=9	1=0 2=1 3=3 4=14	1=0 2=0 3=2 4=20	1=0 2=0 3=0 4=3	1=0 2=0 3=0 4=8	1=1 2=1 3=3 4=5	1=0 2=0 3=1 4=1
12.	Graphics Support	1=3 2=6 3=5 4=12	1=0 2=2 3=0 4=29	1=1 2=0 3=0 4=12	1=0 2=0 3=0 4=18	1=0 2=0 3=2 4=20	1=0 2=0 3=0 4=3	1=0 2=0 3=0 4=8	1=0 2=1 3=0 4=9	1=0 2=0 3=1 4=1
13.	Cost	1=3 2=3 3=18 4=1	1=1 2=4 3=20 4=6	1=1 2=0 3=10 4=2	1=0 2=0 3=3 4=15	1=1 2=3 3=11 4=7	1=0 2=0 3=0 4=3	1=0 2=0 3=1 4=7	1=0 2=0 3=1 4=9	1=0 2=0 3=2 4=0

**Table 3.2:** Summary Result of Factor Analysis

Windows O/S	Extraction sum of squared loading				
	Variable	Total Variance	% of Variance	Cumulative %	Factor Model
'95	Processor speed	10.000	76.924	76.924	Processor speed=0.809F <sub>1</sub>
'98 SE	Booting speed	9.796	75.356	75.356	Booting speed = 0.940F <sub>1</sub> +0.202F <sub>2</sub> -0.223F <sub>3</sub>
	Cost	1.386	10.662	86.017	Cost=0.806F <sub>1</sub> +0.308F <sub>2</sub> +0.373F <sub>3</sub>
	Ease of installation	1.0796	8.441	94.458	Ease of Installation = 0.977F <sub>1</sub> +0.00807F <sub>2</sub> +0.18F <sub>3</sub>
'98FV	Booting speed	9.796	75.356	75.356	Cost =0.806F <sub>1</sub> +0.308F <sub>2</sub> +0.373F <sub>3</sub>
	Cost	1.386	10.662	86.017	Cost=0.8806F <sub>1</sub> +0.373F <sub>3</sub>
	Ease of Installation	1.0796	8.441	94.458	Ease of Installation =0.977F <sub>1</sub> +0.00807F <sub>2</sub> +0.18F <sub>3</sub>
2000	Booting speed	10.342	79.556	79.556	Booting speed =0.941F <sub>1</sub> +0.103F <sub>2</sub>
	Cost	1.767	8.975	88.531	Cost=0.707F <sub>1</sub> +0.569F <sub>2</sub>
ME	Booting speed	9.570	73.618	73.618	Booting speed =0.946F <sub>1</sub> -0.199F <sub>2</sub>
	Cost	2.156	16.586	90.205	Cost=0.808F <sub>1</sub> +0.486F <sub>2</sub>
XP (HE)	Booting speed	10.000	76.923	76.923	Booting speed =0.945F <sub>1</sub> +0.327F <sub>2</sub>
	Cost	3.000	23.077	100.00	Cost=0.945F <sub>1</sub> +0.327F <sub>2</sub>
XP (PE)	Booting speed	8.016	61.658	61.658	Booting speed =0.995F <sub>1</sub> +0.0090F <sub>2</sub> -0.0117F <sub>3</sub>
	Cost	2.392	18.404	80.062	Cost =0.206F <sub>1</sub> +0.801F <sub>2</sub> -0.249F <sub>3</sub>
	Ease of Installation	1.320	10.155	90.216	Ease of Installation =0.995F <sub>1</sub> +0.0090F <sub>2</sub> -0.0117F <sub>3</sub>
NT	Booting speed	8.547	65.748	65.748	Booting speed =0.833F <sub>1</sub> +0.471F <sub>2</sub>
	Cost	3.431	26.393	92.141	Cost=0.924F <sub>1</sub> -0.374F <sub>2</sub>
CE	Booting speed	13.000	100.000	100.00	Stability=1F <sub>1</sub>

The factors examined are consequent upon user's responses regarding reasons for their preference of one Windows Operating System version over others. The table shows how the contribution of each of the factors examined can be measured in relation to the general performance of each of the of the windows operating systems. The first principal component is used in Table3.2. Using the Kaiser criterion, the following variables were retained as factors: processor speed, booting speed, ease of installation and stability. The following summarize the results of Tables 3.1 and 3.2.

a. Win '98 and CE were both explained by a common set of factors (processor speed and

booting speed respectively. Win '95 has a cumulative % variance of 76.924 (explained by the Processor speed), Win CE has a cumulative % variance of 100.00. This shows that Windows CE is perceived to have a higher overall performance than Win '95.

b. Win 2000, Win ME, Win XP (HE) and Win NT, all built along the NT chain, were all explained by two factors: booting speed and cost. Their individual cumulative % variances are 88.531, 90.205, 100 and 92.141 respectively. It shows that of the Windows Operating Systems built along the NT chain, Win XP (HE) is

adjudged to have the highest overall performance, followed by Win NT, Win ME, while Win 2000 has the least.

- c. Win '98 SE, Win '98 FV and Win XP (PE) were also explained by three common factors: booting speed, ease of installation and cost. Their individual cumulative % variances are 94.458, 94.458 and 90.216 respectively. It is clear from these figures that Win '98 (both versions) with the same cumulative % variance outweigh Win XP (PE) in overall performance based on the three factors. This has also been established in the test carried out by Scoot Spanbauer [2001].

#### 4.0 CONCLUSION AND RECOMMENDATIONS

The study shows that the general performance of Windows Operating System is co-determined by the processor speed, booting speed, cost of purchase and maintenance, and ease of installation. Also, each successive Windows Operating System is an improvement over the previous versions. However recent versions tend to compromise stability and efficiency for effectiveness (robustness). For instance, Windows ME and Windows '98 are easier to install than Windows 2000 and less crash-prone than Windows ME. Windows XP is Microsoft's biggest Operating System upgrade in recent years. In addition, some of Windows Operating Systems are application specific. For instance, Windows 2000 and Windows NT are mainly server based, Windows CE is mainly for laptop computers and wireless communication devices, while Windows '95, '98, ME, and XP are meant for general purposes

Most computer users in Nigeria prefer Windows '98, even for their Ethernet connections. This is explained by the fact that Windows '98 seems to be the least crash prone Windows Operating System especially in an environment that suffers from frequent power outages. Nigeria as a developing country, has a poor electricity system. Equally, majority of the users are not able to afford an Uninterruptible Power System (UPS). It therefore becomes imperative that Windows Operating System developers should make recent upgrades of Windows Operating System more resistant to corruption resulting from frequent power outage. This is more imperative, considering the fact that Nigeria and other developing countries rank very high in the patronage of Microsoft Windows Operating Systems.

Since most users are novice about the rationale behind Windows Operating Systems Versions, confused about its selection, there is need to curtail some of the problems associated with Windows Operating System conversion (especially data loss and time wastage). As manufacturers eagerly strive to satisfy new user request by upgrading, there should be care in determining the frequencies of such upgrades as users tend to relate such frequencies to marketing motives.

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