ASEE 2014 Zone I Conference, April 3-5, 2014, University of Bridgeport, Bridgpeort, CT, USA.

Operating System and Decision Making

Hussain A. Alhassan
Department of Computer Science & Engineering
University of Bridgeport
Bridgeport, CT, USA
halhassa@my.bridgeport.edu

Dr. Christian Bach
Associate Professor, Department of Engineering
University of Bridgeport
Bridgeport, CT, USA
cbach@bridgeport.edu

***Abstract*—The diversity of operating systems offer users more options to choose. The point of this study is to understand the aspects that affect the decision with respect to user's background and what core factors drive their choice of operating system. There are five elements that need to be considered before making a decision. The following factors and model were developed based on literature reviews on convenience, capability, security, interface, and recovery. Those elements and model provide rich prospective on acquiring an operating system for an organization based on surveys and analysis. The market is affected by customer satisfaction. Meeting consumer needs is a way to improve business and they can be met through many aspects such as education, prices, simplicity, support, and security. We evaluate the factors, and mention several minor causes based on people's motivation and company philosophy. Reading the result, which lead people's choice of operating system, and suggest some ideas to help normal users to understand the point of view from the designer's perspective about the operating system. Manufacturing policy and market influence contribute to operating popularity and spread. The paper represents a general view about the most famous operation system, taking into consideration both advantages and disadvantages.**

Keywords—Operating System (OS); performance; security; interface; capability.

I. Introduction

An operating system is software which has a wide range of definition and is considered as a bridge between human command and hardware response. In layman's terms, an operating system may best be summarizes as the spirit and mind which makes objects made of silicon and wire come alive on the screen. It can be as basic as software interacting with simple hardware installed in kids' toys. What complicates operating systems is that it has the capability to respond to human command which is called intelligent operating [1]. Since there are many operating systems invented to perform certain tasks, our paper focuses on operating systems which work on computers, whether it is a personal computer or a mainframe computer [2].

There are many operating systems developed in the world; some of them are for private at home or school, some are for government use, such as in the military, while others are distributed in the marketplace on a wider scale for businesses. The most well known released operating systems are Window, Mac, UNIX, and Linux. Users pick out the operating system they want based on experts' recommendation, their background experience, and their needs [3] .

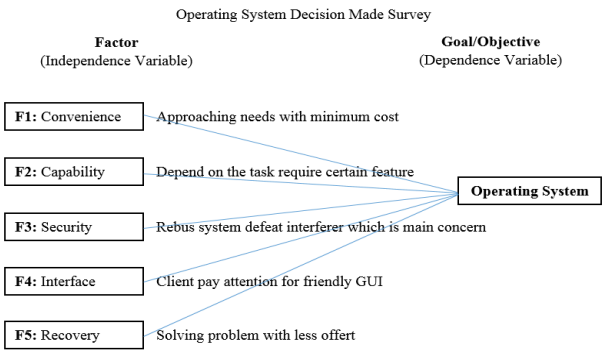
Operating systems are categorized in many sublayers due to the provider. As a consequence, each operating system has a strong and weak side which makes it unique and diverse; these minute elements of diversity distinguish them from their competitors. However, many elements play a major role that affect people's denervation. These factors generally include: user-friendliness, cost, support, confidentiality, integrity, capability, and availability [4].

II. Research Method

Research papers are assessed based on the source of information. University of Bridgeport provide its members whether, they are faculty members or students, access to thousands of digital resources via digital library [5]. Digital libraries have permission to access a collection of articles, journals, and books which gain access to secure databases, such as IEEE Xplore, ScienceDirect, and Routledge Encyclopedia of Philosophy. The academic needs of students and faculty are taken into account when considering which databases to purchase rights to and, then, make accessible to the University's population [6] .

This method of research has led to a precise understanding about comprehensive factors behind people's decisions toward an operating system after analyzing data according to technique suggested by LePine [7]. This paper represents the new vision-inspired user based on evaluating the elements according to Irani's example [8] .

III. Model



- FACTOR 1: Clients concern about the advantages and the disadvantages of an operating system is based on their needs. For normal users, it is focusing on an application which works with an operating system. Secure operation motivates business consumers to ensure the information is protected from adversary intruders [9]. People naturally tend towards convenience. Many average users like to own an operating system that is well known and available most places. This is in order to avoid confliction and better facilitate replacements and trouble-shooting help when needed [10] .
- FACTOR 2: Processing graphic demands, robust Circuit Process Unit (CPU), and comparison with the compiling programs require enough Random Memory (RAM). Having enough memory to store and perform all tasks efficiently is important to most users. However, certain operating deals with hardware are better than other operating systems which make them unique and different [11].
- FACTOR 3: Security level is one side of an effective decision, and it ranges from personal use to business managing. Sometimes the operating system is known for a high standard of security which may compensate for small shortcomings in features and flexibility. As a consequence, the operating system is not secure enough. In this case, a third party third party may provide a security application, such as Norton [12].
- FACTOR 4: Graphic User Interface (GUI) delight people's senses because visualization is a language that can be understood by a normal operating's user. When consumers are skillful, they look at interface as minor issue. They see themselves with a command screen where they can interact deeply with the machine [13]. Therefore, the ascetics of a machine are judged based on the user's needs and level of expertise, in most cases.
- FACTOR 5: Format is the last solution that users want to go with because they do not want to lose their data. Some operating systems need to be renewed for many reasons and some of them are to get rid of a virus, or systems start too slowly [14]. The older models of operating systems have added new features to recover without using a Compact Disc (CD). Other operating systems are stable and have capabilities to restore documents internally through the operating system itself [15].

IV. Operating System

A. UNIX

In 1969, a group at AT&T developed a small operating system with a limitation function at Bell Labs. They called their innovative new system UNIX. The UNIX operating system has been on the market over the past 44 years. They wrote it in C programming language, and UNIX has the capability to run on both Macintosh and Personal Computer (PC) [16]. After that, UNIX became a robust operating system for the multiuser computer to do multitasking, and many companies ran their business depending on UNIX's reliability. UNIX became the backbone for running businesses and many applications such as e-commerce and managing phone systems [17].

Many operating systems are root built based on UNIX with some modifications and developments, and some of them are Macintosh, Windows, and Linux [18], but UNIX is an open source, working with the developer community. UNIX has many versions such as UNIX 93, UNIX 95, UNIX 98, and the latest version is UNIX 03. UNIX is a powerful operating system used to do complicated tasks, where programmers need to work with command line, even if it has a graphical user interface. Because of that, UNIX is categorized for serious programmers using shell interface. UNIX is so sensitive to mistakes because it's hard even for an expert user to debug the mistake easily [19], which requires high patience and plenty of time.

B. Windows

Window is an operating system developed by the Microsoft Corporation as closed-source and they launched the first version on November 20, 1985 [20]. Which is one year after Apple released their first operating system. It is based on the Disk Operating System (DOS) system which is well known as the black screen and command line. Microsoft dominated the market of operating system after they released Windows 95. This new domination of the operating system world was held (and, many would argue, still is) for many reasons [21]. Windows 95 was the first version that had the Graphic User Interface (GUI) in front and the DOS in back, and it was considered a revolution for a non-computer person because they can interact graphics instead of memorizing commands [22]. It was a cheap operating system compared with the others which cost $50. It had capability to be installed on any computer, built by any manufacture.

Since that time, they have kept their success [23], and they have adapted the style of releasing operating systems for every other year. The last operating system that was released on October 26, 2012; it is called Windows 8 and is a personal operating system. Each windows operating system has many versions such as student, home, professional, unlimited, and enterprise version [24]. These distinctions lead to users being able to choose the system that best fits their unique needs. They released another type of operating system for servers in 2003. With an enterprise and home edition, they named them Server 2003 or Home Server, respectively. Currently, their share of the server market is approximately a massive sixty four percent.

Hardware industries compete to develop computer parts by trying to achieve optimization of performance because windows operating system does not band with specific manufacturers. Some of manufacturers are well-known because they do global business [25] such as Dell, Asus, Toshiba, Acer, and HP. These global brands all sell personal computers and servers for big companies, and they are taking the middle layer between Microsoft Corporation and Client.

They provide the Client hardware, customer service, and a warranty. Also, local stores with basic knowledge can build computers and install Windows. Because of competition, industries release a series of same parts with the latest technology within a short period of time; sometimes this can be within a year. That leaves the option for users to build their computer [26] based on their budget and needs. It also gives people the resilience to upgrade their machine inside, out from screen to motherboard with certain rules. As a consequence, gaming people favor Windows because they can upgrade the newest video card without needing to change whole body [27].

Coherence of parts to an already built computer are not always promised. Users can feel operating response smoothly with manufacture device, and awkwardly with other industry product because Microsoft released their operating system based on general requirements, not based on quality. After a certain period of time Windows looses its performance due to overrides of an application and folder, so it has to reformat to get rid of unwanted data [28] .

C. *Macintosh*

Apple Company is considered as a strong competitor for Microsoft Corporation. They were the first company to release personal computers that run via their operating system with GUI. On January 24, 1984s consumer were able to use a mouse to move the arrow and perform an action based on button clicked. Their machine was called Macintosh which nowadays people recognize as MAC [29]. Apple counts the pioneer company which produce personal computer, while International Business Machine Corporation (IBM) aim business class. Their target was home and education. Also Apple operating system is a closed source.

Apple is considered the first company that sells their operating systems [30] which are installed into and are compatible only with their machine. They developed their machine while developing their operating system which makes them unique, and they could be known as pioneer of new computer and laptop design which has been imitated by many other manufactures. For example, Mac Air and Mac Pro [31] quickly became copied after their release for their sleek design and lightweight feel. Their latest operating system was released on July 25, 2012. It is called OS X Mountain Lion and is considered the cheapest operating system, as closed-source, which serves their personal computer. Furthermore, they offer server operating systems based on UNIX as a combination between the closed source and open source components. It was released on September 19, 2012 [32] .

Apple had dealt with Motorola that produced a special process. While working on Mac, Apple modified their operating system to work smoothly only on their machine. That caused limitation to be spread worldwide [33]. Compared with other operating systems, this factor makes a Mac OS limited, because consumers could not buy different machines that were built by manufactures such as Dell, HP, and other companies and use these computers with Apple's operating system [34]. On the other hand, Apple is successful in providing their customers with high quality machines running with a stable operating systems. Their product is recognized as a powerful bundle of operating systems, and hardware supporting Multimedia, because they apply new designs of multi-core processers that rapidly execute the task, and support graphics application to give excellent framework. As a consequence of that, most photographers and film makers prefer the Mac machine [35].

New generations start to be touched by the Apple brand after Apple released iPod fifth generation on October 25, 2005. Besides, Apple has an elegant design that makes their device outstanding and it drives other company to remodel [36] their product. Apple's customers have an opportunity to experience Apple's products in Apple's store before they decide to buy them [37]. Customers have the advantage of Apple stores, which are distributed around the world, when they want to buy new device, fix their device, or ask questions. Moreover, Apple's teams are well trained to advertise Apple's product so they are capable of giving an oriented course for customers [38]. On the other hands, customer see Apple's products as quite expensive compared to the prices with other manufactures, and upgrading their product only can be done inside their store, otherwise devices will lose the warranty [39] .

D. *Linux*

In 1991, a new operating system launched by Linus Torvalds, who was a computer science student at University of Helsinki in Finland; it is named Linux. Linux operating system was based on Unix [40], C and C++ programming language [41]. When Linux launched, it was planned to be open source operating system, but it attracted many developers worldwide to contribute in development. Moreover, Linux is available to download and it does not require a license to install because it is a free operating system for individuals to use, but if an organization wants to have it, they have to pay for Linux organization fees [42] .

Linux is a powerful and unique operating system compared with other operating systems, such as Windows and Macintosh. Moreover, installing Linux in a machine is simpler than with other operating systems, such as Windows and Mac. Many programmers have preferred a Linux-based project for many years. The developer counts the Linux operating system as friendly [43] working to be developed and writing application code through an accessing network. It does not require the latest hardware material, so it could be installed and give life to old computers. Besides, many programmers have a favorite Linux operating system because it support multi-processing [44].

Linux developed a variety of organizations and they release modified versions under their name after Linux distributed their software as package in late 1990 [45]. Some of organizations are well known such as Red Hat, Gentoo, Debian, SuSE, Turbolinux, and Ubuntu. Besides, tremendous numbers of industries support Linux such as Dell, Oracle, IBM, AOL, Compaq, Netscape, Intel, Informix, Sybase, Silicon Graphics [46], and Sun. In the market, Linux was not widespread among ordinary people compared to Macintosh and Windows for many factors. It required programming skills to run any application because it was based on command text

environment. Nowadays, Linux has become a strong competitor of other operation systems [47] due to many organization developers implementing Graphic User Interface (GUI). Because of that, Linux has become easy for a user who is not a programmer by allowing them to interact with graphics more than commend lines.

As a powerful operating system, Linux is also a light operating system running into a machine which does not require a powerful process [48]. A comparison of Linux with Windows is that Linux quite rarely crashes which is known in Windows as blue screen or that Windows usually goes down because of over load. In terms of paying hundreds of thousands dollars to protect data from being leaked or attacked via adversary [49], users could have that free in the market of Linux whereas with Windows you need to pay for it. Linux has very strong firewall which makes Linux undefeatable in terms of attacks. It has a unique technique for reducing virus activity. The rate of malware is less in Linux compared with Windows' operating system because the designer targeted to attack a large number of computer users. Besides, spyware and viruses designed for Windows cause it to slow down, and as a consequence, the performance of the operating system is reduced [50].

Hardware drives have been added to the new version of Linux to setup primary elements of computers such as wireless cards, monitors, and secondary devices such as printers, scanners, and other similar things to the Windows operating system. These are generally referred to as "plug & play." These can offer advantages. For instance, users can save money, even hundreds of dollars, and get most of the applications free, in relatively easy to install programs. On the other hand, users find disadvantages to Linux where many applications are not being designed to run in Linux or not exist in Linux, such as iTunes and Microsoft program. This is considered as an obstacle to people who care about applications and do not want to replace their whole operating system just to have a "plug & play" application that they desire. It takes time for some people to be familiar with and learn Linux's many advantages and its limitations [51].

V. Evaluation

Results show that the majority of people choose the Windows operating system when they are a new user of operating systems. They find it easy to work with, it has a friendly graphic user interface, and a new user could buy a cheap computer where Windows is already installed. Besides, Microsoft is doing well in advertisement. Because of those reasons, some people keep using Windows even if they are aware of weakness in stability and sometimes the security issue.

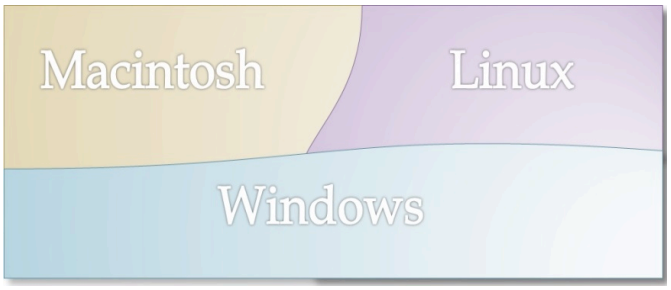


Fig. 1. Most famous Operating System in the Market.

When people go deeper and gain more skills dealing with operating systems, they look for advanced features. If they want to be close to the machine language, and they plan to use assembly language, they would rather use Linux operating systems because it gives them more flexibility compared with other operating systems. Sometimes their interests force them to gravitate to a certain choice. If they are a photographer, they will favor a Mac operating system, where they can get high quality of pictures, due to powerful CPU, and supporting applications.

Fig.1 The graphic summarized the competition between the operating system producers, and their size serving the user, where Microsoft is the owner of Windows operating that occupied approximately fifty percent of the market, and Apple is the owner of Macintosh, and Linux share the another half of the market.

VI. Conclusion

Operating systems are invented to reduce human effort and can save time. Our focus on Operating Systems (OS) relates to the computer machine, and our result of analysis shows there is no one single good or bad operating system. The target was to expand user understanding of the variety of systems. If their concern is about security, and stable operating, the Mac, and Linux can be the best choice; their security rating is high. Moreover, in terms of application and availability, Windows and Mac are the leaders in the market; they are supported by millions of developers. When users are concerned about the latest technology of hardware, Linux, and Windows operating systems can fit in the category. Besides personal knowledge of computers, after carefully analyzing the leaders of the industry, we may conclude that the main determining factors in choosing an operating system are user requirements and their intended use of the operating system itself.

References

[1] P. L. Ackerman, K. R. Bowen, M. Beier et al., "Determinants of individual differences and gender differences in knowledge," Journal of Educational Psychology, vol. 93, no. 4, pp. 797, 2001.

[2] T. Chiba, Y. Itami, M. Yoo et al., "A Distributed Real-Time Operating System with Location-Transparent System Calls for Task Management and Inter-task Synchronization." pp. 1133-1138.

[3] L. Hongjuan, and L. Yuqing, "A Design of Trusted Operating System Based on Linux." pp. 4598-4601.

[4] G. Martinovic, J. Balen, and S. Rimac-Drlje, "Impact of the host operating systems on virtual machine performance." pp. 613-618.

[5] H. K.-H. So, and R. W. Brodersen, "Improving usability of FPGA-based reconfigurable computers through operating system support." pp. 1-6.

[6] L. Zhou, H. Li, W. He et al., "Scheduling non-periodic tasks using sporadic server in AUTOSAR Operating System." pp. 315-321.

[7] M. Archer, E. Leonard, M. Pradella et al., "Modeling security-enhanced Linux policy specifications for analysis." pp. 164-169.

[8] P. De, R. Kothari, and V. Mann, "Identifying sources of operating system jitter through fine-grained kernel instrumentation." pp. 331-340.

[9] R. J. Huebsch, R. J. Prieve, and L. Kampa, "System and method for multiplexed data back-up to a storage tape and restore operations using client identification tags," Google Patents, 2002.

[10] B. P. Miller, L. Fredriksen, and B. So, "An empirical study of the reliability of UNIX utilities," Communications of the ACM, vol. 33, no. 12, pp. 32-44, 1990.

[11] S. Surisetty, and S. Kumar, "Is Apple's iMac Leopard Operating System Secure under ARP-Based Flooding Attacks?." pp. 60-64.

[12] L. Zhu, M. Zhang, Y. Huang et al., "Formalizing Application Programming Interfaces of the OSEK/VDX Operating System Specification." pp. 27-34.

[13] D. Bailey, K. Gribbon, and C. Johnston, "GATOS: a windowing operating system for FPGAs." p. 5 pp.

[14] D. Gohringer, M. Hubner, E. N. Zeutebouo et al., "CAP-OS: Operating system for runtime scheduling, task mapping and resource management on reconfigurable multiprocessor architectures." pp. 1-8.

[15] S. Kim, F. Liu, Y. Solihin et al., "Accelerating full-system simulation through characterizing and predicting operating system performance." pp. 1-11.

[16] J. Pardo, J. Campelo, and J. Serrano, "Robustness study of an embedded operating system for industrial applications." pp. 64-65.

[17] J. Wang, G. Gu, S. Xie et al., "Design of Smart Phone-Oriented Embedded Real-time Operating System." pp. 758-763.

[18] S. Beyer, R. Taylor, and K. Mayes, "Operating system support for dynamic code loading in sensor networks." pp. 5 pp.-315.

[19] D. Golub, R. Dean, A. Forin et al., "Unix as an application program."

[20] J. J. Lee, and V. Mooney, "Hardware/software partitioning of operating systems: focus on deadlock detection and avoidance," IEE Proceedings-Computers and Digital Techniques, vol. 152, no. 2, pp. 167-182, 2005.

[21] S. Pravin, and R. BalaKrishnan, "Set top box system with android support using Embedded Linux operating systempaper." pp. 474-478.

[22] L. Xing, L. Yan, C. Mian et al., "The Testing and Evaluating System for the Security Operating System Based on the Mechanism of Keyword-Driven." pp. 471-474.

[23] H.-y. Zhou, F. Wu, and K.-m. Hou, "An event-driven multi-threading real-time operating system dedicated to wireless sensor networks." pp. 3-12.

[24] A. Borg, W. Blau, W. Graetsch et al., "Fault tolerance under UNIX," ACM Transactions on Computer Systems (TOCS), vol. 7, no. 1, pp. 1-24, 1989.

[25] R. Gulbranson, "UNIX-A Solution to the Conpatibility Problem," Nuclear Science, IEEE Transactions on, vol. 30, no. 5, pp. 3731-3734, 1983.

[26] H. Li, C. Yin, Y. Xu et al., "Construction of the Practical Teaching System on Operating Systems Course." pp. 405-408.

[27] P. J. Roy, D. B. Noveck, and W. J. Bryant, "State management in a distributed UNIX system." pp. 170-179.

[28] Z. Xiong, M. Zhang, S. Li et al., "Virtual embedded operating system for hardware/software co-design." pp. 939-943.

[29] H.-Y. Zhou, and K.-m. Hou, "LIMOS: A lightweight multi-threading operating system dedicated to wireless sensor networks." pp. 3051-3054.

[30] F. Buendia, and J. Cano, "WebgeneOS: A generative and web-based learning architecture to teach operating systems in undergraduate courses," IEEE Transactions on Education, vol. 49, no. 4, pp. 464-473, 2006.

[31] W. Guoqin, and X. Meihua, "Research on Tightly Coupled Multi-Robot Architecture Using Microkernel-Based, Real-Time, Distributed Operating System." pp. 8-13.

[32] S. Liu, "Research of operating system virus defense strategy." pp. 3419-3421.

[33] N. A. Rumman, "Operating System Support for Multimedia: Survey." pp. 30-34.

[34] L. Teo, and G.-J. Ahn, "Towards the specification of access control policies on multiple operating systems." pp. 210-217.

[35] S. Cahya, "Designing Operating System Simulator: A Learning Tool." pp. 156-160.

[36] M. Hasan, and S. Ahmad, "Development of a highly optimized Preemptive Real Time Operating System (pRTOS)." pp. 52-55.

[37] W. Liu, X. Li, W. Huang et al., "OSISS: An operating system integrity surveillance system based on VMM." pp. 546-549.

[38] M. D. Santambrogio, V. Rana, and D. Sciuto, "Operating system support for online partial dynamic reconfiguration management." pp. 455-458.

[39] A. S. Tanenbaum, J. N. Herder, and H. Bos, "Can we make operating systems reliable and secure?," Computer, vol. 39, no. 5, pp. 44-51, 2006.

[40] C. Centioli, F. Iannone, G. Mazza et al., "Open source real-time operating systems for plasma control at FTU," Nuclear Science, IEEE Transactions on, vol. 51, no. 3, pp. 476-481, 2004.

[41] J. N. Herder, H. Bos, B. Gras et al., "Construction of a highly dependable operating system." pp. 3-12.

[42] G. N. Meira, A. A. Frohlich, and A. Hoeller Jr, "Real-Time Dynamic Voltage Scaling for the EPOS Operating System." pp. 65-70.

[43] K. Srinivasa, H. Raddi, S. Mohan Krishna et al., "MeghaOS: Cloud based operating system and a framework for mobile application development." pp. 858-863.

[44] S. Narayan, S. S. Kolahi, Y. Sunarto et al., "Performance comparison of IPv4 and IPv6 on various windows operating systems." pp. 663-668.

[45] W. Chengjun, "The analyses of Operating System structure." pp. 354-357.

[46] L. Huan, L. Hang, and Y. Xia, "Access control technology research in embedded operating system." p. 7 pp.

[47] H. Momeni, O. Kashefi, and H. Sharifi, "How to Realize Self-Healing Operating Systems?." pp. 1-4.

[48] M. Jasiunas, A. Chakraborty, and D. Kearney, "A distributed operating system supporting strong mobility of reconfigurable computing applications in a swarm of unpiloted airborne vehicles." pp. 392-398.

[49] D. N. T. INSIGHT, "EDITORS'COMMENTS: DEVELOPING NOVEL THEORETICAL INSIGHT FROM REVIEWS OF EXISTING THEORY AND RESEARCH," Academy of Management Review, vol. 35, no. 4, pp. 506-509, 2010.

[50] R. Goeckelmann, M. Schoettner, S. Frenz et al., "A kernel running in DSM-design aspects of a distributed operating system." pp. 478-482.

[51] Y. Cui, Y. Wang, Y. Chen et al., "Experience on comparison of operating systems scalability on the multi-core architecture." pp. 205-215.