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Decision Making Model to Select the Best Operating System- based PC

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ABSTRACT

Today, computer technology has come a long way from the days of desktop machines to portable computers (PCs). Due to their size and construction, the desktop machines lost their popularity to the laptops (PCs) which are by design, smaller, compact and therefore portable. This brought a big change in a student's or a professional's mindset because, now they can work or study from wherever they are. The PC industry ever since revolutionized to an extent that today, we have a plethora of buying options between laptops and notebook computers. With Apple's innovation of the MacBook, it became the best-selling notebook computer of any brand around the globe. This project intends to use a decision model to determine which is the best-operating system based PC when a buyer encounters a conflict between a Windows, Macintosh or Android based portable computers like the laptops and notebook computers.

The decision model for this study is developed using the Hierarchical Decision Model and all the decision elements of this model are decided through literature search. An expert panel is approached to assist in the decision making and their preferences in the form of weights to all the elements in the model are collected to analyze and arrive at the final results. The analysis of this data shows that the Macintosh based MacBook is preferred more than the other two operating system–based PCs. It is also found that the device integration and security are the most important factors to be considered when making this decision.

This study considers only three kinds of operating systems that could be used for universal purposes in different fields. Therefore, further studies could be carried out to include a broader variety of operating systems and restrict to specific purposes.

1. INTRODUCTION

1.1. Overview of Portable Computers (PCs)

The computer technology industry has witnessed remarkable advancements ever since the introduction of the first computer. After the first personal computer was developed, gradually the need of portability and convenience was also realized. In 1981, the first mass produced portable computer, Osborne1 was invented that included most of the productivity software which proved beneficial (Wilson, 2006). This breakthrough led to the evolution of phenomenal innovations in the decades that followed and today, portable computers are available to the users in various forms like laptops, PDA's, notebooks and tablets. Apart from being compact, lighter and smaller when compared to the desktop computers, the portable computers (PCs) are equipped with high performance features, storage capacity and capable of performing multi-tasks (Nasir, et al., 2006). Today, they are not only used in businesses, government, academic institutions and commercial applications, they have become an integral part of our lives because of their profound uses and convenience.

1.2. Overview of Operating Systems (OS)

The rapid developments in the fields of engineering and technology have led to impactful innovations like the PCs and this includes the laptops and notebook computers. The features that distinguish them are hardware design, processor speed, memory and other multiple components. Another most important component to run such devices is the operating system (OS). An operating system (OS), is a fundamental component of any computer system (Subbarao, 1994). It acts as an intermediary between a user and the system and manages all the operations of the system's hardware devices that makes it easier for the associated programs to function. Nearly every device like desktops, laptops,

notebook computers, supercomputers, tablets, smart phones or even video game consoles use some type of operating system. And today, one could also choose between different operating systems to configure their devices.

The two main drivers between revolutionizing the PC industry are globalization and the technological advancements in an unimaginable pace (Dedrick, et al., 2000). In today's age when the key indicator of success is productivity and individuals prefer working faster and more efficiently to keep up with the competitive world, the highly advanced portable devices prove extremely beneficial for professionals to work from anywhere and anytime. At the same time, professionals from various fields, academicians, researchers and students face with the challenge of selecting the best laptop or notebook computer that suit their needs as they have to consider innumerable manufacturers and key criterion before making the final purchase (Belanger, 2000). This paper aims at creating a decision model with selected criterion and perspectives based on the best operating system that will assist the professionals and students to effectively make the decision of buying a PC which greatly impacts their lives.

2. RESEARCH OBJECTIVE & SCOPE

2.1 Objective

The recent tremendous advancements in the design and development of the portable computers have increased the competition among the manufacturers to come up with products that consist of features and capabilities unique and advanced when compared to its competitors. In this way, we have laptops and notebook computers that outrank each other in terms of weight, hardware design, processor performance, operating system, user interface, peripheral specifications, physical features and connectivity. These features challenge the users who are at the receiving end when they have to decide a product that meets all their demands.

The main objective of the project is to assist professionals, academicians and students in their decision of selecting the best and most conducive operating system based PC. This is achieved by defining and optimizing a decision model using the Hierarchical decision method. This study also aims at analyzing the decision-making process which involves a panel of experts. The study will conclude with a discussion on the final results acquired through the judgements given by the experts.

2.2 Scope

As discussed in the previous section, the objective of this study is to achieve the result of the best operating system based PC. After analyzing the objective to be achieved, numerous operating systems were listed down that are considered to configure the laptops or notebook computers. The examples are different versions of Windows OS, the Macintosh OS by Apple, Android, Linux, Chrome OS, Ubuntu, Fedora, Remix OS, Meego platform and so on (Raymond, 2003). But among these different operating systems, only

those were considered as alternatives, which proved to be a stand-alone operating system for all the needs of the user. Therefore, as part of a narrowed approach, only three operating systems were finalized and other excluded from the list. It was decided to focus only on Windows, Macintosh and Android operating systems. But a detailed study is performed to analyze the all criterion that will influence the user's buying decision. The alternatives and the criterion are discussed in the further sections of this paper.

3. RESEARCH METHODOLOGY

A literature review of the hierarchical decision model (HDM) is followed in the process of developing the decision model in this study. After the final analysis of the criterion and the alternatives, the model is developed and the expert panel is involved further to conduct pairwise comparison in each level of the model. The study will present the final calculations on the weightings of each criteria and alternative given by the experts.

The hierarchical decision model (HDM) is a multi-criteria method that allows to model complex problems in a hierarchical structure. HDM was developed by Prof. Dundar F. Kocaoglu in 1979 using a pairwise comparison scale and judgmental quantification technique (Kocaoglu, 1998). Later, he developed a more general form of the HDM, with Dr. Cleland in 1981 which consisted of five hierarchical levels as Mission, Objectives, Goals, Strategies, and Actions (Kocaoglu, et al.,2008). These levels are flexible to be incorporated and related to the requirements of any cases under study. Also, the complexity of the decision problem is determined by the number of hierarchical levels.

When following the hierarchical decision modeling, the problem under study is first decomposed into a hierarchy of levels to be easily comprehended and analyzed independently. Each level in this hierarchy will comprise of decision elements, which

relates to any aspect of the problem under study. The decision elements in each level are connected to decision elements that reside on the levels above and below. The objective is always placed at the top of the hierarchy followed by the criteria and the sub-criteria in the second and third levels respectively. The potential alternatives reside at the bottom of the hierarchy. Additionally, this method also implements several techniques to analyze the data acquired during the judgement process. These techniques are judgement quantification, pairwise comparisons, inconsistency, disagreement analysis, sensitivity analysis, desirability curve and HDM validations. Overall, this method is an effective way that assists decision makers to break down the problem in a simpler way and also assists in synthesizing a large amount of information at different scales along with converting the judgments into data for that allows quantitative decision makings in different fields.

In this study, the HDM decision model will be used with judgement quantification, pairwise comparison, inconsistency and disagreement analysis.

4. DATA AND DATA SOURCE(S)

4.1. Experts

In order to solve complex problems and finding appropriate solutions and successful decisions often requires high technical knowledge and considerable experience. Due to the complexity of the problem in few cases which impede right decision making, additional inputs are acquired from a group of individuals belonging to different disciplines who are equipped with knowledge and experience. This group of individuals can be called the “Expert panel” (Steyeart et al., 2005). This study uses a panel of seven experts that belong to the technological field and aware of the current advancements in engineering innovations. Two experts have an engineering background with valuable experience in

the semi-conductor industry and five other experts are also engineers by profession and simultaneously pursuing academic studies.

4.2. Criteria

A comprehensive literature search is performed on the decision elements so that the experts could be provided with all the information related to the criteria, sub-criteria and alternatives for them to deliver their comparison and judgements.

1. Features:

It is very essential that we understand the features of an individual operating system (OS) as it plays a major role in deciding what operating system anyone can bank on. These features deal with data management where one can store the data on a secondary device such as optical drive and modify the data whenever they wish to. It includes networking with other devices where data packets are sent/received by just dragging it from external devices (Silberschatz, 1998). Another important feature of an OS is how well can it handle multiple tasks at the same time and how does it prioritize the active jobs. The PCs and notebooks are used in various businesses, for example, medical industry wherein the OS should be integrated and compatible with medical equipments and should be user friendly. This helps the hospital to manage data for various purposes like documentation, patient history etc.

1.a) Device Integration and Connectivity: The most versatile feature of Device Integration is connectivity among various products. The feature of connectivity to move seamlessly between devices such as cell phones, tablets, laptops, smart wearables is one of the most useful features of today's technology known as "Continuity". Features such as receiving calls/messaging/Phone call forwarding without actually handling cell

phone, editing documents in one device and continuing it another, activating the cell phone hotspot without taking it out of your pocket are few examples of continuity.

1. b) User Interface and Display Screen: Having great features and a powerful program will be useless if it's not user friendly and poorly designed. And this feature depends on numerous input devices and softwares used. User interface is defined as use of commands to communicate with the program (Jeffries, et al.,1991). There are two types of interface sets, a menu driven and command driven. A command interface is where one wants the program to do what he/she want to. The menu interface is where one selects the type of command. A third type of user interface is Graphic user Interface (GUI), this type of interface includes opening the program in windows, minimizing the open windows, scroll features, arranging the icons etc. Another part of GUI that comes in a big demand is use of multimedia for creating and editing videos, sound and virtual reality pictures. For such kind of applications, display resolution is one of the most important criteria. Better the resolution, higher is the quality of motion pictures, it becomes an important part of decision making especially in use of PCs with higher resolution.

2. Security

Operating System integrity is one of the most important feature to prevent from data being stolen or hacked for personal gains. OS security encompasses confidentiality and preventative measures to protect data when attacked by viruses and malwares or if stolen (Enck, et al., 2009). OS security includes features and programs that are designed to self-lock important data files, when compromised. Most of these virus and malware impregnates when an external device is connected to the PC or via internet through various websites. Examples are Viruses, Trojans, Cookies, spyware, adware etc. There

are certain Trojan horses that can cause program threats. OS security should possess features that can carefully scrutinize network traffic and data transfer from any device. This type of OS security feature have a firewall that follows user defined rules of incoming and outgoing network traffic. Without this crucial OS security feature, one can compromise all the data within no time.

2. a) Malware and Viruses: Malware stands for "malicious software" and are designed to damage the PCs and renders the data unusable. The malware is programmed to intrude within the data, software and programs for either monitoring the activity or completely delete. The malware could be in any form like Viruses, a Trojan, or as simple as a Worm. Among the three, Virus is the most common type of security breach. It is a program designed to modify the data, replace or even delete the data. Trojans are a special kind of security threat, they neither replicate nor damage the files/program but rather open a backdoor for other various kinds of malicious software to easily breach the security. They also pose a security threat by secretly transferring all the personal information. The firewall configuration in operating system thus play a very important role and this largely depends on type of operating system used (Swain, 2009).

2.b) Privacy: Most of the viruses, malwares are executable files that comes attached with image files. Some of the adware are automatically downloaded from websites that one is browsing on. This Adware runs a program in the background and using a pop-up window advertises various industrial products, commercials. The other types of privacy breach would be in the form of spyware, spam, cookies. These spyware and spam are designed to install on one's computer without any permission. Once installed on the laptop, they keep a track of web browsing history, sites visited, products viewed, most searched sites

and automatically send all the information about users. Most of these can be prevented by using some kind of authorization, for example using time card, username/password, fingerprint, voice recognition etc. Using one time password is idle as the system generates random numbers as unique password and validates it before applying to the network settings. These can be configured with the type of OS used.

3. Software

Not all operating system can run application based softwares whether it's a business based or a gaming software. For example, running windows based softwares on MAC is a possibility by virtue of installing some additional extensions. For gamers, windows based OS is more customizable and cost effective to boost up power and graphic cards for better performance. But when it comes to any photo or video editing MAC based OS provides more features and user interface is far more superior. Availability of software for specific task becomes another limiting factor while deciding the type of OS you want to choose.

3. a) Compatibility

Some operating system do come with pre-installed user friendly apps that can perform the day to day jobs. For example, apps that can perform photo editing, a word processor, a garage band, movie editing, etc., are all preloaded with MAC OS. It is known that MAC OS have the capability of running multiple OS like Windows, Linux etc. The OS needs to be compatible opening file types saved in various formats (Lorch, et al.,1997).

3. b) Stability: Stability of an operating system and various application software it runs is the one important factor that helps to choose between available operating systems. With

all the multiple viruses, malwares and malicious softwares out there in the market, it is vital that the operating systems are stable. Stability of OS becomes an important feature when an operating system is compromised or crashed resulting in a blue screen and have to recover/restore data file, programs installed without corrupting any of the executable files. This largely depends on the type of OS installed on the laptops (Lorch, et al.,1997).

4. Cost

4.a) Programs and Accessories: Accessories vary largely depend on type of operating system, as some of the OS supports optical drives and other input devices. This becomes a deciding factor where one wants to use PCs in medical/semiconductor businesses wherein numerous input devices must be compatible with the OS embedded in the laptop. A wide variety of programs are required to perform daily tasks for example, anti-virus, PDF maker, photo edit softwares, MS package and various other softwares have to be compatible and supported by the installed OS. The cost of these software depends on the type of OS platform they are required to work on (Nasir, et al., 2006).

4.b) Upgrades and Repair Cost: One has to configure the PC depending upon on the OS he is interested to buy, by upgrading certain hardware components like type of processor, memory, optical device, speakers etc. One has to do a thorough research if these upgrades are compatible and supported by the OS installed and the cost of upgrading these components. The stability of many hardware components depend on the number of programs running in the background and this indirectly depends on type of OS and the number of programs it can run and support simultaneously. Customer support and repair cost plays another important role in deciding the type of PC one has to buy.

4.3. Alternatives:

The alternatives or substitutes that are considered in this study are Windows based PC, Macintosh based MacBook and Android based PC. The following data with respect to the criteria and sub-criteria discussed in the previous section are forwarded to the experts which will help the study to evaluate the HDM model developed.

1.Windows based- PC: The most traditional operating system is the Windows which is still popular among masses (Allen, 2008). The windows based PCs is capable of using different file formats to exchange documents and materials. But device integration is difficult due to the unavailability of suitable drivers. These drivers get released in each Windows OS version are either incompatible or include lagging. It is not possible to connect windows-based devices to phones for calling, texting. The work done on one device cannot be continued onto the windows based PC. To make calls, via, Skype or Facebook, the respective apps have to be installed in Windows based PCs. Hackers can easily target these PCs, compromising personal data because they come with third party application that are pre-installed which prove dangerous for the privacy of the user. Windows OS is highly compatible with an enormous number of programs and software. When it comes to gaming, it supports a plethora of gaming software which no other OS supports (Microsoft, 2017). But this OS based PC doesn't open MS Office, Internet Explorer, Media Player, Media Center, Windows Defender, SkyDrive, VLC media player, Chrome browser Mac-based files (.DMG) until their software/apps are installed. Windows OS runs on many types of PCs and computes due to which there are problems in hardware configurations within those devices and this is a cause of instability. The windows OS software is proprietary and therefore very expensive compared to others

(Nasir, 2006). The software program once installed cannot be reused since it comes along with an activation key that can be used only once.

2. Macintosh-based PC: The Macintosh operating system was designed by Apple during the 1980's and it was released in 1984 (Williams, 1984). Mac OS X operating system is best described by its unique features of device integration, security and compatibility. The Mac OS commendably supports device integration of MacBook with devices like the iPad, iPhone for messages and calling using iMessage, Google Talk and Facetime (Apple). The interface is extremely user friendly with effortless interaction between the system and the trackpad, keyboard and other peripherals. No third-party software or apps have to be used with the Macintosh systems since all such apps and software are pre-installed. The MacBook are prone to fewer malware. The threat of malicious software when compared to the Windows OS is also low. it has proven compatible to run other operating systems like the Windows XP, and Vista with software like parallels desktop and VMware fusion. In terms of browsing, it supports Safari, Chrome, Firefox and so on internet browsers (Lorch, et al., 1997). Supports multiple advantageous applications and in multi-lingual format like Photos, iMovie, GarageBand, One Note, App Store, iTunes, iBook, Maps, Photo Booth. It also avoids activation of programs and can be reinstalled any number of times. It supports only few gaming software that are inbuilt (Nasir, 2006). The Mac OS requires very low level of maintenance with limited occurrences of worms, viruses and spyware. Any person equipped with technicalities can perform repairs and upgrades. Local stores are always available to be contacted for repairs and AppleCare provides an extended warranty always. The system has controlled model updates which assists in its smooth operation without any lag, incompatibility providing the most stable performance.

3. **Android-based PC:**

The Android is one of the latest operating systems which is still at its nascent stage of use. The Lenovo Idea pad A10 comes with the Android operating system. This OS grew popular with smartphones allowing a touchscreen for the users and therefore most of the apps were touch based. But, the same apps are less compatible with the keyboard and mouse interface when compared to the Windows or Mac operating systems. It offers Kingsoft office similar to Microsoft office but fails in terms of robustness (Ahmad, et al., 2013). There is no support for professional applications yet. Also, the internet browsers are poorly supported in PCs. The multi-tasking is poor. The area where Android dominates is one gets a full access to the full google play music library, Play movies library of films with various TV shows and Playbook library of novels and magazines. In this case, Android out pars the other operating systems. Android OS would need more RAM and third party apps or downloads for ease of use in the PCs (Google, 2017).

5. MODEL DEVELOPMENT

The objective is defined at the topmost level of the model and as discussed in section 2, the objective of this study is to select the best operating system based PC. The second level of the model is defined by the decision elements called criteria. In this study, there are four criteria considered to break down the decision problem. The four criteria are Performance, Security, Compatibility and Cost. This level is connected to first level above and the third level below. In the third level, decision elements called the sub-criteria reside that belong to the criteria in the above level. For the purpose of this study, there are totally eight sub-criteria which are also connected to the bottom most level of the model. This is the level where the alternatives are defined. The three alternatives in this study are

Windows- based PC, Macintosh-based MacBook and the third is Android-based PC. Figure 1 shows the four-level hierarchical decision model with the decision elements at each level.

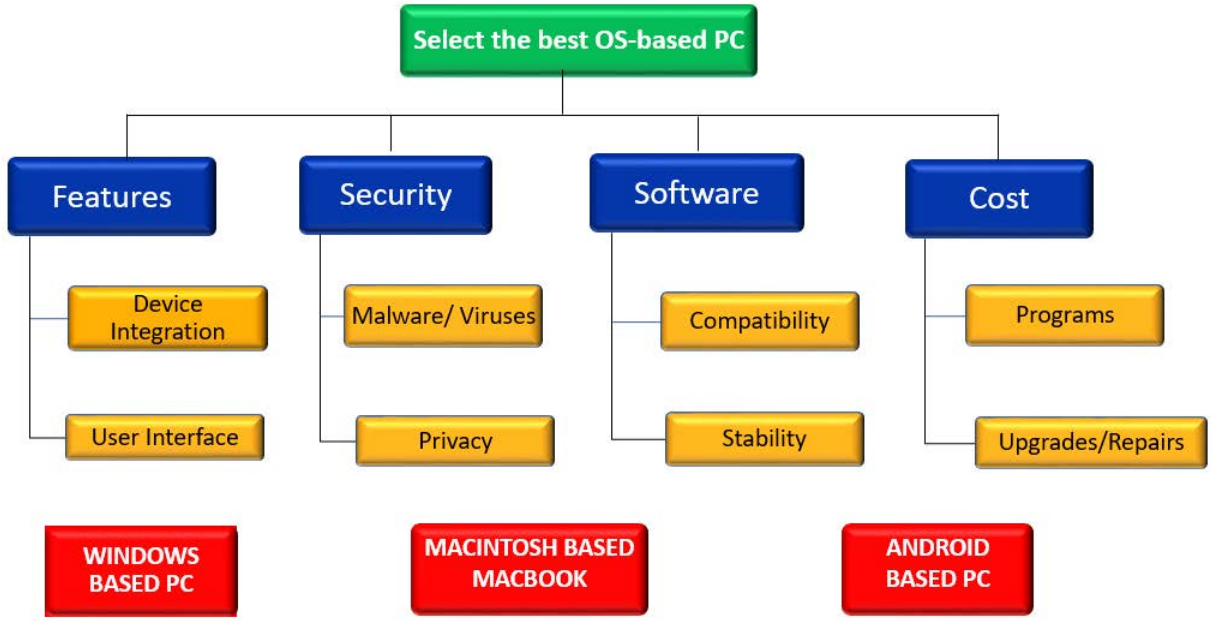

Figure 1: Hierarchical Decision Model

6. MODEL EVALUATION AND DATA COLLECTION

The model evaluation includes a process of assigning preferences or weights to each decision element in the model in the numerical form. The experts involved in the decision-making process have strong technical background and adequate experience to offer their judgements based on the selected criteria and sub-criteria. They were provided with enough literature on each of the criteria and the alternatives considered in this study so that their judgements could be both transparent and convincing. As part of data collection and by using the online HDM tool, the experts received an online link to contribute their data on the entire model. The experts were required to click on the link and perform

pairwise comparisons between the criteria, sub-criteria and the alternatives in the HDM model. Figure 2, shown below is the online HDM model as seen by the expert panel.

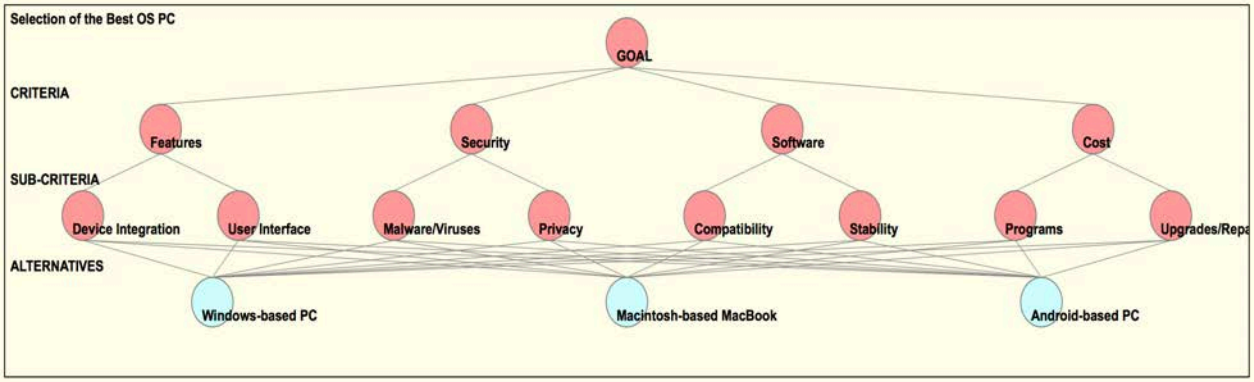

Figure 2: Online HDM Model

The steps to perform the pair-wise comparison are also included as part of the literature to the experts, following which, each of the experts would click on every node in the model and then compare each of the two criteria by assigning a value say n which lies between 1 and 99 to one of them and the software would assign a value, 100-n to the other criteria. In this way, the experts completed the pair-wise comparison on all the nodes of the model. Figure 3 shown below is an instance of pairwise comparison to be executed by the experts.

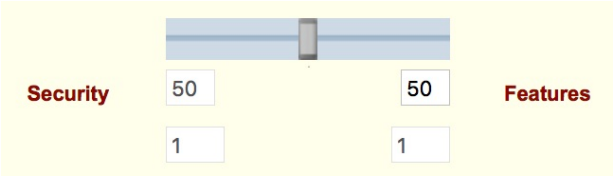

Figure 3: Pairwise Comparison

The data submitted by all the experts are collected to perform the analysis and quantification of the HDM model.

7. KEY FINDINGS AND ANALYSIS

After the completion of the model evaluation process by the expert panel, the data was collected and analyzed. The results obtained from the analysis and the distribution of weights for each criteria and sub-criteria are shown in Appendix A and Appendix B.

The key findings obtained from the above results are described below.

- The mean value of the second alternative which is Macintosh-based PC is the highest among the three alternatives with a value of 0.46. This shows that the Macintosh-based PC is the preferred product over all other PCs.
- The Windows and Android based PCs have values of 0.33 and 0.21 respectively.
- The mean values of the criteria and sub-criteria were computed by computing the average of the weights given by all the experts. It is found that the Security is the most important criteria with a value of 0.28 and preferred more by the experts when a decision of best operating system based PC has to be made.
- The second most important criteria is Features with a value of 0.27, which is very close to the value of Security criteria discussed.
- The most important sub-criteria from the results is found to be Device Integration with a value of 0.546 followed by the sub criteria, Malware/Viruses that was specified under the Security criteria with a value of 0.509.
- The table in Appendix B shows that the inconsistency in the decision making of the experts while assigning weights to all the criteria and sub-criteria is below 10% showing an inconsistency between 0 and 0.02.
- The disagreement between all the experts is also found to be less than 10% with a value of 0.061.
- The F-test value between subjects from the second table in Appendix B is found to be 13.64.

The results above prove that with very little inconsistency a disagreement of 0.06, the Macintosh based PC by Apple is preferred over Windows and Android based PCs. Also, the criteria selected to make this decision are Security followed Features. It is worth mentioning that the device integration capabilities are preferred more followed by protection from malware and viruses when making the purchasing decision.

8. CONCLUSION

In this study, the decision of best operating system based PC is made for users who are identified as the professionals that belong to different fields and businesses, academicians and students in universities and schools. And in today's market, a variety of operating systems are compatible with PCs. The most popular ones are Microsoft Windows, Linux, Android, Chrome and so on. The other most popular operating system is the Macintosh that runs only on MacBook. Though Windows based PC's are widely used for gaming, video and audio editing along with academic purposes, the Macintosh based systems are popular in the market even though they have posed certain limitations in case of cost and gaming applications. Therefore, there is a thin line of difference which makes it difficult for our users identified in the study to make the best decision. This study implement the HDM decision model and with the assistance of an expert panel and their judgements, it is found that Macintosh-based PC is the best choice among all other operating systems. Yet, the results show that Windows- based PCs are the second most preferred choice. The criteria that are most important while making the decision of purchasing a PC are found as Features followed by Security. This shows that device integration and protection from malware and security threats are the most important criteria to be considered while making the decision.

The HDM model helps in arriving at the decision that the Macintosh-based PCs have many beneficial features with high degree of device integration and user interfaces which make them unique. Also, it is extremely difficult to hack the Macintosh-based systems as Apple provides the highest level of security from malware and viruses. Therefore, it is concluded that our users should prefer the Macintosh-based MacBook over other PCs.

9. FUTURE RESEARCH

This study was conducted using a robust HDM model to help users decide the best operating system based PC. In today's age of high advancements in technology, apart from the traditional operating systems in the market, we also find operating systems which are used for specific purposes, but have limited functionalities. Therefore, for the ease of study and also to help user to derive maximum functionalities from the operating system, only three operating systems, namely, Windows, Android and Macintosh are considered. Also, the perspectives considered for the decision model are only the software component. The outer hardware design or peripherals are not included in the study. The other important consideration made is, this decision is applicable for universal uses and not specific to particular field.

With the above considerations, further research could be conducted to include different manufacturers with both software and hardware components as the decision criteria. Also, the second kind of study might be conducted to pertain to specific fields like only gaming, or photo-editing, auto-cad designing or machine drawing. A robust and effective decision modeling for the above-suggested studies could be made using the HDM methodology and arrive at best possible outcomes.

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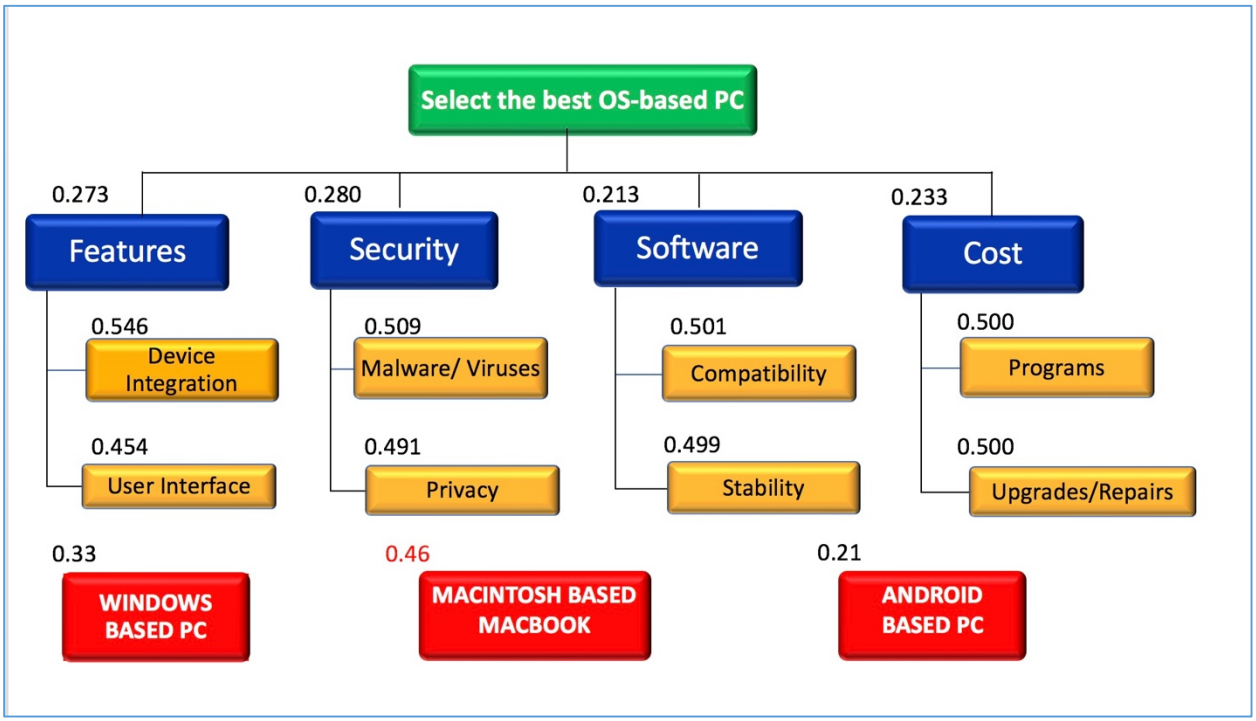
APPENDIX – A

Computation of the average of the weights on level 1 and level 2 criteria.

Level-1	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Average
Features	0.25	0.24	0.29	0.16	0.5	0.13	0.34	0.273
Security	0.25	0.35	0.28	0.28	0.16	0.43	0.21	0.280
Software	0.25	0.21	0.13	0.15	0.23	0.23	0.29	0.213
Cost	0.25	0.2	0.3	0.41	0.11	0.21	0.15	0.233
Inconsistency	0	0.02	0.08	0.02	0.05	0	0.01	

Level-2	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Average	STD.DEV
Device Integration	0.5	0.39	0.72	0.3	0.76	0.45	0.7	0.546	0.18
User Interface	0.5	0.61	0.28	0.7	0.24	0.55	0.3	0.454	0.18
Malware/Viruses	0.5	0.6	0.21	0.6	0.25	0.7	0.7	0.509	0.20
Privacy	0.5	0.4	0.79	0.4	0.75	0.3	0.3	0.491	0.20
Compatibility	0.5	0.4	0.75	0.35	0.72	0.4	0.39	0.501	0.17
Stability	0.5	0.6	0.25	0.65	0.28	0.6	0.61	0.499	0.17
Programs	0.7	0.42	0.72	0.35	0.2	0.55	0.56	0.500	0.19
Upgrades/Repairs	0.3	0.58	0.28	0.65	0.8	0.45	0.44	0.500	0.19
Inconsistency	0	0	0	0	0	0	0		

Distributed weights on all the decision elements of the HDM model



APPENDIX – B

Final Results obtained from the Online HDM model

GOAL	Windows-based PC	Macintosh-based MacBook	Android-based PC	Inconsistency
EXPERT 1	0.38	0.32	0.3	0
EXPERT 2	0.29	0.5	0.21	0
EXPERT 3	0.31	0.52	0.17	0.02
EXPERT 4	0.23	0.56	0.2	0.01
EXPERT 5	0.48	0.38	0.14	0.02
EXPERT 6	0.33	0.44	0.23	0
EXPERT 7	0.27	0.53	0.2	0
Mean	**0.33**	**0.46**	**0.21**	
Minimum	**0.23**	**0.32**	**0.14**	
Maximum	**0.48**	**0.56**	**0.3**	
Std. Deviation	**0.08**	**0.08**	**0.05**	
Disagreement				**0.061**

The statistical F-test for evaluating the null hypothesis (Ho:ric = 0) is obtained by dividing between-subjects' variability with residual variability:

Source of Variation	Sum of Square	Deg. of freedom	Mean Square	F-test value
Between Subjects:	0.23	2	.116	**13.64**
Between Conditions:	0.00	6	0.000	
Residual:	0.10	12	0.008	
Total:	**0.33**	**20**		
Critical F-value with degrees of freedom 2 & 12 at 0.01 level:				**6.93**
Critical F-value with degrees of freedom 2 & 12 at 0.025 level:				**5.1**
Critical F-value with degrees of freedom 2 & 12 at 0.05 level:				**3.89**
Critical F-value with degrees of freedom 2 & 12 at 0.1 level:				**2.81**