Analysis of features of Operating System Products

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Abstract

Information Technology has evolved over a period of time from Electronic Data Processors (EDP) to Cloud based technologies. Software is a critical component in this industry. The core product component in software is the set of instructions in the form of source code. During inception of the industry, programs were available at no cost. In the next era of information technology, programs which were free off cost were sold at a price. The programs were sold in the form of licenses. Proprietary software dominated the industry. The hardware manufacturers, users and organizations had to largely depend on propriety software. In the recent years users are moving towards open source applications. In specific, open source based operating system is being used and preferred by most of the users. Microsoft has considerably lost its market share in operating system products from 94.38%(based on data compiled by Authors) in Jun 2007 to 86.58% in May 2011. One of the main drivers of market share is product acceptance. Product acceptance is largely dependent on product features. This paper makes an attempt to identify critical features of operating system that may result in product acceptance and increase market share.

Introduction

Computers have been an integral part of the organizations. Most of the operations in any organization are entirely dependent on computers. The performances of these operations are dependent partially on the performance of computers. Early computers were just processors similar to calculator. These processors were designed to bring efficiency in the operations of organization. Along with efficiency, effectiveness also became a necessity for computer designers and manufacturers. Therefore designers ended designing a computer which is efficient and effective. These computers could process only one job at a time. Only one user could use computer at a time and run only one task. The user had to write the necessary code to process his data. This code was fed into the input/output control system. Since computers were able to run only one job/application at a time, there was a need to develop a system which can process multiple applications at a time. IBM mainframes were one of the pioneers to develop multitasking systems. The feature of multitasking can be facilitated through a feature in operating system. Share operating system was one of the early OS released in late 1950's which had multitasking capability. An operating system is software, consisting of programs and data that runs on

computers and manages the computer hardware and provides common services for efficient execution of various applications software.

Operating system is one of the most important components in computers. Every computer system requires a microelectronic chip called the central processing unit (CPU) plus operating system (OS) software. The OS directs the instructions requested by the application software, while the CPU performs the numerical computations. More Importantly, CPU and OS are almost always combined in fixed proportions: one of each is needed per system (Baseman et.al. 1995). Operating system is technically indispensable component in IT hardware.

The role of operating system products in information technology industry has been vital right from the inception of information systems in the organization. All hardware and software are dependent on operating system. The performance of a software application or hardware is largely dependent on the functions and features of operating system. Some of the basic function of an operating system is resource management, task management, file management and a few of utilities functions. Operating system functions and features have evolved over a period of time depending on the customers/consumers requirement. OS products are considered to be technology driven product. The functionality and features are adapted with evolving technology. Operating system is no more restricted to desktops, laptops and servers; it has been used extensively in mobile and other technology devices.

Operating system is available in various forms. It is available as an independent product or it is embedded with the hardware. The operating system products are generally purchased through licenses. The form in which the operating system is made available drives the business model of organization that develops operating system. The various business models adopted by a few of the major players have been discussed in the below section.

An operating system is software, consisting of programs and data that runs on computers and manages the computer hardware and provides common services for efficient execution of various application software. A generic view of the operating system integrated in a computer is shown below,

| USERS |
| APPLICATIONS |
| OPERATING SYSTEMS |
| HARDWARE |
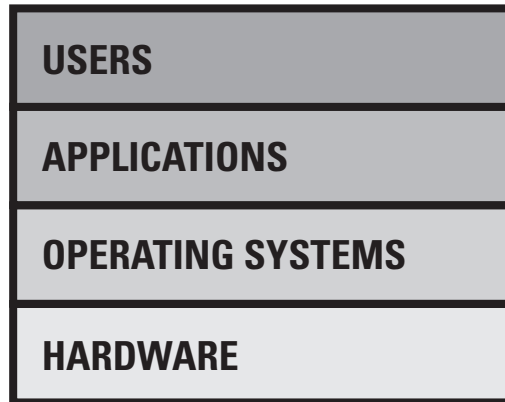
Source : Authors

Operating system helps the processor to read input from hardware, allocates memory, calls the required application software to process the input and sends output to the hardware device.

Operating system acts as an intermediary between the hardware and application software. A few of the critical components of operating system are listed below:

Graphical user interface

Kernel

Program execution

Interrupts

Modes

Memory Management

Virtual memory

Multitasking

Disk access and file system

Device drivers

Networking

Security

Operating systems are designed for Desktops/Laptops and Servers. The major players in this industry are Microsoft, Linux and Mac OS. Under Desktop category, Microsoft (MS) Windows and Mac OS are the major players. Mac OS is referred as Mac in the descriptions below. In server category, it is mostly MS and Linux. Mac's presence in this category is considerably less.

Current Market share in Operating System products

Microsoft (MS) is a proprietary operating system. Users buy licenses to use MS operating system. License provides authorization to use operating system. Apple Mac is also license based operating system, but is a hardware integrated operating system. Mac is compatible with only Apple computers. Linux is open source code based operating system. Communities of users develop and test source code. A set of distributors download OS code and sell the code as a package to users under various versions. A few of the dominant distributors of open source OS are Redhat, Fedora, Suse, Ubuntu etc,.

Table 1: Average Brandwise Market Share of Operating System Product

	Microsoft	Apple Mac	Linux	H- Index
May-07	94.3	3.9	1.3	0.89
May-08	93.9	4.3	1.4	0.88
May-09	92.6	5.6	1.1	0.86
May-10	90.0	7.5	1.3	0.82
May-11	87.8	8.5	1.0	0.78
May-12	86.4	9.3	1.1	0.76
Mar-13	83.8	7.5	1.4	0.71

Source: Compiled by author from various sources

Table- 1 shows the average operating system market share of three major players who dominate the market. This data is compiled based on the market share data from four sources namely Net share, Stat owl, Stat counter and w3counter. As shown in Table-1 Microsoft has lost nearly 10.5% of the market share between June 2007 and March 2013. It was a dominant player holding nearly 95% of the market share for a long period of time. Linux's average market share has increase by 0.01% from 1.31 between June 2007 and March 2013. However, Apple Mac's average market share has increased from 3.9% to 7.5%. The market share for Apple Mac has increased by 3.6%. The last column in the table above is Herfindahl Index(H.I.) which is an indicator of the trends in the state of competition of the industry. The computed H-Index during May 2007 was

0.89. This is an indication of the presence of a dominant player. The H-Index during March 2013 is 0.71. The changing pattern of dominance in the market share is clearly evident form the H-Index. Table-1 also shows the volatility involved in the market share for operating system products.

It is known that market share of organization is dependent on sales. If sales increases, market share also increases. There are various factors that drive sales. One of the critical factors is product. The description of a product is expressed through its features.

At this juncture, it is imperative that there is a paradigm shift in operating system's market share. There could be many reasons for the paradigm shift. One of the reasons could be features that offered by operating system products. In this study, an attempt has been made to identify critical features of operating system products.

Research Methodology

Operating system is highly technical product. Therefore the target group has to be technically sound. The customers of operating system can be classified as enterprise and home segment customers. Generally, Enterprise customers are more informed about operating system as compared to home segment customers, since the performance of enterprises' product performance might be dependent on operating system.

Hence, the target group selected for the research is enterprise users. The enterprise users in information technology industry use operating system product extensively. Therefore, the research focuses only on the enterprise users in information technology.

An instrument was developed to capture the experiential perception of operating system products. The instrument consisted of questions relating to the operating system product features and the experiential reflection of operating system usage across Microsoft, Mac and Linux brands. In all 554 valid responses were considered for analysis.

The responses were collected through online as well as physical survey. Convenient sampling was adapted to collect the responses. The target group was technical users who are working in the domain of information technology.

Results and Discussions

Exploratory factor analysis was used to identify interdependency and cluster of operating system features. This clustering help identify critical features of operating system and bundle them appropriately in the product.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.933
Bartlett's Test of Sphericity	Approx. Chi-Square	5913.422
	df	153.000
	Sig.	.000

KMO sampling adequacy is 0.933 which is an acceptable range of adequacy. Large KMO values are good because correlation between pairs of variables can be explained by other variables. The significance value of Bartlett's test of sphericity is 0.00 <= 0.005. These two measures indicate that there is adequate sample and the responses are valid and suitable to run factor analysis.

Principal component analysis has identified three main components that explain the variation of close to 63%. Eigen values of all these three components are greater than 1.00.

The first component consists of features of interface. All the features of interface have value of 0.7 and above. The features namely ability to support legacy

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.833	49.072	49.072	8.833	49.072	49.072
2	1.367	7.592	56.663	1.367	7.592	56.663
3	1.048	5.824	62.487	1.048	5.824	62.487
4	.933	5.181	67.669			
5	.731	4.059	71.728			
6	.648	3.601	75.328			
7	.598	3.324	78.652			
8	.539	2.996	81.649			
9	.491	2.729	84.378			
10	.439	2.441	86.819			
11	.400	2.220	89.040			
12	.363	2.016	91.056			
13	.333	1.849	92.905			
14	.298	1.655	94.560			
15	.287	1.593	96.153			
16	.266	1.476	97.629			
17	.242	1.343	98.972			
18	.185	1.028	100.000			
Extraction Method: Principal Component Analysis						

Rotated Component Matrix			
	Component		
	1	**2**	**3**
Ease to Install	.276	.080	.774
Graphical user interface	.179	.319	.783
Customer support	.289	.347	.583
Data Security	.201	.753	.298
Compatibility with software	.246	.809	.217
Ease of use	.255	.656	.401
Compatibility with hardware	.381	.765	.096
Updates/patches availability	.559	.506	-.010
Ease of troubleshooting	.569	.432	.201
Portability	.637	.266	.271
Value for money	.532	.317	.273
License options	.606	.244	.189
Data recovery/backup	.581	.440	.230
Ability to support Multiprocessors	.762	.216	.149
Ability to support multiple file types & bit structures	.753	.284	.092
Ability to support legacy application software	.784	.176	.191
Has a better interface to work on multiple platforms	.758	.127	.305
Supports many application development platforms	.674	.192	.297
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization			
a. Rotation converged in 6 iterations			

application software, ability to support multiprocessors, better interface to work on multiple platforms and ability to support multiple file types and bit structures. All the latter features correspond to the features of interface. These features are related to the ability of operating system to support multiples platforms. These features enable the software developers to leverage the benefits of various platforms of software development.

The second component consists of compatibility and data security. The compatibility of hardware and software is a critical feature of operating system. Essentially operating system acts as an interface between hardware and software. Data security will ensure that the data residing in the computer is safe and is not vulnerable to cyber intrusion.

The third component is again related to interface and ease of use and installation. Graphical user interface is a tool for users to interact with hardware and software. A better GUI will always facilitate users to use computer system at use. The feature of ease to install is a result of a good GUI.

In sum, the critical features of operating system can be categorized in three segments, namely,

1. Interface with hardware/software

2. Interface with users

3. Data security

The above three broad classification of operating system features have been identified based on the experiential reflection of users. However, the success of

operating system products not necessarily depends on these features, but play a significant role in capturing the market share. Further study can be conducted to analyze the other factors that drive the operating system product market and establish the linkage of the critical features identified through this research.

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