Network and Complex Systems
ISSN 2224-610X (Paper) ISSN 2225-0603 (Online)
Vol.13, 2022

Software Market in Nigeria: A Case Study of Its Buying Behaviour Heterogeneity

Akomolafe, A. A.[1] Oloyede A.O.[2] Awogbemi C.A.[3] Oladimeji A.O.[4] Oyegoke.O.A.[5]
1.Department of Statistics, Federal University of Technology, Akure, Nigeria.
2.Department of Computer Engineering, Yaba College of Technology, Yaba, Lagos.
3.Department of Statistics, National Mathematical Centre, Kwali, Abuja, Nigeria
4.Department of Statistics, Federal Polytechnic, Ile-Oluji, Ondo Stae
5.Department of Statistics, Osun State Polytechnic, Iree, Osun State
*Corresponding Author: akomolafeayotade@gmail.com

Abstract
The impact of the software buying decisions has a rising relevance in social and economic terms This research focused on the organizations buying decisions of Operating Systems and Office Suites for personal computers and the impact on the competition between incumbent and alternative players in the market in these software categories. Questionairing method of data collection was used using 5-point likert scale mode, some hypothesis testing were carried out on the most relevant factor of the subject matter at 5% level of significance. It was concluded that in this market beside brand image, product features or price, other factors could have influence in the buying choices. Network effect, switching costs, local network effect, lock-in or consumer heterogeneity all have influence in the buying decision. The results showed that the free licensing with the perception that Open Source Software global cost is lower than the local network effect. The influence of market factors like network effects, lock-in, consumer heterogeneity or switching costs also favors the incumbent Proprietary Software.
Keywords: Consumer Behaviour, Software Market, Lock-in, Network Effect, Switching Cost, Software Buying Decision.
DOI: 10.7176/NCS/13-02
Publication date: May 31st 2022

INTRODUCTION

Over the years, the relationship a company develops with the customer has become a key point for competitive advantage and one of the main elements for the survival in the marketplace. The software market with its specific characteristics has evolved through a mix of suppliers' offer of standards and technologies, standard decisions and definitions by independent organizations and consumer choices with the adoption of technologies and standards. The implementation of what is called Customer Relationship Management proved successful in many cases, but failed in many others. Concepts such as retention, satisfaction, loyalty and acquisition became part of the vocabulary in many organization and their understanding and measurement became a synonym of success. Analysis of consumer buying behaviour as a concept has grown quickly over the year, but the idea of creating or developing models that are more acceptable and understandable is still in need. As a result, domain knowledge will be used as part of the data mining process in order to develop the models for strategy development. When evaluating the relationship of customer with the wholesaler or retailer, concept that can only be used as part of an analytical approach are customer live time value which incorporate frequency, recency and the customer dropout process (churn). In this research, we study the impact of factors like network effects, switching costs, lock-in, local network effect, brand perceptions, consumer's heterogeneity and costs on the consumer choices of software, considering the Operating System (OS) and Office Suite (OFFS) for a personal computer (PC), desktop or notebook.

2. LITERATURE REVIEW

The literature review in this paper focused on the competition and consumer behavior research in the software market. One of the first concepts is the network effect or network externality, where the consumer's utility of the products and services rises with the number of consumers that already consume that product or service [Katz and Shapiro 1985]. The network effect can be a direct network effect, when the rise of the consumer utility is the result of more consumers consuming the same product or service or an indirect network effect when the rise of the number of consumers in a network raises the offer of complementary products and services [Katz and Shapiro 1985] and [Economides 1996]. The costumer forecast of the future dimension of the network of each of the market standards also contribute to network effects [Katz and Shapiro 1986], but suppliers can influence the consumer forecasts of market shares with advertising and branding campaigns [Clark and Sangit 1999]. If the consumer considers switching to a new network, even superior, he has switching costs that can cause a switching decision delay. That delay can lock-in the market with a technology or standard technically inferior [Farrell and Saloner 1985, 1986]. Richard Langlois and Paul Robertson [1992] concluded about the existence of three

categories of switching costs when the switch causes problems of compatibility, while Chuang [2011] consider the switching between standards as being influenced by the consumer satisfaction with the actual standard, switching costs, habit strength and alternatives attractiveness. Brian Arthur [1989, 1990] introduced the concept of positive feedback, where a raise in the standard demand induced by the network effects raises the production level, lowering costs and prices, with positive effect on the standard demand.

The consumer's decisions are influenced by the network effects and consumer's heterogeneity, with the additional influence of the local network effect, which is the counseling from friends, family, work colleagues, suppliers, customers or competitors [Dalle 1997] and [Birke and Swann 2010]. The behavioral lock-in can also exist when the consumer is "locked" in choices less optimal due to habit, organizational learning or culture [Barnes et al. 2004], a concept that develop the concept of "irreversibility due to learning and habituation" [David 1985]. Considering the software competitors, we can also consider the competition between Open Source Software (OSS) against Proprietary Software (PS). In the former the code can be accessed, developed, modified, adapted and integrated in other software without payment of any royalties to the authors of the software and has free licensing [Raymond 2001]. The Open Source Software success probability relates directly related with the implementation costs [Mustonen 2003]. The Open Source Software has an "indirect network effect" based on the legal access by the users to a large number and variety of free applications, which combined with consumer's heterogeneity and local network effect can help the Open Source Software growth [Bonaccorsi and Rossi 2003]. The Open Source Software competitiveness growth also rises with the rise of human resources with experience and skills to implement Open Source Software solutions [Lin 2004]. The Open Source Software has advantage with heterogeneous customers, because they can customize it to meet their own particular needs [Bessen 2005] if there aren't any relevant compatibility problems [Dalle and Jullien 2002].

3. Research Hypotheses

This research evaluates the hypotheses in two categories of software, Operating Systems and Office Suites for PC, categories where the main competition is between Open Source Software and Proprietary software. This addresses the research question: "Which factors have influence on the buying process decision of Operating Systems and Office Suite for PC, considering Open Source and Proprietary software alternatives, and how these factors influence the consumer's choices?" Most of the hypothesis extensively considered in this research basically centered on consumer choices which is in two fold

(i) The lower the probability that the consumer will choose the alternative standard against the incumbent standard

(ii) The higher the probability that the consumer will choose the alternative standard against the incumbent standard

The null hypothesis (H_o) that goes with the first consumer choice are

H_{o1}: the higher the network effect in the market

H_{o2}: the higher the switching cost in the market

H_{o3}: the higher the lock-in weak and strong

H_{o4}: the higher the network effect in the market

H_{o5}: the better the perception regarding innovation,quality,securityand support of the incumbent standard

Also, the null hypothesis (H_o) that goes with the second consumer choice are

H_{o6}: the higher the heterogeneity of the consumer [the lesser the network]

H_{o7}: the lesser the associated cost to adoption of the alternative standard[licensing,support,training, compactibility e.t.c.]

4. Research Methodology

In this research, we channeled down the software buying decision mode to eight categories, these are switching cost, lock-in, network effect, software innovation and quality, software security and support, consumer heterogeneity, software cost [licensing, support]. The data was collected using self administered questionnaire which is done directly and electronically. The questionnaire had multiple choice questions and Likert scale [Likert 1932] questions. The first ones were mainly to collect the data about the organization like companies' sales, workers, location, Information Systems infrastructure, etc. The second ones collected data regarding the different research hypotheses, including companies' perceptions about image, costs, characteristics, innovation, quality, security, etc., of software suppliers, brands and products considering Proprietary Software and Open Source Software. The questionnaires included questions about the companies' choice of software brands and products and the factors that influence those choices, considering personal computers Operating System and Office Suite choices (Table 1).

Table 1: Questionaire Likert Scale Questions

Questions	Aspect covered in the 5-point Likert scale Questions
2	Application and file compatibilities with business partners
3	Legacy files or applications still in use
1	Factors that influence software choices [18 factors]
1	Knowledge of main software supplirs [12 PS and OSS brands]
6	Innovation, quality and security perception of different brands [software] in the market[Operatin system-7;Office Suites-8]
2	Innovation, quality and security perception of PS vs. OSS
1	Technical support availability for PS and OSS
1	Cost Considering PS and OSS
5	Easiness of switch operating system.

5. Data Analysis and Results

The questionnaire had at least one question for each of the hypotheses presented in this research. A set of statistics were applied to each question's result (variable) as well as the Kolgorov-Smirnov normality test to allow the choice between the non-parametric Wilcoxon Signed Rank test for the median or the parametric t-test (5% significance level). The hypotheses tests were made considering lower or equal than mean (or median) versus higher than the mean (or median) in a Likert scale of one to five, because we only want to consider answers that go "above" the more neutral point of 3, that usually means "neither agree or disagree", even if 3 could mean "slightly agree" [Lodico et al. 2006].

After statistically analyzing each question (variable), constructs were built from the hypotheses made in this research that helps to explain the factors behind organization's decisions. The construct unidimensionality was assessed through factor analysis conducted on each construct scale and the construct build through the factor scores obtained from the factor analysis. The construct validity was evaluated by the extent to which items in a single scale all measure the same construct [Flynn et al. 1991]. The Cronbach's α [Cronbach 1951] test was applied to test the internal consistency of the unidimensionality of these constructs. To each construct, hypothesis tests were made using the methodology presented above.

Table 2 : Incumbent versus alternative choice influencing factors [OS and OFFS]

Hypothesis	**Variables and construct [considering 5% significant hypothesis test]**	**OS**	**OFFS**
H_1 Network effect	• Applicants available in market for OS and possibility of usesame application as business partners • File compactibility with partners [office suites]	I	I
H_2 Switching costs	• Are considered as existing, being lower for the office suite switch	I	I
H_3 Lock-in	• Weak lock-in caused by path dependence[same application updated through the years] and also influencing switching costs • Computer, peripherals and application owned[operating system] • Knowledge to install, uninstall, and work with software • Incumbent file owned [office suites]	I	I
H_4 Local Network effects	• Exist through information system staff inside or outside the company	A	A
H_5 Software brand image, innovation, quality, security	• Brand global perception and consideration of actual and potential future needs relevant in choice. • Comparison between OSS and PS operating systems and office suites concluded that there is no significant difference between them. • Comparison between OSS and PS global perception [image, quality, security] concluded that there is no significant difference between them. • Comparison between OSS and PS technical support concluded that there is no significant difference between them.	I	I
H_6 Heterogeneity degree	• Low software heterogeneity with Microsoft windows and Microsoft office dominating the software environment.	I	I
H_7 Software global costs	• Software global costs are relevant in software choice; OSS and perceived as cheaper than PS	A	A

I signifies **Incumbent Proprietary software**; **A** signifies **Alternative Open Source Software**

6. Conclusion

Considering only the statistically significant results, we concluded that the software markets are different from other markets regarding the choice influencing factors. In software markets there are other additional factors that influence the standard choices, as presented in the literature review and in the hypotheses of this research, that were confirmed. Some of these research hypotheses study different viewpoints (brand, market, market category in Operating System and Office Suite) and software business model (Open Source Software versus Proprietary Software). Some choice influencing factors have different influencers. For example, the weak lock-in can happen because of the user knowledge (or lack of it), hardware or peripherals owned, or application and files owned. The software choice influencing factors (variables and constructs), were statistically confirmed with the exception of some aspects considered in each one (Table 2). The results obtained demonstrated the influence of the considered factors on the software buying behavior, confirmed by the seven research hypothesis, answering the proposed researchquestion. Table 4 present the research hypotheses with influence in the software user decisions considering Operating Systems (OS) and Office Suites (OFFS).

Considering Operating Systems and Office Suites for personal computers where the incumbent dominant brands are Proprietary Software, we concluded that it seems difficult that Open Source Software can have relevant market share gains in these specific market categories. The results showed that the free licensing with the perception that Open Source Software global cost is lower than Proprietary Software global cost or the local network effect, can be not enough arguments against the Open Source Software lack of perceived features advantage and disadvantage in technical support availability. The influence of market factors like network effects, lock-in, consumer heterogeneity or switching costs also favors the incumbent Proprietary Software.

The research results also showed that even if the incumbent Operating System (Microsoft Windows) has Proprietary Software and Open Source Software Operating System alternatives with better global perception and the incumbent Office Suite (Microsoft Office) is better perceived than all the other Office Suite alternatives, the differences in both cases aren't statistically significant. Considering the consumer perceptions, there is a low incentive to switch the Operating System or Office Suite.

The research relevance is founded on the presentation of a global model of the consumer selection in the Operating System and Office Suite for PC market categories, the main software categories for professional use. This research provides a better knowledge of the consumer selection decision to help the supplier's managers in their marketing strategies while also helping the regulatory authorities regarding the search for market abuse of monopoly power due to specific factors that can easily allow it to the incumbent player. The main implication of this research is the conclusion that in a software market with a dominant incumbent (like the studied markets), it will be very difficult for a competitor to gain market share against the incumbent unless there is some kind of external intervention, like the Government using an alternative software standard, allowing it to reach a critical mass of users.

7. References

Arthur, Brian (1989), "Competing Technologies, Increasing Returns, and Lock-in by Historical Events, *Economic Journal*, 99, 116-31.

Arthur, Brian (1990), "Positive Feedbacks in the Economy", *Scientific American*, 262, 92-99.Barnes, William and Gartland, Myles and Stack, Martin (2004), "Old Habits Die Hard: Path Dependency and Behavioural Lock-in", *Journal of Economic Issues*, 38 (2), 371-377.

Bessen, James (2005), "Open Source Software: Free Provision of Complex Public Goods",Research on Innovation; Boston University - School of Law.

Birke, Daniel and Swann, Peter (2010), "Network effects, network structure and consumer interaction in mobile telecommunications in Europe and Asia", *Journal of Economic Behavior & Organization*, 76 (2), 153–167.

Bonaccorsi, Andrea and Rossi, Cristina (2003), "Why Open Source Software can succeed", *Research Policy*, 32, 1243–1258.

Chuang, Yi-Fei (2011), "Pull-and-suck effects in Taiwan mobile phone subscribers switching intentions", *Telecommunications Policy*, 35, 128-140.

Clark, Bruce, and Chatterjee, Sangit (1999), "The evolution of dominant market shares: The role of network effects", *Journal of Marketing Theory and Practice*, 7 (2), 83-96.

Cronbach, Lee. (1951), "Coefficient alpha and the internal structure of tests", *Psychometrika*, 16(3), 297-334.

Dalle, Jean-Michel (1997), "Heterogeneity vs. Externalities in technological competition: A tale of possible technological landscapes", *Journal of Evolutionary Economics*, 7, 395-413.

Dalle, Jean-Michel and Jullien, Nicolas (2002), "Open Source vs. Proprietary Software", 2001 *ESSID Cargèse Summer School lecture*.

David, Paul (1985), "Clio and the Economics of QWERTY", *The American Economic Review*, 75 (2), 332-337.

Economides, Nicholas (1996), "The Economics of Networks", *International Journal of Industrial Organization*, 14 (6), 669-71.

Katz, Michael and Carl, Shapiro (1985), "Network Externalities, Competition and Compatibility", *The American Economic Review*, 75 (3), 424-440.

Katz, Michael and Carl, Shapiro (1986) "Technology Adoption in the Presence of Network Externalities", *Journal of Political Economy*, 94 (4), 822-841.

Langlois, Richard and Robertson, Paul (1992), "Networks and Innovation in a Modular System: Lessons from the Microcomputer and Stereo Component Industries", *Research Policy*, 21 (4), 297-313.

Liebowitz, Stan and Margolis, Stephen (1994), "Network Externality: An Uncommon Tragedy", *Journal of Economic Perspectives*, 8 (2), 133-150.

Liebowitz, Stan and Margolis, Stephen (1995), "Path Dependence, Lock-In, and History", *Journal of Law, Economics and Organization*, 11, 205-226.

Liebowitz, Stan and Margolis, Stephen (1996), "Market processes and the selection of standards", *Harvard Journal of Law and Technology*, 9, 283-318.

Likert, Rensis (1932), "A technique for the measurement of attitudes", Archives of Psychology, 22 (140), 1-55.

Mustonen, Mikko (2003), "Copyleft—the economics of Linux and other open source software", *Information Economics and Policy*, 15 (1), 99-121.

Wilcoxon, Frank (1945), "Individual Comparisons by Ranking Methods", *Biometrics Bulletin*, 1(6), 80-83.