

# Buying Behavior and Competition in the Software Market

João Carlos V. Ferreira do Rosário <sup>1</sup>, António Palma dos Reis <sup>2</sup>

1) Escola Superior de Comunicação Social-Instituto Politécnico de Lisboa, Lisboa, Portugal

[jrosario@escs.ipl.pt](mailto:jrosario@escs.ipl.pt)

2) Instituto Superior de Economia e Gestão, Lisboa, Portugal

[apreis@iseg.utl.pt](mailto:apreis@iseg.utl.pt)

## Abstract

In the actual world, the impact of the software buying decisions has a rising relevance in social and economic terms. This research tries to explain it focusing 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, although the research hypotheses and conclusions may extend to other software categories and platforms. We 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, protecting the incumbent and making it difficult for the competitive alternatives, based mainly on product features and price, to gain market share to the incumbent. This happens in a stronger way in the Operating Systems category.

**Keywords:** *Consumer behavior, Software buying decision, Information Systems, Software market, Open Source Software, Network Effects, Switching Costs, Lock-In*

## 1. Introduction

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. In this paper 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.

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## **2. Literature Review**

The literature review in this paper focus 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. Consumers consider in their decisions the benefits of the network dimension by guessing the dimension of the markets and can become locked-in in the chosen network [Liebowitz and Margolis 1994, 1995], but in the end a superior standard can eventually win over the incumbent, even more if it applies marketing strategies like a lower price or an advertising campaign to increase market share [Liebowitz and Margolis 1996]. The lock-in can be a strong lock-in or a weak lock-in, the first one regarding compatibility with others and the last one the compatibility with himself, with the former more difficult to overcome [Liebowitz 2000]. 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 Model and Hypotheses**

The literature review showed that the software market has some distinct factors that influence the consumer’s choices. From this, seven hypotheses were developed considering the factors that influence the consumer choices of software. The model is presented in Figure 1 and the concepts presented in the seven hypotheses are showed in Table 1. This paper 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?”

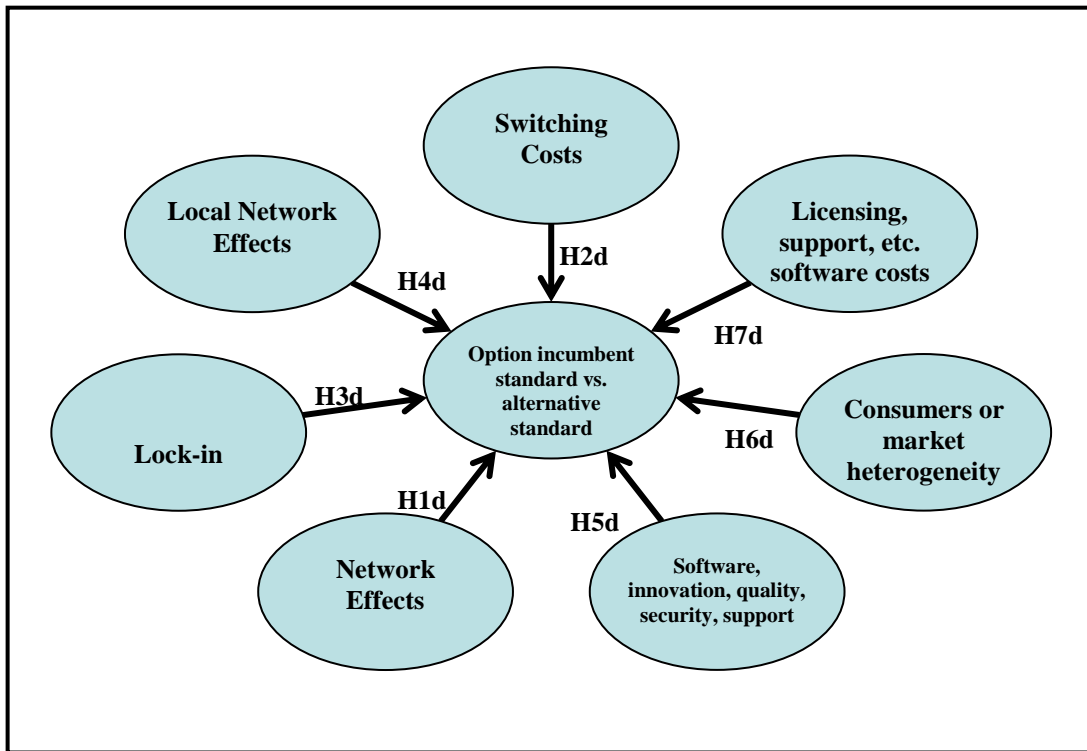


Figure 1. Software buying decision model

Hyp.	Literature Review	Consumer Choice
H1	The higher the network effects in the market <i>[Katz and Shapiro 1985], [Economides 1996], ...</i>	Lower probability that the consumer will choose the alternative standard against the incumbent standard
H2	The higher the switching costs in the market <i>[Farrell and Saloner 1985, 1986], [Langlois and Robertson 1992], Chuang [2011], ...</i>	
H3	The higher the lock-in weak and strong <i>[Farrell and Saloner 1985, 1986], David [1985], [Liebowitz and Margolis 1994, 1995] [Liebowitz 2000], [Barnes et al. 2004], ...</i>	
H4	The higher the local network effect in the market <i>[Dalle 1997], [Birke and Swann 2010], ...</i>	
H5	The better the perception regarding innovation, quality, security, support, etc. of the incumbent standard <i>[Liebowitz and Margolis 1996], [Clark and Sangit 1999], ...</i>	
H6	The higher the heterogeneity of the consumers (the lesser the network effect) <i>[Dalle 1997], [Dalle and Jullien 2002], [Bonaccorsi and Rossi 2003], [Bessen 2005], ...</i>	Higher probability that the consumer will choose the alternative standard against the incumbent standard
H7	The lesser associated costs to adoption of the alternative standard [licensing, support, training,	

	compatibility, etc.] [Bonaccorsi and Rossi 2003], [Liebowitz and Margolis 1994, 1995], [Mustonen 2003], [Lin 2004], ...	
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Table 1. Research hypotheses

#### 4. Research Methodology

The data was collected through a questionnaire available at Instituto Superior de Economia e Gestão and also a link in IDC Portugal. Small and Medium Size Enterprises and Large Companies with activity in Portugal were invited to collaborate in the research by email, with a presentation of the objectives of the research. 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 2).

Nr. questions	Aspects covered in the 5-point Likert scale questions
2	Applications 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 suppliers (12 PS and OSS brands)
6	Innovation, quality and security perception of different brands (software) in the market (Operating Systems-7; Office Suites-8)
2	Innovation, quality and security perception of PS vs. OSS
1	Costs considering PS and OSS
1	Technical support availability for PS and OSS
5	Easiness of switch Operating System and/or Office Suite switch and influencing factors on that easiness (OS-8 factors;OFFS- 6 factors)

Table 2. Questionnaire Likert scale questions

#### 5. Data Analysis Methodology

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  $\alpha$  [Cronbach 1951] test was applied to test the internal consistency reliability of the unidimensionality of these constructs. To each construct, hypothesis tests were made using the methodology presented above.

## **6. Main Research Conclusions**

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 paper, 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 3). The results obtained demonstrated the influence of the considered factors on the software buying behavior, confirmed by the seven research hypothesis, answering the proposed research question. 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.

<b>Variables and constructs</b>	<b>Not confirmed considering:</b>
H1 Network Effects	Installation of same software as the business partners
H3 Lock-in	Weak lock-in considering older applications and files not updated with new software versions Office Suite weak lock-in due the personal computer available
H4 Local network effects	Advice from sources that aren't Information Systems staff

Table 3. Hypothesis confirmation

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.

### **Research implications, contributions and future research**

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 paper 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.

From this research, further research aspects can be object of study. It includes the temporal evolution of choice's influencing factors research and research considering other consumer segments. The research on other software categories like multimedia software, database software, browsers or other platforms like servers, smartphones, tablets or social networks is also relevant to ascertain whether the hypotheses presented in this research are confirmed in other software categories. New developments like "Cloud Computing or "Software as a

Service”, the evolution of the file compatibility between alternative applications considering the “openness” of the formats and their influence over the market evolution are also a relevant research area. Last but not least, research about the impact on organizations of the shift from Proprietary Software to Open Source Software will also enhance the knowledge about the competitive software market.

<b>Hypothesis</b>	<b>Variables and constructs (considering 5% significance hypothesis test)</b>	<b>OS</b>	<b>OFFS</b>
H1 Network Effects	. Applications available in market for OS and possibility of use same application as business partners (Operating System). . File compatibility with partners (Office Suite).	I	I
H2 Switching costs	. Are considered as existing, being lower for the Office Suite switch.	I	I
H3 Lock-in	. Weak lock-in caused by path dependence (same application updated through the years) and also influencing switching costs: . Computer, peripherals and applications owned (Operating System) . Knowledge to install, uninstall, and work with software (Operating System and Office Suite) . Incumbent files owned (Office Suite).	I	I
H4 Local network effects	. Exist through Information Systems staff inside or outside the company. While the advice can go one way or another, it seems to favor OSS (Information Systems staff means less need of search of technical support and less knowledge lock-in).	A	A
H5 Software brand image, innovation, quality, security, support	. Brand global perception and consideration of actual and potential future needs relevant in choice and: . Comparison between OSS and PS Operating Systems and Office Suites concluded that there is no statistically significant difference between them. . Comparison between OSS and PS global perception (image, quality, security) concluded that there is no statistically significant difference between them. . Comparison between OSS and PS technical support availability concluded that PS has statistically significant advantage.	I	I
H6 Heterogeneity degree	. Low software heterogeneity with Microsoft Windows and Microsoft Office dominating the software environment.	I	I

H7 Software global costs	. Software global costs are relevant in software choice; OSS perceived as cheaper than PS	A	A
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Advantage for: I – Incumbent Proprietary Software; A – Alternative Open Source Software

Table 4. Incumbent versus alternatives choice influencing factors (OS and OFFS)

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