Open-Source Platforms:
Multiple studies in the mobile devices industry

Jose Teixeira

University of Turku, Finland

Turku Centre for Computer Science, Finland

EIT ICT labs, Finland

jose.teixeira@utu.fi

Abstract

This doctoral student research addresses the emergence of open-source based platforms currently attaining notorious relevance within the mobile devices industry. It aims at providing a better understanding on "how and why corporations follow open-source based platform strategies?" within high-networked markets under constant technological evolution. Drawn over the constructs of multi-sided platforms (Rochet & Tirole, 2003; Hagiu & Wright, 2011) and plenty of studies on open-source software adoption such as Lerner and Tirole (2002), Feller and Fitzgerald (2002) and Weber(2004), this research also bridges business strategy in network economics (Gawer & Henderson, 2007; Gawer & Cusumano, 2008) with the psychological and anthropological concepts of sense of community (SoC) and communities of practice (CoP).The researcher follows a theory testing approach, where established theories developed on previous decades over the Personal Computer and Operating Systems are replicated in a completely new and emergent context. By taking a pure qualitative case-study approach on the moulds of Eisenhardt (1989) and Yin (2008 , the researcher developed a set of descriptive and in-depth case-studies within he mobile devices industry, answering the lack of empirical research on strategies used by open-source platform providers. Natural occurring data was collected from Internet s and semi-structured interviews were conducted within an industrial key-player with the goal of providing a framework and a theory that would extend what is known on open-source products to open-source platforms. Practitioners

are then provided with better guidance for designing and implementing their networked technological strategies, to let their computer-based platforms succeed in high competitive under network effects.

1 Introduction

The research author seeks to complement the existing body of theoretical knowledge on open-source software, drawn mostly from research on open-source software products, by pointing his lenses to software platforms (often referred empirically as "ecosystems").

With a purposive-focus on the telecommunications industry, the researcher studies the emergence of mobile open-source platforms such as Maemo, Meego, Android and Bada empowering big corporations such as Google, Nokia, Intel and Samsung within the high-competitive mobile devices market.

Computer-based platforms combine core components with complementary products and services habitually made by a variety of external entities (Gawer & Cusumano 2008). In the case of high-technology and high-competitive markets, many firms follow a platform-based strategies due to the impossibility of satisfying by themselves an exceedingly complex consumer group (Hagiu 2004).

2 Research questions

The aim of this research study is to investigate the strategies used by open-source platform providers. Its core objective is to provide a better understanding on how companies like Apple, Google and Nokia integrate open-source software technological components under public domain into their platforms empowering proprietary mobile devices. A set of research questions include:

- RQ1: **What** are the **open-source** software technological **components** integrated by the mobile devices vendors?

- RQ2: **How open-source** software **affects** the competitive dynamics of the **mobile devices** industry?

- RQ3: **How** rival platform-vendors **collaborate** in the **open-source arena**?

- **RQ4: Why** companies follow open-source **platform-based strategies**?

The research questions follow and What, How and Why logic. The researcher strategically addressed first the What and How questions, without rushing to answer to the final Why question (RQ4).

3 Literature review

This research reviews multi-disciplinary literature, mostly within the information systems, economics and strategy research streams. The research author pursued to cover the current body of theoretical knowledge addressing the open-source software (OSS) phenomena, as addressed by Lerner and Tirole (2002), Feller and Fitzgerald (2002) and Weber (2004); research addressing computer-based platforms and multi-sided platforms (Rochet & Tirole, 2003; Hagiu, 2004; Hagiu & Wright, 2011); and research bridging business strategy and network economics (Gawer & Henderson, 2007; Gawer & Cusumano, 2008).

Regarding the review of OSS literature, a crucial part of this research, the author identified several recent and comprehensive literature reviews addressing the OSS phenomena (Stol & Babar 2009; Aksulu & Wade 2010; Hauge et al. 2010; Lindman 2011).

A notable systematic literature review by Stol and Babar (2009), covering specialized conference proceedings, pointed-out the heterogeneity and lack of empirical studies dealing with OSS in organisations. Another systematic literature review from Hauge et al. (2010), confirmed the heterogeneity in which companies approach OSS prompting lack of empirical research on OSS adoption in organizations.

Lindman (2011) extended the two previous mentioned reviews, in yet another systematic literature review covering both open-source journals (Hauge et al. 2010) and top Information Systems journals (Rainer & Miller 2005). He argues that current body of knowledge emphasis on OSS community-driven development with limited interest on OSS within organizations.

Last but not the least, yet another literature review by Aksulu and Wade (2010) paused and reflected on the state of open-source research; analysed and categorized a wide-set of open-source research; and proposed a framework to situate OSS research within a wider nomological network while proposing future directions for open-source research.

Besides the existence of the previously reported recent, comprehensive and systematic literature reviews on OSS, and in order to review relevant theoretical knowledge on other relevant constructs such as computer-based platforms and multi-sided platforms (Rochet & Tirole, 2003; Hagiu, 2004; Hagiu & Wright, 2011), business strategy and network economics (Gawer & Henderson, 2007; Gawer & Cusumano, 2008), the author was forced to perform his own systematic literature review.

From the beginning of the doctoral project, the author kept reviewing by systematic manners a literature review bridging OSS with platforms. This in-progress literature review, based on search keywords and research

databases, was initially defended at the Information Systems Research Seminar in Scandinavia (IRIS) seminar in 2011, and submitted as a working paper to the European Conference on Information Systems (ECIS) in 2012. The research author identified a set of emergent research, with stronger focus on platforms over products, that highlighting the limited empirical research on strategies used by open-source platform providers on industry.

For concluding this chapter, from reviewing a very wide body of theoretical knowledge, the author identified a limited but emergent research stream addressing both OSS and platforms. If the scholars Stol and Babar (2009), Hauge et al. (2010) and Lindman (2011) argue, on a common voice, that current research lacks empirical studies bridging OSS with organisations, the author argues that **current research lacks** even more **empirical studies bridging OSS platforms with organisations**.

4 Theoretical background

This study lays down on previous research built around the concept of multi-sided platforms as introduced by Rochet and Tirole (2003) and further developed by Hagiu (2004), Rochet and Tirole (2006) and Boudreau (2008), the concept of computer-based platforms first coined by Pohl (1998); and key studies on OSS adoption (Wang & Wang 2001; Feller & Fitzgerald 2002; West 2003; Dedrick & West 2004).

With a strong multidisciplinary research character, constructs from outside the perceived boundaries of the information system research were included; Such as the Gawer and Cusumano (2008) strategy tool kit for firms pursuing platform based operational models and the work from Katz and Shapiro (1994) who looks at the role of network effects in the telecommunication industry in a pure network economical context. From philosophy, the theoretical propositions of sense of community (SoC) from McMillan and Chavis's (1986) were adopted, as well as the concept of community of practice (CoP) as proposed by the cognitive anthropologists Lave and Wenger (1991).

5 Methodology and scope

5.1 Epistemological Ontologies and Method

The research author, committed to an article-collection dissertation strategy, did not follow a single epistemological and ontological trajectory. Rather than choosing a particular research approach *apriori* of the field work, the researcher adopted different approaches for each paper while pursuing epistemological consistency on each individual research project.

The author took the stance of a pluralist (Mingers, 2004) employing multi-dimensional research strategies (Mason, 2006) that is, accepting and celebrating a wide variety of paradigms and research approaches on the same topic (Mingers, 2001), in this case the integration of OSS by platform-vendors in the emergent mobile devices industry.

Driven by What, How and Why research questions, the approach of this research is mostly qualitative and most original articles are interpretative (Klein & Myers 1999; Walsham 1995). The research was conducted according to ethnographic principles that empower data collection with limited influence from the established body of theoretical knowledge (Myers 1999; Atkinson 2006). The author was more interested by grounding theories rather than building variance based models (Benbasat et al. 1987; Myers 1997; Markus & Robey 1988; Urquhart & Fernández 2013). By taking and ethnographic approach, the theoretical integration was performed *a posterior* of the field work and data *collection.*

The researcher built its methodological awareness both by attending doctoral-level courses and seminars and by reviewing three books in the following order Silverman (2009) , Eriksson & Kovalainen (2008) and Myers (2002), all wide-recognized methodology book on qualitative research applied on social sciences, business studies and Information Systems.

The following table summarises the research questions, methods and methodological sources driving each individual research project, as reported in more detail on the author's article collection bundled in doctoral dissertation.

Author article	Research question	Method	Methodological references
Article 1	What do we know about open-source and platforms?	Literature review	Webster & Watson 2002 Järvinen 2008
Article 2	Measuring the openness of computer-based multi-sided platforms	Literature review	Webster & Watson 2002 Järvinen 2008
Article 3	RQ1	Descriptive case-study	Yin 1989
Article 4	RQ2	Descriptive case-study	Yin 1989 Eisenhardt 1989 Kozinets 2002
Article 5	RQ3	Ethnographic case-study	Eisenhardt 1989 Myers 1999
Article 6	RQ4	Interpretative case-study	Eisenhardt 1989 Darke et al. 1998

Table 1: Methods employed in each article

5.2 Data collection

Data was collected mostly from public-available and naturally-occurring qualitative data on the Internet such as: listed-companies public financial information, companies-press releases, generalist press, specialized press on technology and mobile devices, open-source software projects source-code and documentation, open-source software projects bug-repositories and the change-log from an open-source software project version-control-system. In addition, and for addressing the Why research question (RQ4), semi-structured interviews were conducted in a major firm within the Mobile devices industry.

The following table sensitises the research data-collection procedures employed at each individual research project. More details are provided on each article bundled with author's doctoral dissertation.

Author article	Research question	Unit of Analysis	Collected data
Article 1	What do we know about open-source and platforms?	Body of theoretical knowledge	Research papers retrieved from research databases indexing books, journals and conferee proceedings.
Article 2	Measuring the openness of computer-based multi-sided platforms	Body of theoretical knowledge	Research papers retrieved from research databases indexing books, journals and conferee proceedings.
Article 3	RQ1	**Mobile devices industry** players controlling the iOS, Android and Maemo platforms.	Open-source software projects source-code and documentation
Article 4	RQ2	**Mobile devices industry** players controlling the iOS, Android and Maemo platforms.	Companies public financial information, companies-press releases, generalist press and specialized press on technology and mobile devices
Article 5	RQ3	The **WebKit** open-source software project	Open-source software projects bug-repositories and the change-log from an open-source software project version-control-system.
Article 6	RQ4	Major **firm** within industry steering an open-source based mobile platform	8 Semi-structured interviews: Software developers, Testers, Integrators, Marketing and Strategy

Table 2: Data-collected for each article unit-of-analysis

5.3 Data analysis

Reflecting the pluralism employed on this research (Mingers 2001; Mingers 2004; Mason 2006) a multitude of qualitative data-analysis and theory-building approaches were employed. The following table enumerates the employed data-analysis and theory-building approaches and corresponding methodological sources that guided the research design. More detail is provided in each dissertation article.

Author article	Collected data	Approach	Methodological references
Article 1	Research papers retrieved from research databases indexing books, journals and conferee proceedings.	Analysis of literature review	Webster & Watson 2002 Järvinen 2008 Vom Brocke et al. 2009 Okoli, K Schabram 2010
Article 2	Research papers retrieved from research databases indexing books, journals and conferee proceedings.	Analysis of literature review	Webster & Watson 2002 Järvinen 2008 Vom Brocke et al. 2009 Okoli, K Schabram 2010
Article 3	Open-source software projects source-code and documentation	Multiple-case study Description of OSS components integrated by Apple, Nokia, Google	Yin 1989 Eisenhardt 1989
Article 4	Companies public financial information, companies-press releases, generalist press and specialized press on technology and mobile devices	Multiple-case study 3 rich description of the OSS strategies employed by Apple, Nokia, Google Cross-case analysis	Yin 1989
Article 5	Open-source software projects bug-repositories and the change-log from an open-source software project version-control-system.	Network Visualization Figuralisation Heterogeneous Network Analysis Actor-Network Theory	Elias 1978 Callon 1986 Walsham 1997 Cambrosio et al. 2004
Article 6	8 Semi-structured interviews: Software developers, Testers, Integrators, Marketing and Strategy	Categorization Grounded theory	Benbasat et al. 1987 Eisenhardt 1989 Darke et al. 1998 Urquhart & Fernández 2013

6 Expected contributions

Besides testing last-decades knowledge on computer-based platforms (Pohl 1998; Gawer & Cusumano 2008) and multi-sided platforms (Rochet & Tirole, 2003; Hagiu, 2004; Hagiu & Wright, 2011), this study aims to provide scholars with rich descriptions of real-world issues faced by corporations following open-source based platform strategies. Both from combining multiple case-studies, multiple-research approaches and from bridging theoretical constructs across different disciplines, the author proposes both a framework and a theory for analysing the manifestations of open-source platform-based strategies in the mobile devices industry.

This researcher also matters to practitioners by producing a valuable framework giving guidance on why and how corporations follow an open-source based platform strategy, what are the main benefits/outcomes pursued and what are the main barriers and risks to face. The research will produce, as well, relevant information for both consumers and suppliers of open-source software competing in today's high-networked economy.

References

Aksulu, A., & Wade, M. (2010). A comprehensive review and synthesis of open source research. *Journal of the Association for Information Systems*, *11*(11), 576–656.

Atkinson, P. (2006). Rescuing autoethnography. *Journal of Contemporary Ethnography*, *35*(4), 400–404.

Benbasat, I., Goldstein, D. K., & Mead, M. (1987). The case research strategy in studies of information systems. *MIS quarterly*, 369–386.

Boudreau, K. (2008). Opening the platform vs. opening the complementary good? The effect on product innovation in handheld computing. *The Effect on Product Innovation in Handheld Computing (August 24, 2008)*.

Callon, M. (1986). The sociology of an actor-network: The case of the electric vehicle. *Mapping the dynamics of science and technology*, *23*.

Cambrosio, A., Keating, P., & Mogoutov, A. (2004). Mapping collaborative work and innovation in biomedicine: A computer-assisted analysis of antibody reagent workshops. *Social Studies of Science*, 325–364.

Darke, P., Shanks, G., & Broadbent, M. (1998). Successfully completing case study research: combining rigour, relevance and pragmatism. *Information systems journal*, *8*(4), 273–289.

Dedrick, J., & West, J. (2004). An exploratory study into open source platform adoption. In *System Sciences, 2004. Proceedings of the 37th Annual Hawaii International Conference on* (p. 10 pp.). IEEE.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review*, 532–550.

Elias, N. (1978). *What is sociology*. Columbia University Press.

Feller, J., & Fitzgerald, B. (2002). *Understanding open source software development*. Addison-Wesley London.

Gawer, A., & Cusumano, M. A. (2002). *Platform leadership*. Harvard Business School Press Boston.

Gawer, A., & Cusumano, M. A. (2008). How companies become platform leaders. *MIT/Sloan Management Review*, *49*.

Gawer, A., & Henderson, R. (2007). Platform owner entry and innovation in complementary markets: Evidence from Intel. *Journal of Economics & Management Strategy*, *16*(1), 1–34.

Hagiu, A. (2004). Japan's High-Technology Computer-Based Industries: Software Platforms Anyone? *RIETI Column October 19th*.

Hagiu, A., & Wright, J. (2011). *Multi-sided platforms*. Harvard Business School.

Hauge, Ø., Ayala, C., & Conradi, R. (2010). Adoption of open source software in software-intensive organizations–A systematic literature review. *Information and Software Technology*, *52*(11), 1133–1154.

Järvinen, P. (2008). On developing and evaluating of the literature review. In *The 31st Information Systems Research Seminar in Scandinavia (Workshop 3)*.

Katz, M. L., & Shapiro, C. (1994). Systems competition and network effects. *The Journal of Economic Perspectives*, *8*(2), 93–115.

Klein, H. K., & Myers, M. D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS quarterly*, 67–93.

Kozinets, R. V. (2002). The field behind the screen: using netnography for marketing research in online communities. *Journal of marketing research*, 61–72.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge university press.

Lerner, J., & Tirole, J. (2002). Some simple economics of open source. *The journal of industrial economics*, *50*(2), 197–234.

Lindman, J. (2011). *Not Accidental Revolutionaries: Essays on Open Source Software Production and Organizational Change*. Aalto University, School of Economics, Department of Information and Service Economy.

Markus, M. L., & Robey, D. (1988). Information technology and organizational change: causal structure in theory and research. *Management science*, *34*(5), 583–598.

Mason, J. (2006). Mixing methods in a qualitatively driven way. *Qualitative Research*, *6*(1), 9–25.

McMillan, D. W., & Chavis, D. M. (1986). Sense of community: A definition and theory. *Journal of community psychology*, *14*(1), 6–23.

Mingers, J. (2001). Combining IS research methods: towards a pluralist methodology. *Information systems research*, *12*(3), 240–259.

Mingers, J. (2004). Real-izing information systems: critical realism as an underpinning philosophy for information systems. *Information and organization*, *14*(2), 87–103.

Myers, M. (1999). Investigating information systems with ethnographic research. *Communications of the AIS*, *2*(4es), 1.

Myers, M. D. (1997). Qualitative research in information systems. *Management Information Systems Quarterly*, *21*, 241–242.

Myers, M. D., & Avison, D. (2002). *Qualitative Research in Information Systems: A reader*. SAGE Publications, Incorporated.

Okoli, C., & Schabram, K. (2010). A guide to conducting a systematic literature review of information systems research.

Pohl, J. G. (1998). The Future of Computing:< em> Cyberspace. *Collaborative Agent Design (CAD) Research Center*, 35.

Rainer Jr, R. K., & Miller, M. D. (2005). Examining differences across journal rankings. *Communications of the ACM*, *48*(2), 91–94.

Rochet, J.-C., & Tirole, J. (2003). Platform competition in two-sided markets. *Journal of the European Economic Association*, *1*(4), 990–1029.

Rochet, J.-C., & Tirole, J. (2006). Two-sided markets: a progress report. *The RAND Journal of Economics*, *37*(3), 645–667.

Stol, K.-J., & Babar, M. A. (2009). Reporting empirical research in open source software: the state of practice. In *Open Source Ecosystems: Diverse Communities Interacting* (pp. 156–169). Springer.

Urquhart, C., & Fernández, W. (2013). Using grounded theory method in information systems: the researcher as blank slate and other myths. *Journal of Information Technology*.

Walsham, G. (1995). Interpretive case studies in IS research: nature and method. *European Journal of information systems*, *4*(2), 74–81.

Walsham, G. (1997). Actor-network theory and IS research: current status and future prospects. *Information systems and qualitative research*, *466*, 80.

Wang, H., & Wang, C. (2001). Open source software adoption: A status report. *Software, IEEE*, *18*(2), 90–95.

Weber, S. (2004). *The success of open source* (Vol. 368). Cambridge Univ Press.

Webster, J., & Watson, R. T. (2002). Analyzing the Past to Prepare for the Future: Writing a Literature Review. *Mis Quarterly*, *26*(2).

West, J. (2003). How open is open enough?: Melding proprietary and open source platform strategies. *Research Policy*, *32*(7), 1259–1285.

Vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R., & Cleven, A. (2009). Reconstructing the giant: on the importance of rigour in documenting the literature search process. In *Proceedings of the 17th European Conference on Information Systems, Verona, Italy* (pp. 2206–2217).

Yin, R. K. (2008). *Case study research: Design and methods* (Vol. 5). SAGE Publications, Incorporated.