Factors influencing the success of platform centric ecosystem strategies : A case study of Google Android

Karthik Jayaraman
Department of Informatics
University of Oslo
Oslo, Norway.

Abstract— **The past decade has evidenced a rapid growth in the usage of mobile phones around the world. The increase in mobile phone usage has led to the emergence of new mobile phone software platforms that rely on third party developers and partners for their growth. One such mobile platform that is growing rapidly is Google's Android operating system. The purpose of this paper is to propose a framework for analyzing the success factors of mobile platform centric ecosystems strategy through a case study of the Android platform.**

Keywords— Software ecosystems, Google Android, platforms, ecosystems success model.

I. INTRODUCTION

The software industry is undergoing rapid transformation. This is due to the needs of the end consumer and the competition in the industry. To meet the needs of the consumers and the market, companies have taken their products, platforms and components and made them available to third party developers to innovate [10]. Once an organization decides to make its platform available to entities outside its boundary, it creates a software ecosystem [14]. This form of innovation by leveraging the talent pool outside the boundaries of the firms gives companies an added advantage in terms of resources and new ideas but also brings about new challenges in collaboration and sharing of control with external entities.

Software products can be classified as open or closed depending on the availability of the source code and freedoms available for end users to modify it, while mobile platform centric ecosystems are based on open innovation. Innovation in mobile platform centric ecosystems is achieved through open source code of the platform or through open interfaces which allows the platform to be extended in new ways to suit the needs of the end consumer [20]. Examples are the iOS and Android, which are both open platform's but with varying degrees of openness to facilitate complimenters to innovate around the platform. While iOS provides open interfaces for complimenters to participate in the innovation process, Android provides both open code and open interfaces to enable complimenters to innovate. Hence in a software ecosystem, strategic activities such as innovation and control are no longer the sole responsibility of platform controllers such as Apple and Google but a shared responsibility of various stakeholders. This distributed innovation model brings about new challenges related to co-ordination and management that differs from the products and platforms of the personal computing era.

There has been a plethora of research that measures the success and failure of software products but there has been limited research so far that is focused on the factors that influence the success of platform centric ecosystems. The emergence and rapid success of mobile platforms such as the Android and the significant differences between software products and platform centric ecosystems warrant a specialized study of the success factors of mobile platform centric ecosystems, which this research aims to study.

From a case study of the Android platform and building upon existing theories, this research creates an exploratory framework to explain the factors that make mobile platform centric ecosystems strategy successful. The results of this research will contribute to the existing literature on frameworks used in analyzing software success and to the emerging literature on platforms and ecosystems research.

II. THEORETICAL PERSPECTIVE

Over the past decade there has been a lot of research on software metrics in specific there has been a plethora of research that describe ways to analyze the success or failure of software projects. The relative success of a project based on open source code can depend on factors such as the chosen forge and distribution [2]. The success of projects will depend on the software system undergoing continuous change, that is it must evolve with time [3].

Some of the well known software projects such as Linux, Apache, MySQL and PHP have achieved high evolvability due to the active contribution of a large developer community and its need for change. The nature of open source licensing has an impact on the success or failure of projects [4]. The restrictive licenses have a negative impact on a project's outcome as the restrictiveness of the license inversely impacts the developer interest. Licensing influences participation in the project and the project activity levels have a strong impact on the outcomes of the project's success measurement.
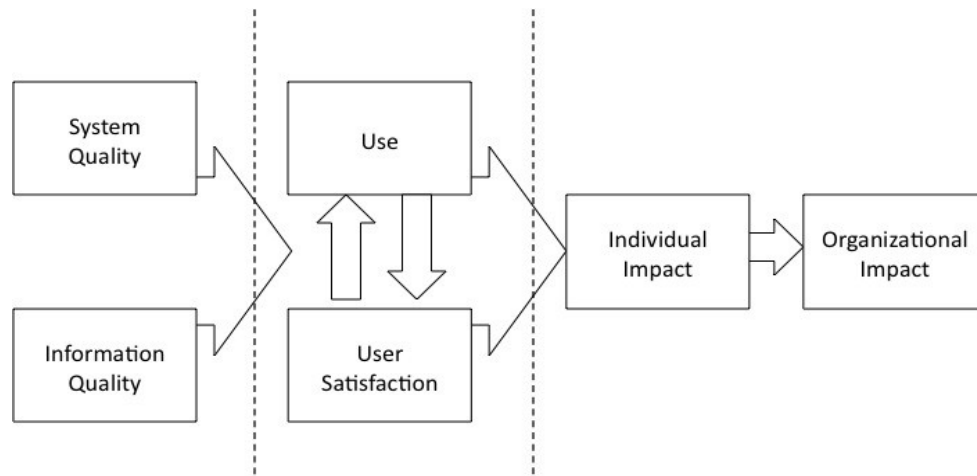
Figure 1: Information Systems Success Model - DeLone & McLean 1992

Indirect factors such as developer reputation and community interest have been key drivers of open source projects [5]. Factors such as reliability, size of the project, age and niche focus of the project can contribute to the success of software projects [6]. A similar research study on sourceforge.net projects reveals the role of developer activity and frequency of releases in different stages to determine the success or failure of open source projects.

The choice of licensing impacts development activity and in turn the overall success of the project [9]. Copy-left licenses when compared with non copy-left licenses are associated with higher developer membership, greater coding activity, faster development speed and longer developer involvement in the project, which are key to the success of software projects based on open source.

Most of the existing research in the field of software success models use either exogenous or endogenous factors to describe the fate of the projects and do not provide a comprehensive framework that combine both endogenous and exogenous factors to explain the success or failure of these projects.

A. DeLone and McLean model

The DeLone and McLean's model for Information systems success (1992) combines both external and internal factors to provide a theoretical framework for analysis of the success of generic information systems [1].

The DeLone and McLean's model shown in Figure 1 evaluates an information system based on six key factors. These factors directly or indirectly influence each other, the six factors are 1) system quality, 2) information quality, 3) use, 4) user satisfaction, 5) individual impact and 6) organizational impact. The arrows in the model describe the interdependence of the various factors.

The model suggests that the success of an information system will depend on the overall impact it has on the organization. The impact that a system has on an organization is influenced by factors such as the quality of the information and the quality of the system. Satisfied users make use of the system across the organization making the information system successful. Considered a comprehensive model to explain IS success of the 90's, the DeLone and McLean model falls short on various fronts to explain the success of open platforms.

Open platforms such as Android are driven by third party app developers in the community. Hence the community activity, response time, friendliness of the community, cycle time for bug fixes and number of active community volunteers all contribute to the success. Hence high activity and quality of service in the community will be a key factor that determines the success of open platform projects.

Although the DeLone and McLean model was updated in 2003 to include service quality, the service quality here is the response time, which is based on corporate SLA's and dedicated paid labor force that cater to servicing the end customer, this works differently in a volunteer driven systems that are based on an open code base or open interfaces where third party developers build apps on the platform.The concept of community, which is the quintessence of ecosystems, is ignored in the updated model [8].

The concept of information quality in the DeLone and McLean model is irrelevant for measuring the success of platform centric ecosystems. Some of the short falls in the DeLone & McLean model is addressed by Gupta et al. In their model, Gupta et al use some of the original concepts from the DeLone and McLean model such as software quality, use, user satisfaction and combine organizational and individual impact into a new category called net benefits [7]. While the model postulated by Gupta et al for open source software success overcomes various short falls in the DeLone and McLean model, it also ignores some of the key factors that are at the heart of the ecosystems success story.

213

Platform centric ecosystems differ in fundamental ways compared to software products that rely on market mechanisms and organizational hierarchies [18]. In software products, the governing logic is centered around product ownership, barriers to entry, switching costs and direct rivalry between various entities. while in a software ecosystem competing rival firms collaborate and exchange value with each other in a value network [21][22].Hence the competitive position of a firm participating in the ecosystem is measured through its relationships to other participants in the ecosystem [23]. Tiwana et al argue that there is a shift from application centric thinking to ecosystems centric thinking in companies and describe a framework to understand ecosystems based software platforms [13]. The metamorphosis from products to platform centric ecosystems brings about elements that are unique to this phenomenon and are not dealt in the existing literature. This research aims to address this gap.

III. RESEARCH METHOD

This research is based on a detailed case study of the Google Android operating system. The qualitative case study method with an interpretive stance is used in this research [15]. The interpretive method was pursued in this research as it facilitates the understanding of a phenomenon under study through the semantics that people assign to the phenomenon within a specific situated context [16]. Various generalizations can be created from case studies, the contributions from this case study are the generation of a framework to explain the success of platform centric ecosystems, rich descriptions of the Google Android case and drawing of some key implications from the case study.

A. Data Collection & Analysis

Secondary data is used in this research. collection of secondary data is essential in situations where information from first hand sources is hard to obtain [25]. Secondary data also helps to avoid biases and prejudices that arise in primary source based data collection methods such as first hand interviews where stakeholders may distort information to protect their organizations. The data since the initial release of the software to the present day was systemically gathered and analyzed. This collected data was then analyzed with the help of Romano et al's methodology for analyzing web based qualitative data[17]. The Romano et al' method is based on a three-step approach to collection and analysis of Internet-based qualitative data, namely: elicitation, reduction and visualization.

In the elicitation step data from multiple sources such as websites, press releases on Android, blogs, mailing lists
etc were collected and stored in a qualitative data analysis tool. Multiple data sources help in analyzing a situation from a holistic perspective and contributes to improving data quality [11] [12]. After the large data set was stored in the tool an initial screening was done with the help of word frequency analysis and querying the data set for keywords such as "Android success".

This resulted in the identification of key concepts such as open handset alliance, ecosystem, apps etc. In the second step reduction the identified concepts from the elicitation step along with the concepts from the literature review were further analyzed and selected for coding based on the initial categories.

Some of the key events, actors, and strategies were identified. Three case episodes were recognized which are described in the findings section. In the visualization phase the results from the analysis is visualized as a framework described in figure 2.

IV. FINDINGS

Three cases were identified from the data analysis in the previous section of this research. The cases describe the various aspects that make Android successful in the market place and are describes below.

Case I : Role of the ecosystem

The concept of the ecosystem is a primary driver of success of mobile platforms as a diverse ecosystem meets the long tail needs of the end user. Eric Zeman an analyst at Information Week describes

" *To say that Android's rise has been nothing short of phenomenal is an understatement. Google is activating 550,000 new Android handsets per day, and those users are downloading new apps at the rate of 1 billion per month. Apps are one reason Android is doing so well.*"

Lance Knoble an analyst with Reuters concurs with this idea, he describes the success of Android and Motorola Droid as

" *The operating system alone, however, doesn't explain the Droid's initial success, or even the iPhone's ascendancy. What Apple has done so successfully is build a thriving ecosystem around its product. The various Android-based phones are following the same path.*"

Case II: Leveraging partnerships

Google benefits from the various partners in the open handset alliance (OHA) that drive the proliferation of the Android platform. Larry Page of Google describes the role of the partners as

"*Many hardware partners have contributed to Android's success and we look forward to continuing our work with all of them on an equal basis to deliver outstanding user experiences. We built Android as an open-source platform and it will stay that way.*"

John Sutter from CNN describes the role of the OHA in the proliferation of Android and its success in the market

"There's basically one iPhone. There are dozens of Android options. At last count, in January, there were 74 smartphones for sale running Google's operating system, said Mark Donovan, a senior analyst at comScore. A Google spokesman said there are 170 Android devices in total. Among phones, Android has models on every major U.S. wireless network and on some of the smaller carriers that offer prepaid plans. AT&T was the exclusive iPhone carrier until recently, when a Verizon iPhone 4 was released. "

Case III: Platform management

The quality of the platform is managed through various control points. One such control point is the App store where Google enforces quality checks to ensure safety and stability of the platform. Gregg Keizer of Computer world describes the role of the App store and Google as

"Google removed a number of malicious applications from the Android Market last week. The programs exploited a vulnerability in the platform that allows attackers to gain root access and apparently create a backdoor for deploying further malware. ".

Google enables innovation through its control points, the platform access is managed through the apache licensing scheme which allows users to adapt and modify the platform without having to contribute back to the original developers. Google's Android project website describes the reason for choosing an open license as

"Launching a software platform is complex. Openness is vital to the long-term success of a platform, since openness is required to attract investment from developers and ensure a level playing field."

Openness assists in innovation and proliferation of Android across various devices and industries in a short span of time.

V. DISCUSSION

The success of software products as described by DeLone & McLean relies on net benefits. From the analysis of the data, the three cases seen in the findings section and review of the literature, it is observed that the success of platform centric ecosystems depends on the use and proliferation of the platform. Proliferation of the Android platform is driven by the adoption of the platform by hardware manufacturers and use is measured by the number of end users using the platform on the devices. Proliferation also entails customizations and derivative works of the original source code through forking the platform into derivatives such as Cynogenmod.

The use and proliferation of platforms is linked to factors such as high quality of the software or a constant improvement in the quality of the software over a period of time and availability of diverse applications that address the long tail needs of the consumer.

As seen in case 1, the availability of a multitude of apps is one of the key attractors for the use and proliferation of a platform. Platform controllers such as google have to facilitate third party app developers to satisfy the long tail needs of the end users. The diversity of the ecosystem is linked to the relationship between platform controllers and the complementers to the ecosystem. Greater activity of app developers that develop new applications keeps the platform innovative and draws end users to an ecosystem.

Unlike software products where innovation is the sole responsibility of the product developers, in ecosystems, innovation is no longer the sole responsibility of the platform controllers but a shared responsibility of various stakeholders such as app developers, handset manufacturers, content providers and mobile carriers. As seen in case 2 of the findings section, Google uses the Open Handset Alliance (OHA) to attract and manage its ecosystem of relationships. The alliance is a community of mobile phone manufacturers, mobile operators, software companies and semiconductor companies that work on standardizing the Android software. Partners assist in reducing the cost of R&D and development [14]. The level of power and control in the OHA is minimal but important for managing the quality of the end product. Google controls the key decisions when it comes to the core of the Android platform release. The Core Technical Team, which is headed by Google, controls the setting up of new projects and decides if the new projects will become a part of the core platform.

Some of the key benefits of the ecosystem approach are improvement in the value of the core offering to existing users, greater attractiveness for new users, improved "stickiness" factor of the end user to the application platform (stickiness refers to the users desire to stick on to the platform and not change it) and accelerated innovation through open innovation with the help of the ecosystem. Hence managing the diversity of ecosystem relationships is a key driver of success in platform centric ecosystems.

Quality of the platform depends on factors such as speed of the operating system, speed of execution of the applications, security of the platform and the application stack among other parameters. From the analysis of the data one of the key challenges with Android quality is the issue of fragmentation. This is caused by compatibility issues between versions or forking. Due to rapid innovation, applications developed for new platforms are often non backward compatible leading to crashes and security issues when executed on older versions of the platforms.

Due to factors such as planned obsolescence, device manufacturers do not often provide upgrades to the latest version of the platform exposing the platform to bugs and security flaws. As seen in case 3, platform controllers such as Google use control points such interfaces and licenses to control the stakeholders
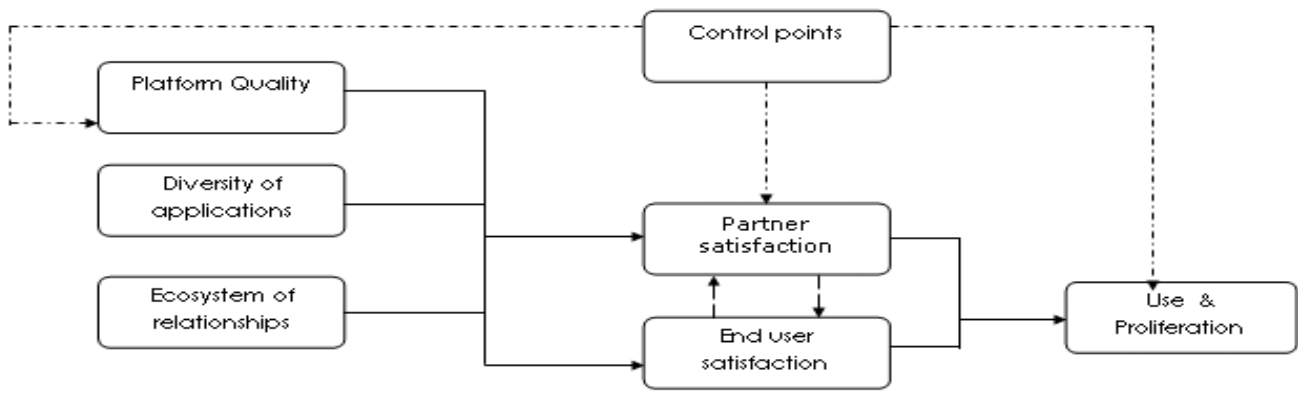
Figure 2: Framework for success of platform centric ecosystems strategy

Licensing plays a key role both in use and proliferation, as mobile software such as mobile operating systems and browsers are often tightly coupled with the hardware, a flexible copy left licensing helps the hardware vendors gain control of the product and plays a key role in the decision making process. Copy-left licenses contribute to greater community involvement, which influences rapid evolution of the product and in turn influences use and proliferation.

Control points can be used by platform controllers as a way to monetize from the platform. The platform controllers have to balance their own interest with the interest of the complementers and take into account the required level of co-specialized investment, value appropriation and the platforms future direction [24]. The rapid growth of Android has been attributed to its flexible platform control scheme which is enacted through a copy left license. Android is licensed under Apache Software License (ASL) version 2. The ASL is designed to promote commercial development and proprietary redistribution of the source. ASL allows for the integration of the source code into proprietary products and allows for the redistribution of the same without the requirement for the changes to be shared with the community. This is a big difference compared to pure open source licenses such as GPL that require changes to be resubmitted to the community. Companies making proprietary commercial products around Android can do so because of the ASL. This applies only to the Android architecture, third party applications that run on top of the Android architecture can be distributed under their own licenses. Android's flexible apache licensing scheme has attracted developers to the community and has led to its use in hundreds of different types of devices ranging from cell phones to television sets. Control points around the platform ensures quality by blocking undesired apps and content. These are enacted in the form of licensing and terms of use for the applications in the Appstore, core platform components and licensing agreements for platform components such as SDK. One of the key challenges in a platform centric ecosystem strategy is to satisfy the needs of the partners.

Platforms that are part of an ecosystem are inherently open to facilitate innovation. This openness can entice unsatisfied partners to either switch to another ecosystem or to fragment the platform through forking. This can lead to security, performance and other quality issues. Factors such as economic interests, technological change, strategy, ideology, political and legal issues lead to the fragmentation of platforms. End user satisfaction is influenced by the usability, quality of the platform, the availability of a wide range of applications in the application ecosystem, a strong community of end users and application developers and finally the ability to access and share information such as email, news, calendar and other key applications across devices.

A survey conducted by ChangeWave with 4068 consumer's shows that the Android operating system is gaining in user satisfaction and ranks second among all the smart phones in end user satisfaction [19]. Android has also been steadily gaining market share and is out competing other well-established players such as Symbian and Blackberry and is today the largest platform centric ecosystem. Use and proliferation is determined by the number of Android activations and the availability of Android on a wide variety of devices. The Android operating system, supported by a vibrant community, large ecosystem, flexible licensing scheme has found its way in over a hundred devices, which include Smartphone's, tablet computers, E-reader devices, televisions and mp3 players. The list of these devices increases with the number of companies joining the open handset alliance and with an increase in unofficial ports across various devices. Use can be measured through the sales and adoption by end users; research on Android suggests that it is the fastest growing mobile OS and it recently overtook Symbian the market leader. Hence use and proliferation depends on both the end user satisfaction and the satisfaction of the partners who contribute to the diversity of the platform. The Framework synthesized in figure 2 describes the fundamental ways in which platform centric ecosystems differ from existing software products. In an ecosystem, outward looking activities such as creating diversity through external contributions and managing relationships with partners are key activities compared to an inward looking approach seen in existing success models of software products.

VI. CONCLUSION & FUTURE WORK

The aim of this research was to study the factors thats make mobile platform centric ecosystems strategy successful. The findings of this research demonstrate significant differences between the success of software products and platform centric ecosystems. One of the key difference is the openness and reliance on third party app developers and partners to make the platform successful. Hence factors such as diversity of the applications and partnerships play a key role in the success of platform centric ecosystems.

This study takes into account, key mobile platform centic ecosystem characteristics and encapsulates both exogenous and endogenous factors to provide a more holistic understanding of the success of platforms such as Android. Use and proliferation the end goal is directly related to user satisfaction and satisfaction of the partners contributing to the growth of the ecosystem. The model in this research is exploratory in nature and is built upon some of the elements of the DeLone & McLean model such as software quality and use and adds some salient factors that are relevant to the success of mobile platform centric ecosystems, which were derived from the case study. While the framework postulated in this research tries to bring together various factors to explain the success of mobile open source software it does not describe the relative significance of one factor over the other.

More research is needed to corroborate many of the findings of this research. One of the caveats is that the analysis is restricted to the Andorid ecosystem. While this restriction has assisted in generating the framework and a better understanding of the factors that make platform centric ecosystem strategies successful, to improve our understanding of the success factors, we would require more cases where the framework and the interplay between various factors described in the model can be tested.

REFERENCES

[1] W. H. DeLone and E.R. McLean, Information systems success: the quest for the dependent variable, Information Systems Research 1992;3(1): pp. 60–95.

[2] S. Rank, K. Beecher, C. Boldyreff and A. Capiluppi, Evolutionary success of Open Source Software: an investigation into exogenous drivers, Electronic communications of the EASST, 8 . ISSN 1863-2122

[3] M.M. Lehman, Metrics and Laws of Software Evolution—The Nineties View. In El Eman and Madhavji (eds.), Elements of Software Process Assessment and Improvement, IEEE CS Press, Albuquerque,New Mexico, 5–7 Nov. 1997. pp. 20–32.

[4] C. Subramaniam, R. Sen and M.L, Nelson, Determinants of open source software project success: A longitudinal study, Decision. Support Systems. 46, 2 , January 2009.

[5] K. Crowston, H. Annabi, H., J. Howison, Defining open source software project success, Proceedings of the 24th International Conference on Information Systems, Seattle,WA, 2003.

[6] S.C. Smith, A. Sidorova, Survival of open-source projects: A population ecology perspective by: Proceedings of International Conference on Information Systems 2003.

[7] S-Y. Lee, H-W. Kim, S. Gupta, Measuring open source software success, 2009, vol. 37, issue 2, pp 426-438

[8] W.H. DeLone, E.R. McLean. The DeLone and McLean model of information systems success: a ten-year update, Journal of Management Information Systems 2003; 19(4): pp 9–30.

[9] J. Colazo, Y. Fang, Impact of license choice on Open Source Software development activity, Journal of the American Society for Information Science and Technology (May 2009), pp 997-1011.

[10] J. Bosch, Software ecosystems: Taking software development beyond the boundaries of the organization, Journal of System Software 85, 7, July 2012, 1453-1454.

[11] J.W. Creswell, Qualitative inquiry and research design: Choosing among five traditions (2nd Ed), Thousand Oaks, CA: Sage.

[12] S.K. Soy, The case study as a research method, URL: http://www.gslis.utexas.edu/~ssoy/usesusers/1319d1b.htm

[13] A. Tiwana, B. Konsynski, A.A. Bush, Research Commentary---Platform Evolution: Coevolution of Platform Architecture, Governance, and Environmental Dynamics, Information Systems Research archive, Volume 21 Issue 4.

[14] J. Bosch, From software product lines to software ecosystems. In Proceedings of the 13th International Software Product Line Conference (SPLC '09). Carnegie Mellon University, Pittsburgh, PA, USA, 111-119.

[15] R.K. Yin, Case Study Research: Design and Methods, Sage, London.

[16] G. Walsham, "Interpretive case studies in IS research: nature and method", European Journal of Information Systems 4: 7.

[17] N.C. Romano, C. Donovan, H. Chen, and J.F. Nunamaker, "A methodology for analyzing web-based qualitative data," Journal of Management Information Systems, (19:4), 2003, pp. 213-246.

[18] R. Adner, R. Kapoor, Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations. Strategic Management Journal, 31: pp. 306-333.

[19] New Survey Shows Android OS Roiling the Smart Phone Market. URL:http://www.changewaveresearch.com/articles/2010/01/smart_phone_20 100104.html

[20] K. Boudreau, "Open Platform Strategies and Innovation: Granting Access vs. Devolving Control," Management Science (56:10) 2010, pp. 1849-1872.

[21] K. Walley, " Coopetition: An Introduction to the Subject and an Agenda for Research". international Studies of Management and Organization, 37(2), pp 11-31.

[22] J. West, D. Wood, "Creating and evolving an open innovation ecosystem: lessons from Symbian ltd", Working Paper

[23] L. Selander, O. Henfridsson, F. Svahn, " Transforming Ecosystem Relationships in Digital Innovation ". ICIS 2010 Proceedings. Paper 138.

[24] R. Garud, A. Kumaraswamy, R. Langlois, Managing in the modular age: architectures, networks, and organizations. Oxford: Blackwell.

[25] A.B. Hargadon, Y. Douglas, When Innovations Meet Institutions: Edison and the Design of the Electric Light. Administrative Science Quarterly, 46, 476-501.