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Software Ecosystems

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The Authors

Dipl.-Wirtsch.-Inform.
Christoph Burkard
Dr. Thomas Widjaja
Prof. Dr. Peter Buxmann (✉)
Information Systems/Software
Business & Information Management
TU Darmstadt
Hochschulstr. 1
64289 Darmstadt
Germany
burkard@is.tu-darmstadt.de
widjaja@is.tu-darmstadt.de
buxmann@is.tu-darmstadt.de

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1 Introduction

In the software industry, more and more products are offered as systems that are composed of complementary components. Certain components constitute the core product which is the center of a so-called "Software Ecosystem" (SECO). In addition, complementary components are offered by independent vendors (Bosch 2009, p. 1). SECOs are generally defined as "a set of actors functioning as a unit and interacting with a shared market for software and services, together with the relationships among them. These relationships are frequently underpinned by a common technological platform or market and operate through the exchange of information, resources and artifacts" (Jansen et al. 2009, p. 35). The idea to offer software systems based on core products combined with complementary solutions from an ecosystem is applied in both the business-to-business (B2B) and the business-to-consumer (B2C) sector. Examples in the B2C sector are *Apple* with its *App Store*, *Google* with its *Android Marketplace* and *Microsoft* with its *Windows Phone Marketplace*. *The App Store* is the biggest SECO of these examples having sold 160 million consumer devices (so-called iOS devices; as of December 2010) and with 70.000 independent vendors participating in the US *App Store*.[1] In the B2B sector, several providers pursue similar approaches. Companies like *salesforce.com* with *AppExchange*, *SugarCRM* with *SugarExchange*, *NetSuite* with *SuiteApp.com*, *Google* with the *Google Apps Marketplace* and *Microsoft* with *Pinpoint* run marketplaces to supplement their products with complementary applications. These applications are either offered by the respective company itself or by independent vendors.

In the existing literature, different types of actors in a SECO are identified and differentiated into "hubs", "niche players", and "customers" (Iansiti and Levien 2004, pp. 5 and 9). While the hub provides the software platform[2] as the SECO's core product, niche players offer specialized products around the core, typically sold via marketplaces like the *App Store*. Although in most cases niche players are numerous, their influence on the SECO is generally limited. Depending on the strategy followed by the hub, three different roles of the hub can be distinguished: the "keystone", the "physical dominator", and the "value dominator". While keystones are characterized by the benevolence of their behavior, physical and value dominators try to dominate a large percentage of the offered products in SECOs or of their value respectively (Iansiti and Levien 2004, pp. 6–9; Bosch 2009, p. 7). In literature, the characteristics of SECOs (e.g., the composition of the SECO in terms of actor types, entry barriers, and robustness of the system; cf., for example, Jansen et al. 2009) and the motives of its actors, as, for example, market access from the perspective of the niche players (e.g., Hilkert et al. 2010) have been analyzed.

2 Software Ecosystems from a Network Effect Perspective

An important underlying economic concept of SECOs is described in the theory of so-called two-sided markets. Rysman (2009, p. 125) defines these as markets "in which (1) two sets of agents interact through an intermediary or platform, and (2) the decisions of each set of agents affects the outcomes of the other set of agents, typically through an externality." Within SECOs, the two actor types, niche players and customers, each constitute one side of the market. Based on the interaction within and between the two sides, so-called network effects occur. Network effects are present when the utility of an item depends on the number of customers using this good. In the context of two-sided markets both consumers and niche players can be considered as users. Literature distinguishes between direct and indirect network effects (Katz and Shapiro 1985, p. 424; cf. **Fig. 1**). While direct network effects occur on the same side (e.g., by a data exchange between consumers), indirect network effects occur on the respective other side of the two-sided market (e.g., caused by an increase of complementary niche solutions offered).

Figure 2 shows the number of niche solutions in the B2B marketplaces presented above.[3] For *AppExchange* and *NetSuite* the initial publication dates of niche

[1] Determined by means of the "Framework for automated Data Collection in Online Marketplaces" (FaDOM) as of beginning of March 2011.
[2] Evans et al. (2006, p. vii) describe a software platform as "a software program that makes services available to other software programs through Application Programming Interfaces (APIs)."
[3] The data are collected weekly by FaDOM since 2010. For every marketplace only Software as a Service products are considered (e.g., the category "Online Application") for reasons of comparability. The data for *Pinpoint* refer to the US version. The gap at *AppExchange* results from a deficient data collection on 2010-11-15 which was not included in the evaluation.

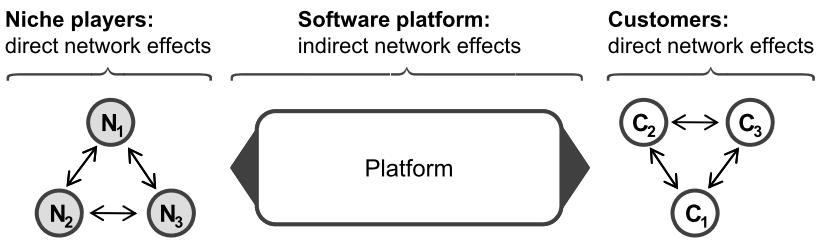

Fig. 1 Direct and indirect network effects

solutions are publicly available. Therefore, the time period before our first collection (marked by vertical black lines) can also be shown. While analyzing the data, we noticed that already at the time of the launch of the marketplace *salesforce.com* offered a significant amount of niche solutions itself via so-called dependent niche vendors (compare the curve "AppExchange" with the curve "AppExchange – independent niche players only").[4] Furthermore, in the following, constantly new niche solutions are offered by *salesforce.com* on *AppExchange* (notice the increasing distance between the two curves for AppExchange). However, for all other examined hubs the percentage of own niche solutions offered is low compared to the entire number of solutions in the respective marketplace (<1.35%).

A possible explanation for *salesforce.com*'s approach can be the so-called "chicken and egg problem" which results from indirect network effects on two-sided markets (Katz and Shapiro 1994, p. 102). Typically, at the time of a SECO's market-launch, neither niche players nor customers are present: While niche players take into account the number of potential customers for the decision whether to participate in a marketplace, the customers preferably join marketplaces which offer a large number of complementary solutions. Therefore, it is difficult for a hub to gain both niche players and customers. From the hub's perspective, an approach to solve this problem during the launch phase of a marketplace, is presented by offering own niche solutions (e.g., Katz and Shapiro 1994, p. 102; cf. **Fig. 2**). Thus, the attractiveness of the platform as perceived by customers can be enhanced.

Multi-homing is a further aspect discussed in the context of the theory of two-sided markets. It can be defined as the strategy of vendors or customers to use more than one platform in order to reach more customers or to use more niche solutions respectively (Armstrong 2006, p. 669).

Figure 3 shows the relations of the respective niche players (circles)[5] to the considered hubs (squares) for the examined B2B environment, i.e. the presence of at least one niche solution offered by the respective niche player in the respective marketplace. The dependent niche players are depicted by means of the pattern of the respective market. It is striking, that the niche player *salesforce.com* (small checked circle) is the only dependent vendor active in two marketplaces. Furthermore, we note that none of the vendors offer solutions in all five examined marketplaces. Only three vendors are active in four marketplaces, while six vendors are active in three marketplaces. 73 vendors offer applications in two marketplaces. In the context of B2C SECOs multi-homing can be observed on the vendor side as well. For example, niche solutions of the social network *Facebook* or the game *Flight Control* are offered for various SECOs.

3 Design Options of a Hub

When it comes to providing a platform and possibly a marketplace for niche solutions, from the hub's perspective several design decisions have to be taken, especially concerning the openness of the software platform, the management of the niche players and the revenue model (Buxmann et al. 2011, pp. 197–203; Roson 2005, p. 146).

3.1 Openness of the Software Platform

The openness of a software platform particularly refers to the degree of restrictions with respect to development, commercialization, and use of the platform. A platform is said to be completely open if no restrictions concerning the mentioned aspects apply. Furthermore, a differentiation between horizontal and vertical openness can be made (Eisenmann et al. 2009, pp. 131–133).

Horizontal openness describes the relations of the hub to other platforms. Apart from licensing new platform operators and including platform sponsors which participate in the further development of the platform, it is an important design decision whether to make the platform compatible with other platforms (Eisenmann et al. 2009, pp. 137–142). In this context, compatibility is defined as the ability to integrate niche solutions of competing platforms into the own platform (Katz and Shapiro 1985, p. 425).

While horizontal openness refers to the relations with other platforms, vertical openness affects the relations of a hub with the niche players. Design decisions concern backward compatibility (securing the functioning of existing niche solutions in updated platform versions), the ex post integration of (mostly successful) niche solutions into the platform (incorporation of functionalities of a niche solution into the functions of the platform; hereby, the respective niche solution might become obsolete for the consumer) as well as the exclusiveness of niche solutions. In this context, exclusiveness stands, for example, for the contractual inhibition of multi-homing on the vendor's side. For the hub, the advantage of such a strategy is the fact that certain niche solutions are available to the consumers only on its own platform. Another aspect is the exclusion of rival niche solutions. This gives niche players the advantage of securing a business segment for their own niche solution exclusively (Eisenmann et al. 2009, pp. 143–146; Cusumano and Gawer 2002, p. 53).

We can illustrate the development of vertical openness by the example of *Apple*'s iOS platform. When the iOS platform was launched, it was only available for *Apple*'s own niche solutions.

[4]The mapping of dependent vendors was conducted by name of the vendor. The three vendors "*Force.com Labs*" (246 niche solutions), "*salesforce.com*" (10 niche solutions) and "*Salesforce.com Foundation*" (5 niche solutions) could be identified as dependent niche vendors.

[5]The bigger, the more niche solutions; the size of the biggest, checked circle – *Force.com Labs* – was reduced due to the large number of niche solutions. Note that the positions of the circles in the figure have no meaning.

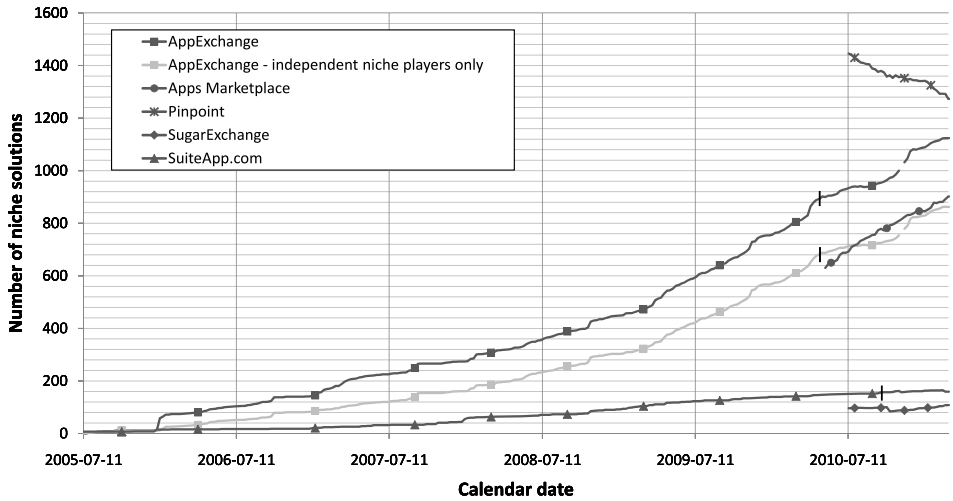

Fig. 2 Number of Software as a Service niche solutions per SECO in the B2B sector

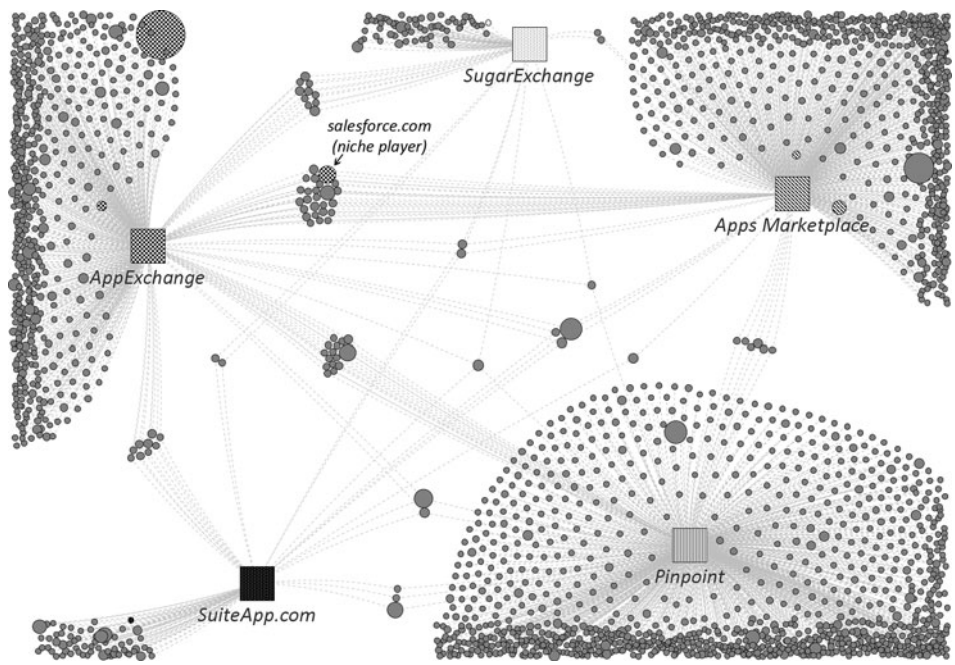

Fig. 3 Multi-homing by vendor in the B2B sector (2011-02-28)

Later on, with the launch of the *App Store*, it opened up for niche solutions of independent vendors. Since then, *Apple* takes the role of a so-called "gatekeeper", as it verifies niche solutions before their obligatory release in the *App Store*. While, for example, the release of *Google Voice* was delayed for a long time, other applications were completely rejected by *Apple*. Furthermore, the iOS platform relies on its own development environment so that niche solutions cannot be transferred to or from competing platforms without adjustments (cf. horizontal openness).

3.2 Management of Niche Players

Due to the increasing enhancement of the hub's core product through niche solutions, handling of niche players gains in importance for the hub (Yoffie and Kwak 2006, p. 90). On the one hand, the hub has to determine the boundaries of the SECO, i.e., apart from specifying the core product (e.g., the platform and the associated marketplace) it is necessary to determine geographic boundaries or licensing rights for the niche players. Another aspect in this context is the degree of support for niche players which is expressed, for instance, in sharing intellectual property with them or in communicating long-term development plans (Jansen et al. 2009, pp. 36–43).

The management of niche players influences their composition. **Figure 4** exemplarily shows the development of the niche players' composition for the *Apps Marketplace* and *AppExchange* over time. For example, whereas 370 vendors (i.e., 72.1%) offer one niche solution, 74 vendors offer two niche solutions on *AppExchange*. Similar percentages of vendors offering only one niche solution apply to the *Apps Marketplace* (84.0%), *Pinpoint* (85.5%), *SugarExchange* (81.0%) and *SuiteApp.com* (78.8%). In general, two growth types can be distinguished for the total number of niche solutions: on the one hand, growth due to new vendors, on the other hand, growth due to new niche solutions by vendors which already participate in the marketplace. While, as of 2010-05-17, 81.8% of the vendors in the *Apps Marketplace* offered only one niche solution, on 2011-02-28 the percentage had grown to 84.0%. On *AppExchange* the corresponding percentage only varied slightly around 73.7% un-

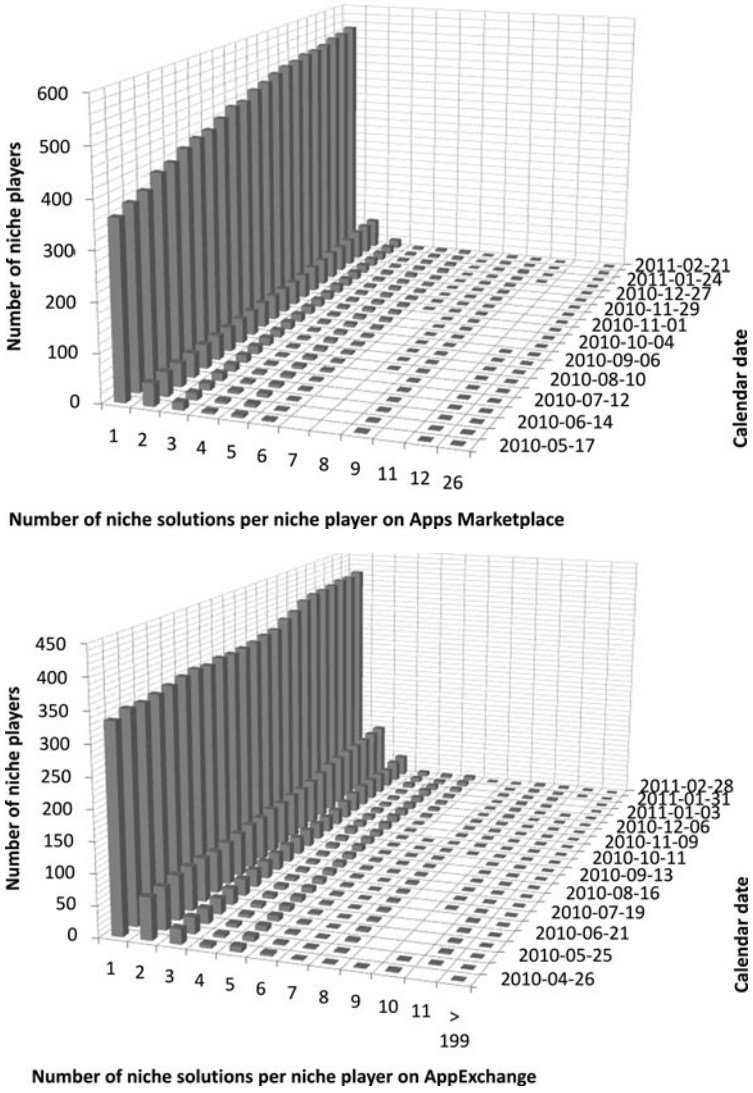

Fig. 4 Number of niche solutions per niche player on Apps Marketplace and AppExchange

til the end of November 2010. This indicates that the *Apps Marketplace* grows via new niche vendors, whereas *AppExchange* expands with a combination of new vendors (with new niche solutions) and vendors with new niche solutions who also previously were active on the platform.

3.3 Revenue Models

In the existing literature, two different perspectives on revenue models in a SECO can be identified. On the one hand, hubs and niche players offer their products to the consumer at a certain price (Lehmann and Buxmann 2009, p. 452). On the other hand, from the hub's perspective, the price model for niche players and their products respectively constitutes an important design decision (Roson 2005, p. 146). In this context, literature frequently distinguishes between fixed and variable price models (e.g., Rochet and Tirole 2003, p. 1010). This fundamental differentiation is also of importance in practice. For example, in the *App Store* each vendor has to pay a fixed charge (99 USD per year) and 30% of revenue obtained from niche solutions. For *AppExchange* there is no charge per vendor. However, the costs for the authorization process of a commercial niche solution amount to USD 300 in the first year and USD 150 annually from the second year. In conclusion, it seems with regard to the considered design decisions that providers of new SECOs merely imitate successful models. A possible explanation may be that the development of theories explaining the interdependencies between the design decisions of a SECO (Sect. 3) and the success of an ecosystem is still subject to current research.

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