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A method for defining a regional software ecosystem strategy: Colombia as a case study

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ABSTRACT

Software ecosystems (SECO) have been related to products or to a community of developers around a product. The SECO concept can also be applied to describe regional software ecosystems in which different software companies collaborate in a specific market based on a set of concrete technologies and using a set of capabilities. This paper details a regional SECO concept and a method based on regional endogenous capabilities and country needs to define a SECO strategy. Traditional strategy definition approaches are top-down, whereas this approach is a blended approach that merges bottom-up based on current regional capabilities and top-down based on market and technology trends. This paper presents a large case study performed in 6 regions of Colombia. We conducted 49 interviews and 16 workshops in which 654 attendees participated, and we developed the Colombian ICT national strategic plan based on this approach.

1. Introduction

The literature relates the software ecosystem (SECO) concept, for example, to a community of developers around a product or developers around open-source communities (Iansiti and Levien, 2004; Lungu and Lanza, 2010; Bosch, 2012a). Thus, software communities are moving from segregated communities/organizations towards open and networked organizations (Hanssen, 2012). Related studies around software ecosystems are mainly focused on products (Iansiti and Levien, 2004), or on software engineering approaches such as software product lines (Bosch and Bosch-Sijtsema, 2010), or they describe software ecosystem perspectives (Jansen et al., 2009). Systematic literature reviews (SLR) (Kitchenham et al., 2010) have been performed in software ecosystems (Manikas and Hansen, 2012). All these studies regarding SECO, from SLR to industry, reveal complex relationships among software ecosystem stakeholders such as in Jansen et al. (2009), in which the authors define different actors in a software ecosystem, or in Manikas and Hansen (2012), in which the authors highlight a software ecosystem architecture that identifies several actors from not only a software engineering perspective but also from a business and management perspective. Thus "*To our knowledge there is no study in the SECO literature on the different management entities and the decision making mechanisms applied to drive the SECO*" (Manikas and Hansen, 2012).

Software ecosystems derive from business ecosystems in such a manner that "*companies coevolve capabilities around a new innovation: they work cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations*" (Moore, 1993). This concept of a software ecosystem also exists in geographic areas such as India (Bosch and Bosch-Sijtsema, 2010). Jansen et al. (2009) define a software ecosystems as "*… a set of businesses functioning as a unit and interacting with a shared market for software and services, together with the relationships among them*".

Our approach for software ecosystems extends the Jansen et al. (2009) approach by including a regional aspect and by merging existing proposals. This approach implies the involvement of different actors playing SECO roles such as "Orchestrator, Niche and Customer" (Manikas and Hansen, 2012). In fact, we include in these environments actors such as governments, support agencies, academia and software industry clusters. This type of ecosystem must be identified and defined when governments want to develop an ICT (Information and Communication Technologies) strategy for a region such as Croatia (Sinjeri et al., 2010) or for general concepts such as eGovernment strategies (Hackney et al., 2008). Traditional approaches for defining a strategy can be applied, such as in Schoemaker (1993), in which multiple scenarios are defined, or in Kanungo et al. (2001), in which the authors analyse IT strategies and relate them to organizational cultures. However, the strategies do not follow a systematic approach based on their software ecosystem's capabilities and are not always appropriate for this type of ecosystem. This paper provides a bottom-up approach based on Technology Roadmapping (TRM) (Geum et al., 2011; Phaal et al., 2003) to define a strategy for a regional SECO to support the definition

Abbreviations: AHP, Analytical Hierarchy Process; FDI, foreign direct investment; GDP, gross domestic product; ICT, Information and Communication Technologies; SECO, software ecosystem.

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of an ICT strategic national plan. In fact, this plan was supported by the Colombian ICT ministry, and it is accessible at http://goo.gl/OlircL (last view 11/18/2015).

This paper reports an industrial experience based on a large case study performed in Colombia that involved 6 different regions where we defined a method to define a strategy for regional SECOs. A regional software ecosystem strategy is defined and applied for developing the strategy based on regional endogenous capabilities.

Based on this situation, we define the following research questions:

RQ1: How can we define a regional software ecosystem strategy?
RQ2: What is the structure of a regional software ecosystem?
RQ3: What are the main findings in a real scenario?

The remainder of this paper is structured as follows. Section 2 presents the research background by introducing software ecosystem perspectives and TRM. Section 3 outlines our regional software ecosystem concept. Section 4 describes our method for defining a regional SECO strategy and shows results from our case study. Section 5 discusses the limitations and findings on regional software ecosystems. Finally, a conclusion is provided in Section 6.

2. Research background

2.1. Strategy formulation

A prescriptive approach can be used for a strategy formulation process (Ansoff, 1965). Several research works have thus been performed such as described by Platts et al. (1998) in which a set of desirable characteristics are defined for a manufacturing strategy formulation. In addition descriptive approaches (Voss, 1990) are also thus used (Platts et al., 1996). All these approaches are under external and internal influences such as environmental, societal and political changes, among others, due to globalization (Shin et al., 1999). Government structures' stability is required for long-term strategies (Shin et al., 1999).

However, Pierre Rossel states in Rossel (2011) that "…*traditional Ansoffian schemes for tackling early evidence of changes is by no means obsolete or off-track, but should be considered with caution as sometimes insufficient, or even, as we have seen, risky (wishful thinking). As a response to the emergence of a clear threat, or as a counter-routine measure, they have to be completed with more demanding epistemologies and their corresponding methods, configured each time according to needs and context*". Therefore, the adaption of strategies to concrete needs and contexts with a focus on local capacities is required (Ika et al., 2012). In addition, an ICT strategy plan should align trends and visions within the ICT industry (Battistella and De Toni, 2011), and this is one of the principles in our proposed method. Hadighi et al. (2013) propose a strategy formulation framework based on a clustering approach for corporate departments in which they highlight the value of different capacities from different departments.

2.2. Software ecosystems

Software ecosystem has been used as a term to refer to a community of developers around a product (Iansiti and Levien, 2004; Jansen et al., 2009). Jansen et al. (2009) provide examples such as Microsoft SECOs and iPhone SECO. Bosch and Bosch-Sijtsema (2010) highlight software ecosystems such as one of the most recent trends in the domain of Web2.0 companies. Open source approaches have also been studied as part of ecosystems (Mizushima and Ikawa, 2011). In fact, Squire and Williams (2012) explore free, libre, and open source forged ecosystem data.

Viljainen, M. and Kauppinen (2011) investigate which management practices can be related to the management of these SECOs such as software supply network management and technology asset management. Bosch (2012b) identifies three stakeholders or parties to be prioritized: the keystone company that provides the basic software ecosystem platform, the external developer community and the end-user who composes the platform with the independent extensions. Manikas and Hansen (2012) analyse software ecosystems from a systematic literature review and they identify a set of actors in SECO (Kitchenham et al., 2010).

As stated previously, a software ecosystem derives from a business ecosystem in which software companies cooperate to provide new products, satisfy customer needs or to incorporate innovations into their products (Moore, 1993). This perspective of software ecosystem can be translated to geographic areas such as Silicon Valley in the United States where we can find keystone companies that provide software platform products, a set of providers and consumers for this platform, and a collaboration network. In fact, we can identify most of the principles of the software ecosystems theory identified by Hanssen (2012). Silicon Valley is considered a start-up ecosystem, and there is a large concentration of keystone software companies such as Facebook, Yahoo, Microsoft, Google, and other companies within their ecosystems (Telefonica digital and Startup genome, 2012; Jansen et al., 2009). Another example is Bangalore and Chennai in India, where Information Technology (IT) companies have enabled software ecosystems around business process outsourcing or software factories (NASSCOM, 2012). These particular cases are special software ecosystems where the geographical component is relevant. In these cases, governments play a key role in SECO as orchestrators. Our approach for software ecosystems includes the geographical dimension, and it extends the Jansen et al. (2009) software ecosystem definition by deriving the following actors (Manikas and Hansen, 2012):

- Orchestrator: One relevant player in SECO is the government layer that can be managed by any organization or government to drive all forces and efforts around a set of products/business units/on specific regions. The software industry's clusters and academia are also perceived as orchestrators when they participate in these management activities.
- Niche: The software industry's clusters and academia also play a niche role depending on the cases that contribute to keystones.

3. Regional software ecosystem

One of the challenges identified by Jansen et al. (2009) is "developing policies and strategies within SECOs for SECO orchestration".

In fact, a strategy steers a SECO, and it may involve different stakeholders such as external actors, vendors, orchestrators, customers and niche during the strategy definition for a SECO according to Manikas and Hansen (2012).

Our approach stresses the geographic dimension to define a regional software ecosystem. A strategy relies on a keystone that is aligned with the conceptual model of a keystone-centric software ecosystem developed by Hanssen (2012). Therefore, a keystone can develop a niche or a set of niches related to this keystone. A strategy should consider these keystones and niches and identify vendors and external actors (e.g., consumers). Orchestrators are enablers of this strategy for a specific region (Fig. 1).

Hanssen (2012) defines certain relationships among stakeholders that relate strategy to product line concepts, and defines two extensions of Trist's work (Trist, 1977) for software ecosystems: "*the shared value of a software ecosystem is both the software product and the business domain*, and *the control of and influence on its development becomes a shared responsibility between the sup- plier and the external environment*" (Hanssen, 2012). These propositions are also considered in our model (Fig. 1).

A software ecosystem can be composed of other software ecosystems. Generally, this fact depends on a geographic component. Cuesta et al. (2010b) and Cuesta et al. (2010a) analyse the software industry of one Colombian region, the so-called Coffee Triangle, and stressed the value of a software industry as an ecosystem. Thus, it is easier to analyse a smaller region than a larger region. This finding is because vast regions contain larger software industries than smaller ones, and