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Motivating the contributions: An Open Innovation perspective on what to share as Open Source Software

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ABSTRACT

Open Source Software (OSS) ecosystems have reshaped the ways how software-intensive firms develop products and deliver value to customers. However, firms still need support for strategic product planning in terms of what to develop internally and what to share as OSS. Existing models accurately capture commoditization in software business, but lack operational support to decide what contribution strategy to employ in terms of what and when to contribute. This study proposes a Contribution Acceptance Process (CAP) model from which firms can adopt contribution strategies that align with product strategies and planning. In a design science influenced case study executed at Sony Mobile, the CAP model was iteratively developed in close collaboration with the firm's practitioners. The CAP model helps classify artifacts according to business impact and control complexity so firms may estimate and plan whether an artifact should be contributed or not. Further, an information meta-model is proposed that helps operationalize the CAP model at the organization. The CAP model provides an operational OI perspective on what firms involved in OSS ecosystems should share, by helping them motivate contributions through the creation of contribution strategies. The goal is to help maximize return on investment and sustain needed influence in OSS ecosystems.

1. Introduction

Open Innovation (OI) has attracted scholarly interest from a wide range of disciplines since its introduction (West and Bogers, 2013), but remains generally unexplored in software engineering (Munir et al., 2015). A notable exception is that of Open Source Software (OSS) ecosystems (Jansen et al., 2009a; West, 2003; West and Gallagher, 2006). Directly or indirectly adopting OSS as part of a firm's business model (Chesbrough and Appleyard, 2007) may help the firm to accelerate its internal innovation process (Chesbrough, 2003). One reason for this lies in the access to an external workforce, which may imply that costs can be reduced due to lower internal maintenance and higher product quality, as well as a faster time-to-market (Stuermer et al., 2009; Ven and Mannaert, 2008). A further potential benefit is the inflow of features from the OSS ecosystem. This phenomenon is explained by Joy's law as *"no matter who you are, not all smart people work for you"*.

From an industry perspective, these benefits are highlighted in a recent study of 489 projects from European organizations that showed projects of organizations involving OI achieved a better financial return on investment compared to organizations that did not involve OI (Du et al., 2014). Further, two other studies (Laursen and Salter, 2006; Munir et al., 2017) have shown that organizations with more sources of external knowledge achieved better product and process innovation for organization's proprietary products. Moreover, a recent survey study (Chesbrough and Brunswicker, 2014) in 125 large firms of EU and US showed that 78% of organizations in the survey are practicing OI and neither of them has abandoned it since the introduction of OI in the organization. This intense practicing of OI also leads 82% of the organizations to increase management support for it and 53% of the organizations to designate more than 5 employees working full-time with OI. Moreover, the evidence suggests that 61% of the organizations have increased the financial investment and 22% have increased the financial investment by 50% in OI.

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To better realize the potential benefits of OI resulting from participation in OSS ecosystems, firms need to establish synchronization mechanisms between their product strategy and product planning (Fricker, 2012), and how they participate in the ecosystems and position themselves in the ecosystem governance structures (Munir et al., 2015; Wnuk et al., 2012; Stam, 2009; Baars and Jansen, 2012). This primarily concerns firms that either base their products on OSS or employ OSS as part of their sourcing strategy. To achieve this synchronization, these firms need to enrich their product planning and definition activities with a strategic perspective that involves what to keep closed and what to contribute as OSS. We label this type of synchronization as *strategic product planning* in OI. *Contribution strategies* (Wnuk et al., 2012), i.e., guidelines that explain *what* should be contributed, and *when* play a vital role here. A common strategy is to contribute parts considered as a commodity while keeping differentiating parts closed (West, 2003; Henkel, 2006). The timing aspect is critical as functionality sooner or later will pass over from being differentiating to commodity due to a constantly progressing technology life-cycle (Van Linden et al., 2009). This strategy is further emphasized by existing commoditization models (Van Linden et al., 2009; Bosch, 2013). However, these models are not designed with active OSS ecosystem participation in mind and lack support for strategic product planning and contribution strategies.

In this paper, we occupy this research gap by presenting a Contribution Acceptance Process (CAP) model. The model was developed in close collaboration with Sony Mobile. Sony Mobile is actively involved in a number of OSS ecosystem, both in regard to their products features and their internal development infrastructure.[1] With the consideration of OSS as an external asset, the CAP model is based on the Kraljic's portfolio purchasing model which helps firms analyze risk and maximize profit when sourcing material for their product manufacturing (Kraljic, 1983). The original model is adapted through an extensive investigation of Sony Mobile's contribution processes and policies, and designed to support firms' strategic product planning. More specifically, the model helps firms to create contribution strategies for their products and software artifacts such as features and components. Hence, the CAP model is an important step for firms that use OSS ecosystems in their product development and want to gain or increase the OI benefits, such as increased innovation and reduced time-to-market. Moreover, we help firms to operationalize the CAP model by proposing an information meta-model. The meta-model is an information support that should be integrated into the requirements management infrastructure and enables contribution strategies to be communicated and followed up on a software artifact-level throughout a firm's development organization. As a first validation outside of Sony Mobile, the CAP model was presented to and applied in three case firms. This provided understanding of the model's generalizability, and also input to future design cycles.

The rest of the paper is structured as follows: In Section 2, we position our study with related work and further motivate the underlying research gap. This is followed by Section 3 in which we describe the research design of our study, its threats to validity and strategies used to minimize these threats. In Section 4 we present our CAP model and in Section 5 we present an information meta-model for how contribution decisions may be traced. In Section 6, we present an example of how the CAP model and meta-model may be used together inside Sony Mobile. In Section 7 we present findings from three exploratory case studies outside Sony Mobile where we focused on early validation the CAP model's applicability and usability. Finally, in Section 8 we discuss the CAP model in relation to related work, and specific considerations, while we summarize our study in Section 9.

2. Related work

Below we describe the context of our research with respect to how software engineering and OSS fits into the context of OI. Further, we give a background on contribution strategies and commoditization models. Moreover, we provide a background of the sourcing model on which the CAP model is based. We than provide an overview on what we label as strategic product planning, as well as on software artifacts, and conclude by describing the research gap, that this study aims to fill.

2.1. Open innovation in software engineering

OI is commonly explained by a funnel model (Chesbrough, 2006) representing a firm's R&D process, see Fig. 1. The funnel (1) is permeable, meaning that the firm can interact with the open environment surrounding it. This conceptualization fits onto many contexts, e.g., a firm that takes part in a joint-venture or start-up acquisition. In our case, we focus on ecosystems (2) and specifically those based on OSS (Jansen et al., 2009a; García-Peñalvo and García-Holgado, 2017). An OSS ecosystem consists of the focal firm along with other actors who jointly see to the development and maintenance of an OSS project, which may be seen as the technological platform underpinning the relationships between the actors (Jansen et al., 2009b; Manikas and Hansen, 2013). In the context of this study, the focal firm represented by the OI funnel is Sony Mobile and their internal software development process. The OSS ecosystem could, for example, be represented by that surrounding the Android Open Source Project[2] (AOSP). The interactions between the focal firm and the ecosystem (see Fig. 1) are represented by the arrows going in and out and can be further characterized as knowledge exchange between the firm and the OSS ecosystem (e.g., Sony Mobile and AOSP). Examples of transactions can include software artifacts (e.g., bug fixes, features, plug-ins, or complete projects), but also opinions, knowledge, and support that could affect any step of the internal or external development.

The interactions (3) may be bi-directional in the sense that they can go into the development process from the open environment (*outside-in*), or from the development process out to the open environment (*inside-out*). *Coupled innovation* (Enkel et al., 2009) happens when outside-in and inside-out transactions occurs together (i.e., consumption of and contribution to OSS). This may be expected in co-development between a firm and other ecosystem participants in regard to specific functionality (e.g., Sony Mobile's developer toolkits[3]).

How firms choose to work with and leverage these interactions with OSS ecosystems impact how they will realize the potential benefits of OI, such as increased innovation, shorter time-to-market, and better resource allocation (Stuermer et al., 2009; Ven and Mannaert, 2008). The CAP model presented in this paper provides operational and decision-making guidelines for these firms in terms what they should contribute to and source of from the OSS ecosystems. I.e., how they should interact with the open environment in an inside-out, outside-in, or coupled direction. Hence, what the CAP model brings in terms of novelty is an operational OI perspective on what firms involved in OSS ecosystems should share, by helping firms motivate the contributions through the creation of tailored contribution strategies.

[1] http://developer.sonymobile.com/knowledge-base/open-source/.

[2] https://source.android.com/.

[3] https://github.com/sonyxperiadev.