Evaluating the Governance Model of Hardware-Dependent Software Ecosystems – A Case Study of the Axis Ecosystem

Wnuk, Krzysztof; Manikas, Konstantinos; Runeson, Per; Matilda, Lantz; Oskar, Weijden; Munir, Hussan

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Krzysztof Wnuk, Konstantinos Manikas, Per Runeson, Matilda Lantz,
Oskar Weijden and Hussan Munir

Abstract

Ecosystem governance becomes gradually more relevant for a set of companies or actors characterized by symbiotic relations evolved on the top of a technological platform, i.e. a software ecosystem. In this study, we focus on the governance of a hardware-dependent software ecosystem. More specifically, we evaluate the governance model applied by Axis, a network video and surveillance camera producer, that is the platform owner and orchestrator of the Application Development Partner (ADP) software ecosystem. We conduct an exploratory case study collecting data from observations and interviews and apply the governance model for prevention and improvement of the software ecosystem health proposed by Jansen and Cusumano. Our results reveal that although the governance actions do not address the majority of their governance model, the ADP ecosystem is considered a growing ecosystem providing opportunities for its actors. This can be explained by the fact that Axis, as the orchestrator and the platform owner, does not address the productivity and robustness of the ecosystem adequately, but has a network of vendors and resellers to support it and some of the governance activities (e.g. communication) are achieved by non-formal means. The current governance model does not take into consideration.

1 Introduction

Nowadays, the software development effort is rarely constrained to a single company investing into developers, technology, marketing and sales activities [1, 2]. Forming alliances, participating and benefiting from the capabilities offered by a software ecosystem, or using open source software, are just a few examples of the development strategies that gain importance in software business. These new forms of collaboration via the "sense of community" [3] come at the expense of decreased control and resulting increase of challenges associated with long term planning. Further, the trade-off between being in control and opening up to ecosystem participants range from technical interface issues to business strategies [4]. Software companies that want to be successful in this context need to learn to open up their platforms and interact with other actors on the ecosystem level, while at the same time ensuring that the strategic goals are fulfilled. These companies need to become orchestrators that mainly determine the growth of their ecosystems [2] and govern them.

Several authors have studied software development governance [3, 5, 6] and proposed different governance techniques, e.g. incremental commitment model [7], decision right automation [8], and transaction cost model [9]. Governance in agile software development was also extensively studied [9, 10, 11, 12, 13, 14]. In the field of software ecosystems, the governance of an ecosystem is argued to have an impact on the overall *health* of the ecosystem [1, 4, 15], i.e.

"the extent to which an ecosystem as a whole is durably growing opportunities for its members and those who depend on it" [16]. Jansen and Cusumano [1, 2] have developed a governance model aiming at preserving or improving the health of an ecosystem. The model addresses governance strategies according to the three areas of ecosystem health, inspired by Iansiti and Levien [16]: productivity, robustness and niche creation. To the best of our knowledge, no study has reported the results from evaluating this governance model on a *hardware-dependent* software ecosystem, where hardware plays a dominant role in the value creation process and where the customers purchase hardware devices with software installed on them. Software, in this case, is an enabler for functionality and the main driver for extendability, but without underlying hardware it provides little value to the customers.

In this paper, we assess the governance activities performed by Axis, a network video and surveillance camera producer, the orchestrator and the platform owner of the Application Development Partner (ADP) software ecosystem by investigating the following research question:

> *What governance activities are performed by Axis as a platform orchestrator?*

We conducted an exploratory case study collecting data from a series of observations and interviews and applying the above mentioned model of Jansen and Cusumano to assess the governance of Axis in the ADP ecosystem. Our results show that although Axis meets only part of the model aspects, it is considered from the surrounding actors as a valid ecosystem to participate. Finally, our case study shows that some of the aspects in the model should be expanded to include wider perspectives of governance.

The rest of this paper is structured as follows: Section 2 presents background and related work. Section 3 presents the details about the case company and Section 4 describes the methodology. The results are presented and discussed in Section 5 and the paper is concluded in Section 6.

2 Background and related work

Developing strategies for effective software ecosystems governance and orchestration was outlined on the agenda for software ecosystems research by Jansen *et al.* [3]. Several authors have studied software development governance. Chulani *et al.* [5] outlined definitions and suggested managing value, developing flexibility and controlling risk and change as the main concerns of software development governance, while Bannerman [6] studied software development governance from meta-management perspective. Several approaches for software development governance were suggested, e.g. based on incremental commitment model [7], using decision rights automation [8], linking long-term business with release planning [9], and using the transaction cost approach [17]. Quite a few articles explore software development governance in agile development [9, 10, 11, 12, 13, 14], yet they do not focus on large-scale hardware-dependent contexts. Only one study explored a context of similar size compared to our case company [11]. From the software ecosystem perspective, Baars and Jansen proposed a framework for software ecosystem governance [15], Jansen *et al.* [4] examined the ecosystem governance from the perspective of the openness of an ecosystem and Jansen and Cusumano [1, 2] build on the top of the two previous studies above to create a governance model for the prevention and improvement of software ecosystem health.

Software ecosystem health is closely related to ecosystem governance: the proper governance decisions can increase the ecosystem health while, ecosystem governance can be evaluated by the effect it has on the health of the ecosystem. Related work contains a number of studies about the health of software ecosystems [18, 19, 20, 21].

3 Case description

Axis is the market leader within network video and surveillance cameras [22]. The company is based in Lund, Sweden, but has offices in 41 countries, partners in more than 179 countries and has 1400 employees [23]. Today Axis' profits are mainly related to sales of camera units, utilizing the two-tier business model with indirect sales. Several different actors such as distributors, system integrators and technology vendors are required to provide complete solutions to end customers. As the amount of software in the video surveillance cameras continues to increase and gains more importance, Axis sees the potential in exploring and developing their *hardware-dependent* software ecosystem.

The Application Development Partner (ADP) is one of the three partner programs at Axis, together with the Application Development Service (ADS) and the Gold Application Development Partner (Gold ADP) programs. The access to the program is rather easy but in order to advance on to higher levels actively engaged with Axis, companies have to prove that their solutions generate a certain amount of camera sales [22].

The ACAP (Axis Camera Application Platform) ecosystem is based on an open application platform that enables development of third party applications to meet evolving end user needs [24]. Thus, the ecosystem resembles an *application-dependent* ecosystem based on a successful platform i.e. the platform offers customer value without third party applications [25, 2]. Furthermore, the ACAP ecosystem can be considered as screened but free [26]. Axis controls the list of extensions available in the ACAP ecosystem but is not handling any sales, neither offering any joint way of purchasing the ACAP applications. Customers of the ACAP applications are redirected to the websites of the companies developing the ACAP applications in order to download or purchase them. This flow of sales is included in red in Figure 1. Optionally, Axis can offer a licensing system which could also be seen as a part of

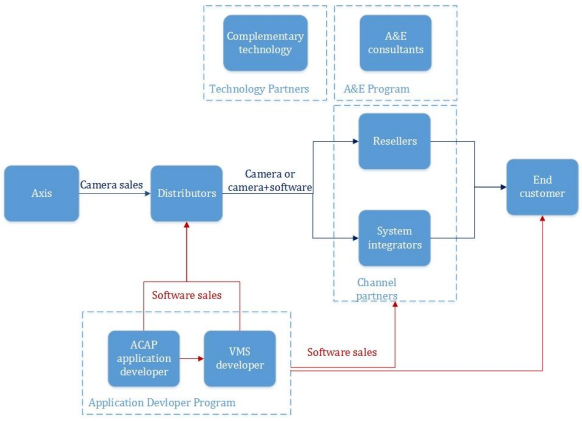

Figure 1: The software ecosystem surrounding the ACAP, also published in [27]

the extension market. As the main source of revenue for Axis remains camera sales, we consider this ecosystem as *hardware-dependent*.

Axis is the platform leader which has the biggest influence on the decision about the ecosystem, see Figure 1. The main group of external actors constitute the Video Management System (VMS) developers who develop external products, running on servers or similar, and most of them receive image output or control cameras. Both small local and large global system integrators and resellers are among the actors and they could be classified as vendor since they generate profit on selling products produced by the ecosystem. Distributors are also among the actors of this ecosystem but they mostly incorporate software into cameras before selling them [28]. End customers indirectly influence the evolution of the ecosystem via their requirements and needs.

Why Axis? Axis was selected as a case company due to the following reasons: (1) it is a large company that operates globally, (2) it develops embedded systems and provides a case of a *hardware-dependent* software ecosystem, (3) it does not have any direct sales of the products to the end customers, and (4) the end customers do not get directly involved in the development or strategic decisions about the ecosystem and (5) Axis was the market leader

also without an ecosystem, which differs from, for example, Android case where Google created the Android ecosystem to enter and become a significant player in the mobile phones market.

4 Research Methodology

As the case company is relatively new in software ecosystems, an exploratory case study method was considered suitable [29]. The main focus of the case study was to understand bridges and barriers in joining the ACAP ecosystem and to investigate the governance model activities. The results regarding the identified motivating and hindering factors are reported in a separate report [27] while this paper focuses on the governance activities.

The study followed the *case study process* proposed by Runeson *et al.* [29]. During the pre-study phase, the company specific literature and related work were studied. Next, ten exploratory interviews among practitioners knowledgeable in the ACAP ecosystem were conducted. The following respondents were interviewed during the pre-study: Global Partner Managers, Product Manager Solutions & Integration Programs, Manager Partner Marketing, Global ADP engineer, Director of System & Services, Senior Engineer for Video Hosting Systems, Business Development Managers, Product Manager API & Components and ADP program manager.

In the next phase, we conducted eight interviews with external developers developing the ACAP applications as well as formal and informal discussions with the Axis employees. Four companies involved in the interviews have an existing ACAP application while the two other companies are not participating in the ACAP ecosystem. Among the participating companies that have ACAP applications, two are quite small with up to 20 employees and two are significantly larger with over 100 employees. These companies offer video analytics solutions based on the ACAP platform. The interviews were transcribed, coded and analyzed by two authors, supervised by more senior authors. Similar statements were put together and abstracted into meta-statements that formed the results statements. The results regarding the ecosystem participation improved the understanding of the governance activities, including some underlying reasons for performing them. In addition to the above mentioned external partners, 20 practitioners were involved in gathering the data about governance model in both formal meetings and informal discussions. The information gathered during these meetings was systematically stored and analyzed with the similar approach than the interview data. Interesting facts were put together into meta-level facts and compared with the descriptions of the governance activities. The resulting mapping of the performed and not performed activities was presented to the practitioners for validation. By identifying connections and correlations between governance activities, the contextual factors and the identified bridges and barriers to participate, we created an understanding of how governance affect the participation in the ACAP ecosystem.

4.1 Validity analysis

Construct validity refers to possible imperfect operational measures used as a representation of the studied phenomena [29]. There is a risk that the interview questions were not interpreted in the same way by the researchers and the interviewees. To mitigate this threat, we piloted the interview questions on three employees at Axis and two researchers in two iterations. During the interview transcription, potential out of context quotations were discussed and resolved. The list of evaluated governance activities is based on previous work [2] and therefore their suitability as operational measures is confirmed. Finally, the results of the study were presented and discussed with the participants at a workshop.

Internal validity deals with potential confounding factors that may affect studied causal relations [29]. Due to exploratory nature of this

study, causal relationships were not considered as the main focus of the study. Therefore, although members of a software ecosystem are often described as closely affecting each other in complex networks [25], the impact of this threat on the validity of the results is minimal.

Reliability refers to the potential biases in the collected data and the analysis methods used by the researchers [29]. We used the governance activity model published earlier, without changing any of the activities. Moreover, we created the interview instrument guided by the existing model and made sure that all relevant aspects were covered in all interviews. However, due to the semi-structured nature of the performed interviews, there are some small differences between the depth of the covered aspects among the interviewees.

External validity discusses the transferability of the findings outside the investigated case. Like for any single case study, threats to external validity remain the main issue in our case. We attempted to mitigate these threats by providing extensive characterization of the studied context [29], including the characterization of the studied ecosystem in order to ease later comparing. Moreover, the studied governance activities are published [1, 2] and by using them we allow other cases to be directly comparable with our results. Finally, we would like to stress the exploratory nature of this study.

5 Governance Activities Performed by Axis

The evaluated governance model for "ecosystem health preservation and improvement" [1, 2] focuses on niche creation, robustness and productivity. The model distinguishes between the software (service) platform and the standard ecosystems, and focuses on the activities that the platform leader should perform in order to improve her position in the software ecosystem. In our case, Axis is the main owner of the software platform which means that the ecosystem is privately owned.

The activities outlined by Jansen *et al.* [1, 2] were compared to Axis' current activities and the results are presented in the subsections that follow. Each activity is marked as **[YES]**, **[NO]** or **[PARTIALLY]** depending on to what degree the activity is performed.

5.1 Activities Connected to Niche Creation

Expand applicability **[YES]** The purpose of the ACAP is to expand the applicability of Axis' cameras to increase sales. Axis is expanding the applicability of the platform by providing access to new features and by releasing more powerful cameras created for new environments. The expansion of applicability should increase the variety of ecosystem participants. This, in turn, may contribute to creating many diverse niches which could allow the ecosystem participants to specialize in their areas, create new products that attract customers to the platform that otherwise would not have been reached [1, 2] and avoid head-on competition [30]. However, as the participants are active within the same industry and provide similar types of applications, the expansion possibilities are limited, causing entry barriers for one of the two studied companies that currently do not develop ACAP applications.

Make strategy explicit **[NO]** None of the interviewees received explicit information about the ACAP strategy and only some respondents stated that they *implicitly* received this information during discussions and collaboration with employees at Axis. Axis has no explicit strategy for ACAP but has transparent relationships with developers. The possible interpretation could be that transparent relationships are enough to ensure niche players about their future position within the ecosystem [1] and create trust among participants towards the platform leader's intention and commitment. This approach seems to be efficient for relatively small number of ecosystems players just like in our context.

We have not identified any trust issues among the ACAP developers participating in

the study. One possible explanation could be that all these developers had, prior to joining the ecosystem, a relationship with Axis and described it as good and transparent, indicating increased trust. Also, several companies received the information about Axis' strategy implicitly through contact with Axis personnel. Therefore, it seems that a healthy relationship and transparent communication decreases the need for an explicitly communicated strategy.

Create API **[YES]** Axis has created a collection of API:s connected to the ACAP that reduced compatibility issues, increased the degree of control [1] and increased the productivity of niche players [19]. Therefore, creating an API was described as one of the benefits and reasons to develop toward the ACAP [27]. The need for an API was fostered by: (1) base technology: several product lines, (2) actors: fragmented customers, and (3) competitors: not offering an internal standard similar to the ACAP.

Co-development **[NO]** Axis does not perform any co-development, i.e. joint development projects with other companies. The lack of co-development has not had any identified effects on this ecosystem. This result could suggest that co-development does not attract niche players in this kind of software ecosystem, which contradicts with the previous studies [1, 2]. Another possible interpretation could be that niche players have knowledge about both the domain and the platform and thus do not need co-development. This contradicts with the viewpoint of Hanssen [31]. Finally, the need for obtaining synergies that can drive innovation, reduce costs and development time [32] may not be that strong in our context.

Develop complementary platforms **[NO]** Axis has no plans to develop complementary platform, thus we consider this activity as not being performed.

Develop new business models **[NO]** Axis focuses on camera sales and utilizes the two-tier sales model. Axis has no requirements regarding the ACAP application sales and distribution. They provide a free licensing system to the users of the platform but at the same time is not involved in sales and distribution of the ACAP applications. Axis offers a licensing for free business model connected to the platform and is not facilitating any other business models. The possible interpretation could be that licensing based business models are a good fit for the environment of this ecosystem.

Axis is restricting third party developers from being a part of their chain of distribution. This has a negative effect on enabling new niches and business opportunities by introducing new business models to third parties, e.g. by introducing a marketplace which enables third party developers to reach customers they would not have reached on their own [1, 2]. Related work by Hagel *et al.* [30] suggested that the platform leader's responsibility is to provide focus through identified business opportunities and forces connected to the ecosystem.

5.2 Activities Connected with Robustness

Create partnership model **[YES]** The ADP (Application Developer Partner) program is an established partnership program offered to all companies interested in developing software for Axis cameras and allows to set up rules for partners in the ecosystem [1, 4]. However, the program is explicitly focused on promoting developers of high volume and broad applications, rather than niche applications, which most ACAP applications are. Thus, the availability of the program is not considered as an incentive for the potential ACAP developers [27].

The requirements to reach the highest partner level are steep, hindering the ACAP developers from advancing to this level due to their size and niched applications. As a result, the support needed to explain the ACAP developers' businesses is blocked (also due to lack of sales) by the inability to advance in the ADP program. Furthermore, Axis' partner program does not allow independent developers, decreasing the variety of the ecosystem.

Do marketing **[YES]** Axis' main market-

ing activities are conducted in order to increase cameras sales. Marketing activities towards potential ACAP developers are sporadic and small compared to the marketing of cameras. As a result, the awareness among customers and developers about the ecosystem is not fully explored and may negatively impact the ecosystem participation [1, 2].

The presence of end customer's demand to develop ACAP applications suggests that the customers are aware of the ACAP platform. Moreover, as the majority of the ACAP developers already had a relationship with Axis before developing the ACAP applications [27], the developers' awareness and marketing activities may have only limited effect on participation.

Grow profits **[NO]** Axis is focusing on camera sales and is not interested in increasing the profits by providing ACAP applications. However, one of the requirements to join the gold application partner level is to prove that the applications generate a certain amount of camera sales. Thus, the potential additional revenue streams for ACAP applications are considered insignificant.

Partner development programs **[YES]** These programs could help Axis to strengthen the potentially less productive weak actors that could decrease the health and stability of the ecosystem. Axis' learning center provides training, seminars, classroom training, tools and quick reference help [33] and is accessible for members in the ADP program.

The learning center is not designed as a program, but rather as a source of information, support and training. Axis does not offer any financial support to partners, but the main reason for a development program is to help strengthen members of the ecosystem and that is fulfilled today. The technical expertise delivered by Axis was found to ease the transition to the platform and to improve the perceived quality of communication with developers, which was also considered as one of the reasons to join this software ecosystem [27].

Form alliances **[PARTIALLY]** Axis has existing alliances with many relevant companies within the industry through their partner programs, see Section 3, but the focus of these relationships is not on the ACAP or its applications. Therefore, the opportunities of forming sub-groups of participants or strategic incumbents in a market and in this way increasing the robustness of the ecosystem [1, 16] are not fully explored. The existing alliances within surveillance industry could be utilized for strengthening the ACAP and its ecosystem.

Stabilize API:s **[YES]** Axis has stable API:s that remained unchanged after integration of new features caused by the ACAP introduction. In this regard, Axis complies with the advices published in related work to ensure backward compatibility, simplify software configuration [34] and create consistency which leads to increased trust in the platform [1, 2]. Axis is aware that the API:s are not optimal, but sees it as a higher priority to keep them stable rather than to change them. This strategy pays off as stable API:s were considered as one of the benefits and reasons to join the ecosystem [27].

Raise entry barriers **[NO]** Entry barriers help to ensure that the right companies join the ecosystem and can be used as a mechanism to steer its growth [1]. If entry barriers are too low, the stability of the ecosystem might decrease because of uncontrolled growth and loss of quality (in developers or the components they develop) and thereby the increases risk of an unhealthy ecosystem [19]. Therefore, high entry barriers are a recommended way to increase the quality of an ecosystem [1, 2] by fees, certification programs for the applications and more rigorous screening of customers [35]. However if the barriers become too high they might exclude too many developers and hinder innovation [19].

Axis does not impose high entry barriers to join their application development program: members only have to be a registered company. However, this blocks access for independent developers, for example students. The company does not take any fees or commissions associated with published applications. However, our results suggest that the barriers could be con-

sidered as high (not deliberately set by Axis) because of the following reasons: the dependence of external software and other actors, the fragmented customer base of Axis end customers, and the lack of an accessible way to reach the market.

The domain dependence together with the relatively low number of third party developers in the studied ecosystem imply that Axis should facilitate participation and lower entry barriers for newcomers in opposite to what is suggested by Jansen *et al.* [1, 2]. This confirms previous research which indicated that high entry barriers might exclude too many developers [19].

Make partners explicit **[YES]** Axis publishes a list of ACAP developing companies on their company website and thus making the partners explicit [36].

Propagate operation knowledge **[NO]** Axis does not have a systematic way to collect end user experiences, knowledge of in-the-field-performance or feedback [37] related to ACAP and is hence not able to communicate these to other members of the ecosystem. Therefore, we assessed this activity as not being performed. No negative effects of not propagating operational knowledge were found. One possible explanation may be that Axis' two-tier business model reduces direct contact with end customers and the ability to collect such data. Therefore, this task might not be suitable for the platform leader in this ecosystem and may not lead to significant performance improvements [37].

5.3 Activities Supporting Productivity

Organize developer days **[NO]** Before launching ACAP, Axis has hosted a training session for developers in Lund. However, the current arrangements of trainings at Axis do not include the ACAP developers, unless they offer an additional product and hence are qualified. Therefore, the potential benefits, e.g. increased interaction [19], a higher degree of connectedness [19], robustness [19, 16], more internal connections, raised awareness of the platform [1] and increased probability of survival [16] are not fully explored. We discovered that this activity directly effects the participation in this ecosystem [27]. Enabling new players to easily connect and creating external standards to increase compatibility could in this case be also helpful.

Collaborative marketing **[PARTIALLY]** Axis does not systematically perform collaborative marketing efforts [38] with third party developers. On a case by case basis, some forms of collaborative marketing are performed at exhibitions and fairs. Thus, the potential benefits derived from fusions of the products or resource pooling are not fully explored [38].

Create sales partner program and create new sales channels **[NO]** Axis has a channel partner program including companies distributing and selling network video products and solutions. This does not apply to distribution of software or more specifically ACAP applications. Axis does not have any outspoken strategy for how ACAP applications should appear on the market. Thus, the possible increase of sales margins of ACAP software could not be evaluated. One of the possible reasons is that many ACAP developers are relatively small players in the surveillance industry and thus less interesting for Axis. It seems like the opportunity of creating more value by connecting niche players to customers and enabling more revenue for the ecosystem participants [1, 2] (both niche players and the platform leaders) is not fully explored in our case [19].

However, Axis has historically seized opportunities to cooperate with existing customers and provided information and sales support, although, this was done sporadically and through personal connections. As a result, new developers without industry experience or a relationship with Axis would find it difficult to identify which relationships are needed to access the end customers [39]. Creating more established relationship with Axis could reduce the perceived risk [39] and open access to important information and support.

5.4 Remarks from the evaluation

Some interesting and important remarks can be made after our evaluation of the governance model proposed by Jansen and Cusumano [1, 2]. Several activities were confirmed as important and necessary, among them the needs to: expand applicability beyond the current domain, create and keep stable API:s, form partnerships, create partner development programs focused on niche players, support developers by organizing developer days, do marketing and extent current business models with niche players in mind.

At the same time, only 66% of the niche creation activities, 44% of the robustness activities and 25% of the productivity activities are fully performed by Axis. Regarding making the strategy explicit, our results suggest that healthy relationship and transparent communication could be a good surrogate for explicit strategy for a relatively small number of ecosystem players. The lack of co-development and complementary platforms have not had any identified effects on this ecosystem. This result could suggest that: (1) co-development does not attract niche players in this kind of software ecosystem or (2) niche players have knowledge about both the domain and the platform and thus do not need co-development, which contradicts with the viewpoint of Hanssen *et al.* [31]. The lack of new business model development suggests that licensing based business models are suitable for this ecosystem. Due to focus on camera sales and relatively low potential of the ACAP applications revenue stream, Axis seems not to be interested in growing profits from the ACAP ecosystem.

Our results confirm that keeping high entry barriers helps to ensure the quality of the ecosystem but also limits the participation of independent developers and students not employed by companies involved in an ecosystem. Similarly, although Axis does not propagate knowledge about the ACAP ecosystem, we did not found this having any negative effects. This might be either because of the specific nature of the ecosystem or because there were other unofficial channels for propagating knowledge. Finally, the possibilities of creating more value and revenue via partner programs by connecting niche players to customers [1, 2] are not explored by Axis.

To summarize, out of 19 activities in three areas Axis fully performs 8 activities, these are marked as "Yes" and two partly, these are marked as "Partially". Nine activities, marked as "No" in all three areas are not performed. This could be an early indication of signs of low health in the ecosystem. However, the ecosystem is slowly growing in actor size and potential and increasing the value for the connected actors. According to the governance framework, the ecosystem has low or no governance activities supporting productivity, with only one activity partially supported. However the Axis ecosystem is differentiated from most of the ecosystems studied in related work [1, 2] by the fact that the platform orchestrator (i.e. Axis) was the market leader before the ecosystem was created and is not the one supporting the business and revenue models for the actors. Cameras with or without developed software are packed and distributed by a set of distributors, resellers and system integrators, that are external to Axis. Therefore although Axis, as platform owner and orchestrator, does not undertake governance activities to ensure productivity, this task is covered by the network of distributors, resellers and system integrators. An expansion of the model, thus, would be to include activities of vendors and resellers into the productivity section, support unofficial or non-formal channels for knowledge dissemination and explore the role of licensing business models in ecosystems governance. Finally, a necessary addition to the current model could be to consider some activities as *satisfy explained* which legitimates their absence due to specific company or business context conditions.

6 Conclusions

In this study, we focus on the governance of a *hardware-dependent* software ecosystem. More specifically, we evaluate the governance model applied by Axis, a network video and surveillance camera producer that is the platform owner and orchestrator of the Application Development Partner (ADP) software ecosystem. We conducted an exploratory case study collecting data from observations and interviews and applied the governance model for the prevention and improvement of the software ecosystem health proposed by Jansen and Cusumano [1, 2].

Only 66% of niche creation activities, 44% of robustness activities and 25% of productivity activities are fully performed by Axis. Our results reveal that although the governance actions do not address the majority of the applied framework, the ADP ecosystem is considered a growing ecosystem providing opportunities for its actors. This is explained by the fact that Axis, as the orchestrator and the platform owner, does not address productivity and robustness of the ecosystem, but has a network of vendors and resellers to support it and several of the governance activities (e.g. communication) are achieved by non-formal means. The current governance model does not take this into consideration.

In future work, we plan to investigate another *hardware-dependent* software ecosystem to enable meta-analysis and comparison. Moreover, we plan to investigate the impact of the business model utilized by Axis on the governance activities and further explore how Axis can integrate the potential additional revenue stream into this business model.

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