

Revisiting the Mobile Software Ecosystems Literature

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Abstract— Software Ecosystems are comprised of a technology platform, business models, internal and external developers, and engaging users. The popularity of smartphones brought along the mobile software ecosystems, such as iOS and Android, which are composed of a platform, a community of users and developers, mobile applications, and online application store, and evangelists that often promote the ecosystem. Given the recent nature of the topic, this paper aims to revisit the state-of-the-art through a systematic literature mapping. We found 63 publications on the topic of mobile software ecosystems that were categorized by year (almost 50% of the publications are from 2015 and on), by author (a few collaboration clusters were identified), and by the mobile ecosystems characteristics (most publications discuss business or technical aspects) and elements (applications and the platform are the most discussed topics followed by the developers and the users). Our results provide an up-to-date map of the topic for those interested in mobile software ecosystems.

Index Terms—Software Ecosystems, Mobile Technologies, Mobile Software Ecosystems, Systematic Mapping

I. INTRODUCTION

Software Ecosystems (SECOs) represent a new approach for software product development. Bosch and Bosch-Sijtsema (2010) [1] argue that an SECO consists of a software platform, a internal and external set of developers, and a domain community that is dedicated to developing solutions that meet the community needs.

The first studies in SECOs are reported in 2007 [2], around the early times of the smartphone market revolution [3]. Mallison [3] discusses the rise of Apple iOS and Google Android in the mobile market and anticipates its worldwide pick in 2016, characterizing the mobile software ecosystems (MSECOs) era.

Although iOS and Android are relevant to the market that they operate in, little is known about related research endeavors in MSECOs. In particular, aside from the review by Fontão, Santos and Dias-Neto (2015) [4], literature is still scattered and it is difficult to promptly say about the extent

of existing scientific literature and what aspects this literature encompasses.

Given the reported growth of the mobile market as argued by Mallison [3], we considered relevant to revisit the state-of-the-art in mobile SECOs and point out recent publications supplementing the work of Fontão, Santos and Dias-Neto (2015) [4]. Also, our systematic literature mapping highlights the main authors and topics of discussion in the area. More specifically, we identified 63 publications, being over 60% published after 2015. This corroborates the contribution that our study brings the mapping of current literature.

The remainder of this paper is organized as follows. Section II presents the background. Section III describes the used systematic literature mapping method. Section IV introduces the results and Section V that discusses them. Section VI reports the study limitations and Section VII concludes the paper.

II. BACKGROUND

A. From SECOs to MSECOs

The rise of SECOs is visible both in literature and in the software development market. Bosch and Bosch-Sijtsema [1] argue that software ecosystems involve more complex factors than simply the process of developing a software. It includes the technologies involved to facilitate this process, i.e., the digital platform; a set of business rules that define and regulate how the parts relate to one another; and the actors involved in the process. All these factors influence how a SECO operates.

MSECOs are a specialized type of SECOs. A MSECO have their focus in the mobile applications market. The growing number of applications around a MSECO is related to the increasing commercialization of mobile devices. Mobile users are more and more migrating the use of desktop functions to mobile applications and discovering new usage to their mobiles. As a consequence, the market for professional mobile

software developers has also grown in recent years. For instance, Mallinson [3] reports that Apple's iOS and Google's Android are the MSECOS with higher profitability and the current market leaders, followed by less popular MSECOS such as Nokia, Blackberry and Symbian.

B. MSECOS Elements

Fontão, Santos and Dias-Neto (2015) [4] disclose in their review that MSECOS are composed of seven items, namely: Platform, Users, Developers, Community, Applications, Application Store, and Evangelists, as briefly described next.

Platform—Refers to technological architecture on which the MSECOS operates. This architecture encloses communication protocols and resources available to players (e.g., tools, programming languages, testing environments).

Users—Considered the most important element for the survival of a MSECOS, since every MSECOS application is intended to meet the users' demands. Users provide feedback to the developers and the community about the applications and promote the financial growth of the application by purchasing them and build-in content.

Developers—Developers are the actors of a MSECOS that develop software solutions to be provided to other actors. There are often two types of developers in a MSECOS: the internal developers—those who develop the MSECOS platform—and the external ones—those who develop the applications available to the users. The external developers can be either professionals or amateurs who want to train their skills or simply satisfy a personal need.

Community—The community is the set of users and developers around a MSECOS. Some communities are restricted to developers and some allow other participants (e.g., application users). These communities encourage the communication among their members through forums, for instance, allowing users and developers to consult with one another.

Applications—Mobile applications, also known as Apps, are artifacts produced by developers to solve the user needs. These applications often need to meet some quality standards that are derived from the policies and business rules of the MSECOS.

App Store—An online store where users can search and acquire software solutions (applications). Developers (or companies) often become well known by the users when an application is widely sold.

Evangelists—Key users or developers of a MSECOS. They plan new applications, bring the community, and invite users to together with developers, solve specific demands from users. They are experts on the MSECOS operation and activities, despite being specialists in computing or business.

C. SECO Classifications

A SECO can be classified in several ways. For instance, Campbell and Ahmed (2010) [5] classified a SECO by aspect, namely: technical, business, and social. The technical aspect depicts technologies and techniques involved in the development of the platform or applications (e.g. programming languages, emulators). The business aspect refers to

the profitability and commercialization of applications, such as improving the income of a developer or the business models that a SECO follows (e.g., business rules, application stores). The social aspect refers to what motivates users and developers to collaborate with a SECO, and how to improve their relationship with it (e.g., the relationship of developers with their community). The three aspects combined involve all elements of a SECO. However, studies in the SECO literature often explore a single aspect (e.g., the social aspect discussed by De Souza et al. [6]), or a combination of two or more aspects (e.g., the business and technical aspects by Yu [7]).

Manikas and Hansen (2013) [8] present a classification by the owner type of an SECO, namely: Free and Open Source (FOSS) (e.g., Github), proprietary (e.g., iOS), or hybrid (e.g., Android). The FOSS are open source SECOS whose decisions are taken by the community and no company has control over its business model. A proprietary SECO is one that a company controls its business model, from the selection of external developers to the form of monetization of the applications. The Hybrid SECOS are usually those in which, although they are open source, there is a company that controls its policies, with smoother settings than an owner.

III. RESEARCH METHOD

We conducted a systematic literature mapping as defined by Petersen, Vakkalanka and Kuzniarz (2015) [9]. In sum, we defined the research protocol composed of research questions, search databases and strings, and inclusion and exclusion criteria for data selection and extraction. Next, we conducted the search, selected and extracted the data followed by the data analysis as described in this section. Results of the analysis are presented in Section IV.

A. Research Questions

RQ1: How many publications are there about MSECOS and how the publication numbers evolved over the years?

Motivation: To identify the number of publications and how this number evolved over the years. This provides us with an understanding of whether the topic is still evolving or is to a certain extent "saturated".

RQ2: Which authors have most published about MSECOS and which are their collaboration networks?

Motivation: To identify the most active authors and with whom they collaborate with. This helps us to identify the leading research groups in the field and others interested in MSECOS.

RQ3: What is the distribution of publications by MSECOS element?

Motivation: To classify the MSECOS literature per element as proposed by Fontão, Santos and Dias-Neto (2015) [4]. This classification allows us to identify gaps in literature and point out the need for future research.

RQ4: How are the classifications found in SECOS literature applied in MSECOS?

Motivation: To identify whether the SECO classifications apply to MSECOS and the distribution of publications per

Table I
SEARCH DATABASES AND RESPECTIVE SEARCH STRINGS

Search Database	Search String
Scopus	TITLE-ABS-KEY("MSECO") OR TITLE-ABS-KEY("Mobile") AND (TITLE-ABS-KEY ("Software Ecosystem") OR TITLE-ABS-KEY ("SECO"))
Science Direct	Title-Abstr-Key(MSECO) OR Title-Abstr-Key(Mobile) AND (Title-Abstr-Key (Software Ecosystem) OR Title-Abstr-Key (SECO))
Wiley InterScience	(MSECO in Publication Titles OR Keywords OR Abstract) OR (Mobile AND Software Ecosystem in Publication Titles OR Keywords OR Abstract) OR (Mobile AND SECO in Publication Titles OR Keywords OR Abstract)
IEEE Xplore	("Publication Title": "MSECO" OR,"Index Terms": "MSECO" OR,"Abstract": "MSECO") OR ("Publication Title": "Mobile" OR,"Index Terms": "Mobile" OR,"Abstract": "Mobile") AND (("Publication Title": "Software Ecosystem" OR,"Index Terms": "Software Ecosystem" OR,"Abstract": "Software Ecosystem") OR ("Publication Title": "SECO" OR,"Index Terms": "SECO" OR,"Abstract": "SECO"))
Springer	(with all of the words: MSECO) OR (with exact phrase: mobile software ecosystem) OR (with all of the words: Mobile SECO) AND Filter by: Computer Science OR Business and Management
ACM Digital Library	(acmdlTitle:(+MSECO)OR keywords.author.keyword:(+MSECO) OR recordAbstract:(+MSECO)) OR ((acmdlTitle:(+Mobile) OR keywords.author.keyword:(+Mobile) ORrecordAbstract:(+Mobile)) AND ((acmdlTitle:(+Software +Ecosystem) OR keywords.author.keyword:(+Software +Ecosystem) OR recordAbstract:(+Software +Ecosystem)) OR (acmdlTitle:(+SECO) ORkeywords.author.keyword:(+SECO) OR recordAbstract:(+SECO))))

category. We used the classifications per aspect by Campbell and Ahmed (2010) [5] and the one by SECO owner type by Manikas and Hansen (2013) [8]. These classifications inform us of what aspects are most explored and which gaps are still present in literature.

B. Search Databases

We searched for primary studies with the help of digital search databases (or libraries). Following Kitchenham and Charters (2007) [10] guidelines for literature reviews, we selected the recommended search databases, namely: Scopus, Science Direct, Wiley InterScience, IEEE Xplore, Springer, and ACM Digital Library. The defined and applied search strings are presented in Table I.

C. Data Selection

Our search revealed 476 publications distributed per database as indicated in Table II. Each publication had its title, abstract, and keywords reviewed for inclusion in the review process and later the entire paper was scanned and fully read (when necessary) for exclusion as per the criteria bellow. We used the StArt tool¹ to help with data selection and extraction.

(I1) *Publications on SECOs that present any mobile characteristic in their title, keywords or abstract.* Older publications on SECO do not use the MSECO definition but might present a study on mobile SECO.

(I2) *Publications indicating MSECO in their title, keywords or abstract.* In this case, our goal was to check whether the selected publications are in fact linked to the topic of MSECO.

(E1) *Duplicated publications.* To avoid duplication.

(E2) *Prior publications to 2007.* Manikas's literature review on SECOs (2016) [2] points out that the first publications were reported in 2007. Thus, we did not look for previous work.

(E3) *Keynote announcements, editorial notes, proceedings booktitle, and extended abstracts.* Publications (or citations entries) that did not refer to a primary study were discarded.

¹<http://lapes.dc.ufscar.br/tools/start-tool>

Table II
PUBLICATIONS PER SEARCH DATABASE

Search Database	Identified	Duplicates	Accepted
Scopus	67	50	13
Science Direct	14	0	12
Wiley InterScience	20	0	2
IEEE Xplore	43	2	7
Springer	240	0	7
ACM Digital Library	92	0	22
Total	476	52	63

(E4) *Publications not written in English.* To allow the authors to access the publication content.

(E5) *Publications discussing natural ecosystems.* We are interested in (digital) software ecosystems and not on those that discuss as animals or human organisms.

(E6) *Publications that did not report a study on MSECO.* Several publications cited the concept of a MSECO but did not report on a MSECO study.

D. Data Extraction and Analysis

Upon the application of the inclusion and exclusion criteria, we accepted 63 publications as reported in Table II. The list of accepted publications is presented in the Appendix A. Next, we extracted the following data from each publication: title, author names, publication venue, citations to the MSECO elements [4] (Platform, Users, Developers, Community, Applications, App Store, and Evangelists), reported aspects according to Campbell and Ahmed (2010) [5] (Technical, Business, and Social), and which MSECOs the study refers to (e.g., iOS).

To answer RQ3 and RQ4, extracted text excerpts were analyzed following Bardin (2016) [11]'s content analysis approach (coding, clustering, and coding refinement). The data analysis was conducted by three of the authors and reviewed by the fourth, for discrepancies and conflict resolution.

IV. RESULTS

As previously mentioned, our systematic mapping identified 63 publications (see Appendix A). This section summarizes the

Table III
RQ1. PUBLICATIONS PER YEAR

Year	Publications	Total
2010	[P46, P54]	2
2011	[P27]	1
2012	[P7, P25, P26, P41, P53, P59]	6
2013	[P6, P24, P29, P31, P43, P47, P49, P58]	8
2014	[P28, P30, P44, P50, P52, P63]	6
2015	[P3, P4, P5, P19, P20, P21, P22, P23, P40, P42]	10
2016	[P2, P15, P16, P17, P18, P32, P35, P37, P39, P55, P60, P62]	12
2017	[P1, P8, P9, P10, P11, P12, P13, P14, P33, P34, P36, P38, P45, P48, P51, P56, P57, P61]	18

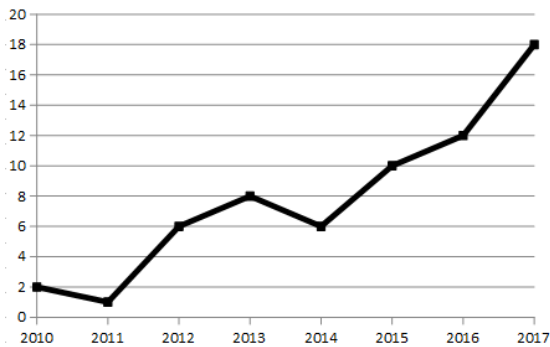


Figure 1. RQ1. Publication numbers evolution over the years

results, organized by each of the 4 posed research question as introduced in Section III-A.

RQ1: How many publications are there about MSECO and how the publication numbers evolved over the years?

Table III presents the distribution of the 63 identified publications over the years. Although the SECO first reported studies are dated in 2007, the first found publications discussing mobile SECO are from 3 years later—2010. In addition, as it is possible to observe in the table, 2015 to 2017 contribute individually to the larger number of publications per year and together both years represent almost 50% of the current MSECO publications. Also, Figure 1 visually confirms that the MSECO area is growing, mostly in the 3 past years.

RQ2: Which authors have most published about MSECO and which are their collaboration networks?

Among the over 150 distinct authors of the 63 publications, 5 of them stood out considering the number of publications on the topic, namely: Arilo Dias-Neto, (UFAM, Brazil, 7 publications), Rodrigo Santos (UNIRIO, Brazil, 6 publications), Awdren Fontão (UFAM, Brazil, 6 publications), Sami Hyrynsalmi (University of Turku, Finland, 6 publications), and Arho Suominen (University of Turku, Finland, 4 publications). We used Newman (2004) [12]’s scientific co-authorship networks method to generate the collaboration network presented in Figure 2. As it is possible to observe, the figure unveils two subgroups, clustered by country—group 1 is formed

Table IV
RQ4. CLASSIFICATION OF PUBLICATIONS PER ASPECT

Aspect	Publications	Total
Technical	[P2, P13, P23, P24, P29, P36, P39, P44, P51, P54, P56, P60, P61]	13
Bussiness	[P6, P7, P8, P9, P14, P25, P27, P31, P33, P40, P53, P57, P58, P62, P63]	15
Social	[P11, P22, P45, P46, P48, P50, P52]	7
Technical & Bussiness	[P5, P16, P19, P20, P26, P41, P43, P49, P55]	9
Technical & Social	[P30, P34]	2
Bussiness & Social	[P10, P12, P17, P28, P35, P37, P38, P59]	8
All	[P1, P3, P4, P15, P18, P21, P32, P42, P47]	9

by the Brazilian cited authors and group 2 by the Finnish ones. Interestingly, although the Brazilian cluster involves a larger number of co-authors, both the Brazilian and the Finnish clusters bring together 5 affiliations, suggesting well-established research groups and partnerships.

RQ3: What is the distribution of publications by MSECO element?

We used Fontão, Santos and Dias-Neto (2015) [4]’s MSECO elements classification to categorize the publications as presented in Table V. Note that a single publication may have discussed more than one element, thus the duplicates in the table. It is remarkable that most of the publications discuss either topics related to the development of Applications (57 out of 63 publications) or to the MSECO Platform (55 out of 63). The Community around a MSECO (23 publications) and the Evangelists (5 of them) are the less discussed elements.

RQ4: How are the classifications found in SECOs literature applied in MSECOs?

We adopted the classification by aspect (Technical, Business, and Social) proposed by Campbell and Ahmed (2010) [5], because this is appropriate with the studies identified, and all present minimally one of the aspects.

The distribution of publications per by aspect [5] is shown in Table IV. About 55.5% of the publications (35 out of 63) discuss only one of the aspects—Technical (13 publications), Business (15), and Social (7). Although Social is the less reported aspect (7 publications), and social with business aspects (8 publications).

V. DISCUSSION

The area of MSECOs already has a mapping of its literature—the study of Fontão et al. (2015) [4]. However, their study focused in mapping the main characteristics, benefits, techniques, and processes used in area of MSECOs until 2015. The contribution of our study was two-folded: we consolidated the body of literature on the topic and identified the gaps in it, i.e., the elements that still have room for contribution.

More specifically, our mapping revealed through the Research Question 1 (RQ1) a growth of almost 50% of the area, especially in the last three years. This implies that we still have

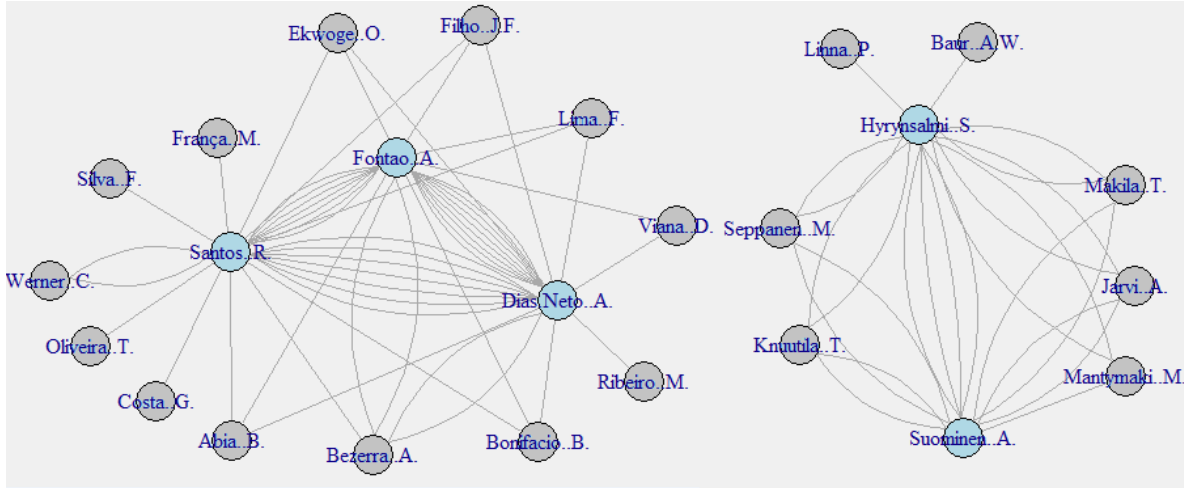


Figure 2. RQ2. Collaborative network of the most active authors

Table V
RQ3. DISTRIBUTION OF PUBLICATIONS BY MOBILE SECO ELEMENT

MSECO element	Publications	Total
Platform	[P1, P2, P3, P4, P5, P6, P8, P9, P12, P13, P14, P15, P16, P17, P18, P19, P20, P21, P22, P23, P24, P25, P26, P27, P28, P29, P30, P31, P32, P33, P34, P35, P36, P37, P38, P39, P40, P41, P42, P44, P45, P46, P47, P48, P49, P50, P52, P53, P54, P55, P56, P59, P60, P61, P62]	55
Users	[P1, P3, P4, P5, P6, P7, P10, P11, P12, P13, P15, P17, P18, P20, P21, P22, P23, P24, P25, P27, P28, P29, P30, P32, P34, P35, P36, P37, P38, P39, P40, P41, P42, P43, P44, P45, P46, P47, P48, P49, P51, P52, P53, P54, P55, P57, P58, P59, P60, P63]	50
Developers	[P1, P2, P3, P4, P5, P6, P7, P8, P9, P11, P12, P13, P14, P15, P17, P18, P19, P21, P22, P23, P25, P27, P28, P30, P31, P32, P34, P35, P36, P37, P38, P39, P42, P43, P44, P45, P46, P47, P48, P50, P51, P52, P53, P54, P55, P56, P57, P58, P59, P60, P61, P63]	52
Community	[P1, P4, P9, P12, P19, P21, P26, P28, P31, P32, P36, P42, P43, P45, P46, P47, P48, P50, P54, P55, P56, P59, P60]	23
Applications	[P2, P3, P4, P5, P6, P7, P8, P9, P11, P12, P13, P14, P15, P16, P18, P20, P21, P22, P24, P25, P26, P27, P28, P29, P30, P31, P32, P34, P35, P36, P37, P38, P39, P40, P41, P42, P43, P44, P45, P46, P47, P48, P49, P50, P51, P52, P53, P54, P55, P56, P57, P58, P59, P60, P61, P62, P63]	57
App Store	[P1, P4, P5, P6, P7, P8, P9, P12, P13, P14, P15, P18, P21, P22, P23, P24, P25, P27, P28, P31, P32, P34, P37, P38, P39, P40, P41, P42, P44, P47, P48, P52, P53, P54, P55, P56, P57, P58, P59, P60, P62, P63]	42
Evangelists	[P1, P19, P21, P35, P37]	5

unanswered and open questions in the field. Research question 2 (RQ2) disclosed the authors with the highest number of publications. From their collaboration network we can infer that there are well-established research groups in MSECO and that these groups often contribute with one another.

RQ3 and RQ4 tackled the classification of the identified publications in order to help us identify gaps in literature. RQ3 focused in classifying the publications according to Fontão, Santos and Dias-Neto (2015) [4] recently introduced categorization of MSECO elements. We found that Platform, Applications, Users, and Developers are the most discussed elements within the literature. Topics within these elements might vary. A deeper understanding and classification of these topics is a next step in our investigation. Our mapping also shows that Communities and Evangelists are the least discussed elements. This might either imply that they are of no interest to the area or that they have just become a topic

of attention. Either way, we will also further investigate them.

RQ4 also focused in classifying the literature. To answer this question, we used the proposed classification by Campbell and Ahmed (2010) [5] on SECO aspects—business, technical, and social. We observed that the MSECO social aspect is less explored than the technical and business aspects. This corroborates with De Souza et al. (2016) [6]’s argument that the SECO social aspect still present several literature gaps and, as such, introduces more research opportunities. Exploring this aspect is of important given the role of developers in the MSECO community and its relationship with the MSECO sustainability.

In sum, our study shows that the area is still growing and that there is room to explore, mostly, the topics related to social aspects as well as to better understand the topics within each MSECO element.

VI. LIMITATIONS

During this work, three main limitations were identified regarding the process of data selection. First, we looked for papers in the chosen search databases (as mentioned in Section III). This list, although comprehensive, might have hindered the finding of a certain publication. To minimize the odds of having missed a paper, we ran an ad-hoc search in Google Scholar and have added no paper to the final selection.

Second, also related to the paper selection, is the fact that we first looked for papers that refer to MSECO or derived keywords in its title, abstract or keywords. This is an intrinsic limitation of a systematic search [10] and was minimized with a manual and random scan of non-selected papers from the initial search results. Again, we added no papers to the final list of selected studies.

Last but not least, we might have missed some publications that refer to a MSECO as “platform” or “mobile ecosystem”. In a manual search on ACM and IEEE digital libraries we found no studies of our interest when using these keywords.

In addition, it is important to emphasize that since this study mapped the literature, there are concepts that could be further developed. For instance, which topics are discussed within each MSECO element. This will be a next step in our study.

VII. CONCLUSION

Software Ecosystems (SECO) are regarded as a new approach for software development [1]. They are not new, but have gained traction more recently in the context of mobile devices, i.e., mobile software ecosystems (MSECOs) [3] especially those from Apple (iOS) and Goolge (Android).

Although MSECOs are extremely relevant today, little is known about the area of research in MSECOs. In particular, it is difficult to know about the extent of the scientific literature existing in this area and what aspects this literature contemplates. Our work, in addition to identifying existing and new studies, illustrated the increasing interest of researchers in MSECOs, indicated the most productive authors in this domain, as well as classified the identified studies by existing categories—Fontão, Santos e Dias-Neto [4]’s by MSECO elements and Campbell and Ahmed [5]’s by SECO aspects.

With our study, we revealed opportunities for future studies to fill in the identified gaps, mainly those related to the social aspects. Community and evangelists are topics little discussed and of paramount importance [6], [13]. Thus, a new horizon for the area of SECOs research might arise with studies that fill in or complement the literature on these topics.

This literature mapping also serves as an instrument for those who want to approach the area of MSECOs for the first time. It can offer a starting point since it maps the literature from its first publication in 2010.

As a future study, we will better understand how each one of the MSECO elements are discussed in literature. We will also conduct a field study to investigate the value of each topic within the elements with developers as a means to understand what motivates them to participate in a certain MSECO.

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APPENDIX

This list presents the 66 publications found in this literature mapping.

- P1. Fontão, Dias-Neto and Santos (2017c) [13]
- P2. Han et al. (2016) [14]
- P3. Hess et al. (2015a) [15]
- P4. Sadi, Dai and Yu (2015) [16]
- P5. Corral, Sillitti and Succi (2015) [17]
- P6. Jansen and Bloemendal (2013) [18]
- P7. Hyrynsalmi et al. (2012b) [19]
- P8. Hyrynsalmi and Linna (2017) [20]
- P9. Dobrica and Pietraru (2017) [21]
- P10. Ribeiro and Dias-Neto (2017) [22]
- P11. Fontão, Dias-Neto and Viana (2017) [23]
- P12. Qiu, Gopal and Hann (2017) [24]
- P13. Krupskiy et al. (2017) [25]
- P14. Hyrynsalmi, Mantymaki and Baur (2017) [26]
- P15. Acar et al. (2016) [27]
- P16. Wang, Hedman and Tuunainen (2016) [28]
- P17. Haile and Altmann (2016) [29]
- P18. Fontão et al. (2016) [30]
- P19. Teixeira, Robles and Barahona (2015) [31]
- P20. Hess et al. (2015b) [32]
- P21. Fontão, Santos and Dias-Neto (2015) [4]
- P22. Lim et al. (2015) [33]
- P23. Siegfried, Koch and Benlian (2015) [34]
- P24. Jaramillo, Newhook and Smart (2013) [35]
- P25. Hyrynsalmi et al. (2012a) [36]
- P26. Pettersson and Vogel (2012) [37]
- P27. Campbell and Ahmed (2011) [38]
- P28. Hyrynsalmi et al. (2014) [39]
- P29. Gaffney (2013) [40]
- P30. Ryu, Kim and Kim (2014) [41]
- P31. Kaareborn and Howcroft (2013) [42]
- P32. Kim, Kim and Lee (2016) [43]
- P33. Suh and Lee (2017) [44]
- P34. Genc-Nayebi and Abran (2017) [45]
- P35. Mukhopadhyay, Reuver and Bouwman (2016) [46]
- P36. Braun, Elberzhager and Holl (2017) [47]
- P37. Hyrynsalmi, Suominen and Mantymaki (2016) [48]
- P38. Goldbach, Benlian and Buxmann (2017) [49]
- P39. Bagheri et al. (2016) [50]
- P40. Mayra (2015) [51]
- P41. Poynter, Williams and York (2014) [52]
- P42. Franca, Santos and Werner (2015) [53]
- P43. Yu (2013) [7]
- P44. Lee, Kang and Kim (2014) [54]
- P45. Fontão et al. (2017b) [55]
- P46. Pettersson et al. (2010) [56]
- P47. Costa et al. (2013) [57]

P48. Fontão et al. (2017a) [58]
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