

Are Product Owners communicators? A multi-method research approach to provide a more comprehensive picture of Product Owners in practice

Carolin Unger-Windeler^{1,2}  | Jil Ann-Christin Klünder¹  | Timothy Reuscher² | Kurt Schneider¹

¹Leibniz University Hannover, Software Engineering Group, Hannover, Germany

²Baker Hughes, a GE Company, Research and Development, Celle, Germany

Correspondence

Carolin Unger-Windeler, Leibniz University Hannover, Software Engineering Group, Hannover, Germany.

Email: carolin.unger-windeler@inf.uni-hannover.de

Abstract

Product Owners have an important role in the agile and hybrid software development process. While this role is supposed to maximize the value of a product, there seem to be several scattered results on how they achieve this, as well as what actually constitutes this role in practice. To consolidate current research results and to further analyze the key attribute of Product Owners, we conducted a multi-method research approach spanning a systematic mapping study and a consecutive case study in a hybrid development environment.

The results of the mapping study states that Product Owners are communicators. We further investigated on this and used the shadowing technique to observe three Product Owners' communication activities. The results support that statement, as the gained data reveal that Product Owners spend 65% of their time in meetings. But rather than just providing the team with the necessary requirements for the product under development, Product Owners need this time to synchronize and align their work, streamline the agile process of large-scale Scrum, discuss team-based topics, and to solve upcoming issues addressed by the team. These results contribute to draw a more comprehensive picture of the important but yet complex role of Product Owners in practice.

KEYWORDS

agile software development, case study, communication, On-Site Customer, Product Owner, Scrum, systematic mapping study, XP

1 | INTRODUCTION

For several years, software producing companies have faced the necessity to develop and distribute high-quality software at a high pace.¹ Especially companies in the system development area struggle with delivering working software at an early stage while remaining flexible and adaptable to changes.¹ Agile software development promises to satisfy these needs.²⁻⁴ Consequently, many companies strive towards a more agile development approach.⁵ However, in particular in large organizations that combine software and hardware production, implementing agile methods is often reported difficult.⁶

This difficulty may be one possible reason why hybrid development methods are state of the art.⁷ Based on the results of the large-scale HELENA¹ study,⁸ nearly three of four companies follow a hybrid development approach combining different development methods

¹HELENA: Hybrid dEvelOpmENt Approaches in software systems development, online: <https://helenastudy.wordpress.com>

[Correction added on 13 February 2021, after first online publication: Projekt Deal funding statement has been added and copyright line was changed in this version]

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and practices.⁷ These customized hybrid methods often include traditional and agile development methods and practices, such as Scrum and the Waterfall model.⁹ Klünder et al⁷ report on Scrum and eXtreme Programming (XP), next to Iterative Development, Kanban, DevOps, and the classic Waterfall model, being among the six most often applied development methods. The Product Owner in Scrum, respectively, the On-Site Customer² as part of XP is a practice reported to be used by nearly 50% (359 of 769) of the participants of the HELENA study.⁸

In XP, the On-Site Customer is a person who has profound domain knowledge, can and should make business decisions, and be on-site with the rest of the XP team.¹⁰ According to Beck,¹¹ the role of the On-Site Customer can be defined as “a role on the team for choosing what stories the system has to satisfy, what stories are needed first and what can be deferred.”¹¹, p177 In the Scrum framework, the role of the Product Owner is represented by a single person who is responsible for requirements elicitation and prioritization.^{12,13} According to Schwaber,¹³ the Product Owner is responsible for maximizing the value of the product under development.

1.1 | Problem statement

Although the importance of the Product Owner role in agile as well as hybrid software development processes is unquestioned, it is neither clearly defined how the Product Owner can maximize the value of the product under development, nor what actually constitutes this role in practice. Instead, Schwaber¹³ clearly states that how the Product Owner role is implemented depends on the organization, Scrum teams, and individuals.¹³

Consequently, what is missing is a bigger picture of current research results regarding the Product Owner role in industry, as well as a further analysis of the key attributes of this role.

1.2 | Research objective

To overcome the shortcoming stated above, we identified two research objectives for this paper: The first objective is to provide an overview of topics regarding the Product Owner role that have been addressed in research. Therefore, we conducted a systematic mapping study to structure the research area and identify the addressed research topics as well as its key results.

The second objective is to further analyze the key statement that resulted from the mapping study: The Product Owner role is a communicator role. Therefore, we conducted a case study on the communication activities of Product Owners to provide qualitative as well as quantitative evidence to support that statement.

1.3 | Contributions

We contribute a systematic mapping study¹⁴ on the Product Owners in industry, which results in the identification of seven research topics and their corresponding takeaway messages. Most of these research topics emphasize the importance of Product Owners communication activities. The results of the mapping study have been published and presented at the International Conference on Software and System Processes (ICSSP) in 2019 held in Montreal, Canada.¹⁴ However, a thorough description of Product Owner's communication activities is missing. In the publication at hand, we further contribute a case study to analyze the actual state of Product Owner communication activities. The results identify the purpose of the individual communication activities, the time spent in meetings, and whom they communicate with during these activities. The gained qualitative as well as quantitative data support the statement that the Product Owner is a communicator role.

1.4 | Outline

The remainder of the paper is organized as follows. In Section 2, we discuss related work to the topics of Product Owner tasks and communication in software projects. We introduce the research designs of the two studies in Section 3, before presenting their results in Section 4 and further discuss them in Section 5. Section 6 concludes the paper and addresses its limitations and future work.

²As these roles can be considered as more or less equivalent, we mean both roles when talking about the Product Owner.

2 | RELATED WORK

Product Owners tasks and activities have been assessed by Bass et al.^{15,16} In 2014, Bass¹⁵ provided insights in the tasks and activities of Product Owners in large companies. He performed a qualitative study with eight international companies and 45 practitioners and identified the following functions of Product Owners: groom, prioritizer, release master, technical architect, governor, traveller, intermediary, risk assessor, and *communicator*.¹⁵ In 2016, Bass et al.¹⁷ compared the identified functions to actual tasks and activities of Product Owners in smaller companies and identified some differences which indicates that the Product Owner role is impacted by the company size. Unger-Windeler and Klünder¹⁸ conducted a case study in the oil and gas industry to check whether these nine functions of Product Owners are also present in this domain. Preliminary results indicate that the tasks differ and that not only the size of the company, but the organizational structure might have an impact on the Product Owner role as well.

In our mapping study,¹⁴ we found communication to be the most frequently mentioned task of Product Owners in literature. Several researcher identified communication to be of particular importance in the development process (cf. previous studies¹⁸⁻²⁵). However, we did not find a publication investigating the communication of Product Owners in detail.

In the greater area of software engineering and (agile) software development, several publications support the relevance and importance of communication for project success (cf. previous works^{19,26,27}). The impact of communication on software quality has also been discussed frequently. Wolf et al.²⁸ identified poor communication as one of the main obstacles to successful collaboration as working in teams always goes along with communication. Especially for software development teams, communication is a key component for successful projects.¹⁹ Requirements that are not properly communicated might be misunderstood and implemented wrongly or not at all, which leads to an unsatisfying software product. To maximize the success of a project, information needs to be communicated with certain team members or the entire team. This information exchange often takes place in meetings.²⁹ When following the scaled Scrum framework (Nexus), a predefined set of formal meetings should be held in order to ensure a fast and wide ranging communication. Although the number of meetings might add up in a scaled project, formal meetings are still the most efficient way to transport information,³⁰ and the more information is transported during a meeting, the less the team needs other communication channels like e-mail, phone, or chat.³¹

However, despite the identification of the relevance of communication in the daily life of software development teams in general and product owners in particular, it remains unclear what exactly defines this communication. Therefore, we investigated this topic and used the shadowing technique to observe three Product Owners.

3 | RESEARCH DESIGN

The research presented in this paper is designed as a consecutive research effort that represents a multi-method research approach spanning two sub-studies. We started with a systematic mapping study to gain an overview of the considered aspects of Product Owners in research and further analyzed the key statement that resulted from this study—the Product Owner role is a communicator role—in a case study.

3.1 | Research questions

In order to achieve the above stated research objectives, respective research questions needed to be phrased for this multi-method research approach.

3.1.1 | Systematic mapping study

In contrast to systematic reviews where a very specific goal has to be formulated, the research questions in mapping studies are more general as they aim to discover research trends.³² Therefore, the questions for the first substudy are as follows:

Research question 1:

What is the current research on the Product Owner role?

We view this question in two parts:

RQ 1.1: What topics regarding the Product Owner role in industry are addressed in research?

RQ 1.2: What research method was applied to investigate these topics?

Answers to these questions help us to classify and structure the research in this area.

Research question 2:

What insights about Product Owners are presented in research?

To get the maximum value out of this research, we preserve and summarize the knowledge shared in the considered publications. Therefore, we structure the content based on the addressed research topics identified in research question 1.

Research question 3:

What external circumstances of the Product Owners' environment have been analyzed in research?

While practitioners have an increased interest in tailoring agile software methods to large-scale offshore enterprise development programs,³³⁻³⁵ a co-located development team with approximately nine members is ideal to work with.¹³ Hence, we were interested in whether these external circumstances are considered in current research. In particular, we want to analyze current literature with respect to the following aspects that are part of the *environment*.

RQ 3.1: What organizational structures are considered in literature?

RQ 3.2: What company sizes are considered in literature?

RQ 3.3: What team dimensions are considered in literature?

RQ 3.4: What team locations are considered in literature?

The key statement that resulted from the above answered research questions is that Product Owners are communicators.¹⁴ This result has been published and presented at the International Conference on Software and System Processes (ICSSP) in 2019 held in Montreal, Canada.¹⁴ However, what is missing is a thorough description of Product Owners' communication activities, a quantification of these activities as well as a clear identification of the roles they communicate with. To extend the results of the mapping study, the following substudy analyzes the actual state of Product Owner communication activities in a case study. Furthermore, as the external circumstances of the Product Owner role are almost neglected in the considered literature, the case study focused on the communication activities of Product Owners in a hybrid environment. This environment has been chosen as it can be considered as state of the art according to the results of the HELENA-study.⁸

3.1.2 | Case study

The research questions for the consecutive case study are phrased as follows:

Research question 4: What kind of communication activities does a Product Owner engage during a sprint?

The answer to this question should help to grasp the actual communication activities beyond the regular Scrum/Nexus meetings.

Research question 5: How much time does a Product Owner spend on these communication activities?

The results of our systematic mapping study allows the conclusion that the Product Owner communicates a lot. However, current research does not provide any quantitative information regarding the communication activities. By answering this question, we would like to close this gap.

Research question 6: With whom does a Product Owner collaborate in these activities?

As results of the systematic mapping study state that the relationship and, hence, collaboration with others is key—it remains unknown whom these other roles are. Although the answer to this question will not identify the most important collaboration partners, it provides a first insight about the roles Product Owners actually communicate and hence interact with. Note that we are not interested in identifying the roles the Product Owners *should* collaborate with. We look at the state of “as-is” rather than on the state “to-be.”

3.2 | Research design of the mapping study

To meet our first research goal of achieving an overview of aspects regarding the role of Product Owners that have already been addressed by researchers, we conducted a mapping study. This method primarily enables to structure a research area and identifies gaps and possibilities for future research.^{32,36} Also, a mapping study allows us to gain a wide overview of the research area.³⁷ The research process described by Petersen et al.³⁶ served as a basis for our research and will be described in this section. However, we have modified this process by adding the step of snowballing search as visualized in Figure 1. By including this step, we achieved a more comprehensive list of relevant papers.

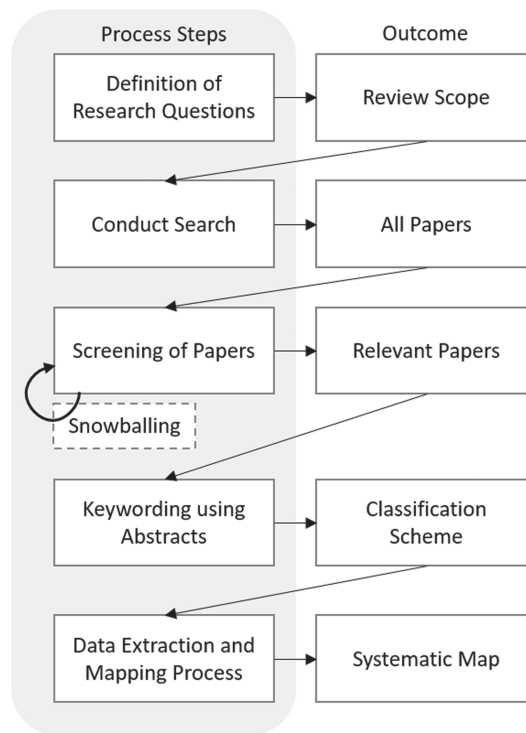
3.2.1 | Research method

This section describes the process followed to conduct the search according to Petersen et al.³⁶

Defining the search string

The keywords were identified using PICO (Population, Intervention, Comparison, Outcomes).³⁷ The PICO criteria were developed to identify keywords and formulate search strings from research questions.³²

FIGURE 1 Modified research process



Population: Population may refer to a specific software engineering role or a category of software engineering.³² In our context, the populations are defined by *Product Owners and On-Site Customers in industry*.

Intervention: In software engineering, intervention refers to a software methodology.³² In the context of this study, we investigate on the intervention of two agile software development methods: Scrum and eXtreme Programming.

Comparison: This is the software engineering methodology; the intervention is compared to previous work.³⁷ We do not compare two methodologies, but we rather compare findings of current research with regard to research topics and methods addressed in literature (RQ1), the key findings (RQ2) and the environment (RQ3).

Outcomes: Outcomes should relate important factors such as reduced production costs or reduced time to market.³⁷ In our context, we expect measurable results in terms of *research gaps or saturation*.

Combining these considerations, we identified the keywords *Product Owner, Industry* and *Agile*. For these three keywords, we used the synonyms and abbreviations shown in Table 1.

The keywords were used to formulate the search string:

("product owner" OR "product owners" OR "PO" OR "POs" OR "product manager" OR "product managers" OR "on-site customer" OR "on-site customers")AND ("industry" OR "industries" OR "organization" OR "organizations" OR "practice")AND ("agile" OR "scrum" OR "extreme programming" OR "xp")

TABLE 1 Overview search keywords

Search keyword 1	"Product Owner(s)"
Abbreviation	"PO(s)"
Related keywords	"On-Site Customer(s)" "Product Manager(s)"
Search keyword 2	"Industry"/"Industries"
Related keywords	"Organization(s)" "Practice"
Search keyword 3	"Agile"
Related keywords	"Scrum" "eXtreme Programming"
Abbreviation	"XP"

Selection of sources

Seven sources were selected for the mapping study: ACM Digital Libraries, Springer Link, Science Direct, IEEE Xplore, Google Scholar, Wiley Online Library, and Scopus. With these sources, a comprehensive search was conducted.³⁶ Although Scopus covers IEEE Xplore and Elsevier, the two sources were included to verify the quality of the results. Based on the selected sources, the search string was adapted to the specific needs of each search engine.

Study selection

The study selection was processed in four iterations. We excluded studies and publications that are not relevant for our mapping study. To make this decision more objective, we defined the inclusion and exclusion criteria as summarized in Table 2.

In the first iteration, we included articles based on title and keywords. In the second iteration, we filtered by abstracts before we read the full article in the third iteration. The studies remaining after this iteration were used as starting set to for the backward and forward snowball search in the fourth iteration. These steps are visualized in Figure 1 and Figure 2.

3.2.2 | Execution

We executed the mapping study as described in the previous section. An overview of the process and the number of papers is shown in Figure 2. In the first iteration, we identified 25 papers addressing the Product Owner and seven addressing the On-Site Customer (without duplicates) based on their titles and keywords. In the second iteration, we filtered the papers with respect to the inclusion and exclusion criteria based on abstract and keywords. This led to an exclusion of three papers addressing the Product Owner. The review of the full text in the third iteration resulted in the preliminary set of 10 (Product Owner) and five (On-Site Customer) papers. However, we used these sets as *starting set* to conduct the snowballing sampling. As described by Wohlin et al,³⁸ we considered the references of the papers and the papers in which at least one of these 15 papers is cited. We applied the same process of the iterations 1 to 3 with the set of papers found during snowballing; that is, we filtered the papers with respect to the inclusion and exclusion criteria and considered the title, keywords, abstract as well as the full text in the according iterations. Eventually, this led to the final set of 10 + 7 (Product Owner) and 5 + 8 (On-Site Customer) papers that provides an insight in the current research status.

TABLE 2 Inclusion and exclusion criteria

Inclusion	<ul style="list-style-type: none"> Paper discusses Product Owner in general Paper discusses Product Owner in industry/organizations Paper is a peer-reviewed contribution to a conference or a journal Publication is a master- or PhD-thesis or a technical report
Exclusion	<ul style="list-style-type: none"> Paper has no accordance with Product Owner and On-Site Customer Duplicated papers Paper is not accessible Paper was written before 2001 Paper is not written in English or German

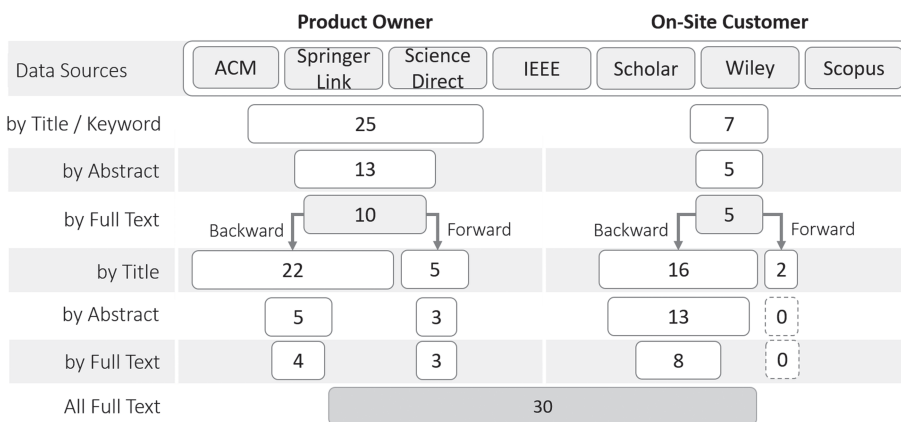


FIGURE 2 Search process and filtering steps

3.2.3 | Data extraction

To extract data from the identified studies, we developed the form shown in Table 3.

Each data extraction field has a data item, value, and, if applicable, is mapped to the corresponding research question. The extraction was performed by the first author and reviewed by the second author by tracing back the information in the extraction form to the statements in each paper and checking their correctness.

3.2.4 | Threats to validity

The outcome of our mapping study is biased by different factors. We will discuss the threats to internal, external, construct, and conclusion validity in the following.³⁸

Internal validity

As the study was mainly executed by one researcher, the decision on the inclusion or exclusion of a paper mainly depended on one opinion and hence was subjective. In order to reduce this bias, we formulated criteria for inclusion and exclusion of a paper. Additionally, the form represented in Table 3 objectified the data extraction process and was revisited by the second researcher. This retains a certain objectivity of the results.

External validity

We cannot guarantee that we have found all papers to structure the research area completely. To mitigate this threat, we performed the snowballing step which led to an inclusion of 15 more papers.

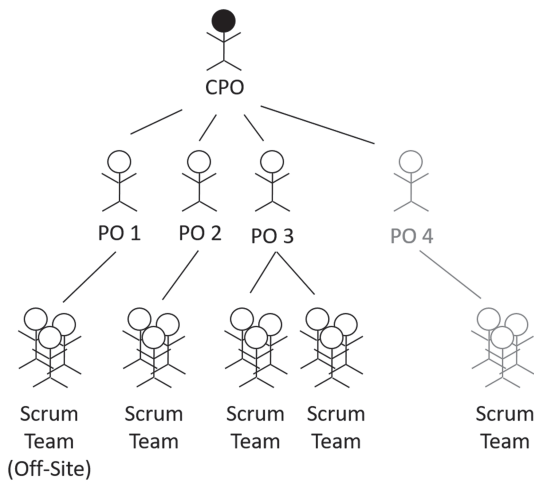
Construct validity

The construction of the mapping study depends on the definition of the research questions, the resulting search string as well as the selection of the sources. Although we used PICO to generate the keywords defining the search string, we cannot guarantee that we have considered all related keywords and synonyms. As the product manager role is often closely related with product ownership we added "Product Manager(s)" as a related keyword to mitigate this threat. Nonetheless, there may be other synonyms, and a different or extended search string probably would have led to different results. However, the papers included in the analysis draw a broad picture of the current state of research.

The results also depend on the selection of the sources. Some publications are found by more than one search engine while others are not. To reduce the threat of missing publications, we conducted the search on seven data sources that are often used in literature reviews.

TABLE 3 Data extraction form

Data item	Valua	RQ
<i>General</i>		
Title	Name of the article	
Author Name	Set of names of authors	
Year of Publication	Calendar year	
Study ID	Integer	
<i>Content</i>		
Research Topic	What topics are addressed	RQ1.1
Research Method	What research method is applied	RQ1.2
Content	What is the content of the contribution	RQ2
External Circumstances	Boolean	RQ3
Organizational Structures	Integer and flat/matrix/top-down	RQ3.1
Company Size	Integer and small/medium/large	RQ3.2
Team Dimension	Integer and small/medium/large	RQ3.3
Team Location	Integer and distributed/co-located	RQ3.4
<i>Agile Methodology</i>		
Methodology	Scrum/XP/non or both	

FIGURE 3 PO team structure

Conclusion validity

Conclusion depends on the obtained data that is based on the construction and external validity. For our purpose—structuring the research area in regard to the Product Owner—as well as to identify gaps in current research, we are confident that the data were sufficient.

3.3 | Research design of the case study

In order to further analyze the key statement that resulted from the mapping study—the Product Owner role is a communicator role—we collected both quantitative and qualitative data in a case study.

3.3.1 | Research site

The case study was conducted in a large-scale project in the context of a systems-development environment at *Baker Hughes, a GE Company (BHGE)*. The company combines capabilities across the full value chain of oil and gas activities—including the development of digital solutions combining hardware technologies with software products. While hardware engineering has always been one of the company's core businesses, software engineering is relatively new to them. In daily business, BHGE develops safety-critical systems based on reliable software. While the software is developed with a rather agile development approach, the overall product development is stage-gate managed. Hence, the Product Owner needs to communicate and negotiate with all stakeholders—including the end user of the overall product, leaders of other departments that are involved in the system development as well as the Scrum teams.

Due to the large scale of the project, the software group is following a slightly tailored Nexus approach as described by Schwaber²⁰ and created a distributed product ownership team (this team can be seen as equivalent to a Product Owner team). This team is similar to the case described by Paasivaara et al.³⁹ It contains a Chief Product Owner (CPO) and 4 Proxy Product Owners³ (PO) as shown in Figure 3.

While the CPO, PO1, PO2, and PO3 are located in Germany, PO4 is located in India. Each Product Owner has assigned at least one full development team including a Scrum Master and is responsible for up to three features within a release cycle of 3 months. While the POs 2, 3, and 4 are co-located with their teams, PO1 works with a team located off-site in Germany. PO3 has two teams assigned. For this research, we collected data from PO1, PO2, and PO3.

3.3.2 | Data collection

In the first quarter of 2019, one researcher observed each of the three Product Owners located in Germany for the duration of an entire sprint (2 weeks). This resulted in an overall duration of observance of 6 weeks and three different sprints. To collect qualitative as well as quantitative data, we used two techniques concurrently: shadowing and the Goal-Question-Metric approach, which are described in the following.

³In order to improve readability and to be in alignment with the naming in the real-world, we refer to the Proxy Product Owner only as Product Owner from here on.

Shadowing

Shadowing is a research technique that was developed to uncover the activities as well as perspectives of a real person in the real-time context of an organization.⁴⁰ This data-generation method is beneficial, whenever the unit of analysis includes an individual as well as his network or organizational contexts. It gains a rich, dense, and comprehensive data set that provides a detailed, first-hand, and multidimensional picture of the role and tasks of the person being shadowed.⁴⁰

While shadowing, the researcher shadowed the respective Product Owner every minute of the day. He had his desk in the same room as the Product Owner, attended a meeting if the Product Owner attended that meeting, was forwarded the calendar and all incoming as well as outgoing emails to/from the Product Owner. Additionally, the researcher and Product Owner discussed the content of the meetings and emails. The researcher used a spreadsheet to track the observed communication activities including the name of the conversation partners, their role, the time, and the duration of the conversation, whether it was formal or informal and the content discussed, followed by how the Product Owner processed the information.

This method collects large amounts of data, which can become difficult to analyze with respect to a specific goal.⁴¹ To avoid this, we followed a goal-centered approach to assure that we did not miss any meaningful data.

Goal-Question-Metric

Goal-Question-Metric (GQM) is a goal-oriented framework.⁴¹ By applying this framework, questions and metrics are tailored to provide meaningful data that are relevant to draw proper conclusions and eventually reach the predefined goal. While the goals are defined on a conceptual level, the questions make the goals operational and the metrics map reality to comparable values and hence makes them measurable. To achieve this, we generated a GQM plan according to Koziolok⁴¹ where we phrased the goal, questions and metrics in a hierarchical structure. An overview is presented in Table 4.

The researcher used a spreadsheet to manually collect the measured data for the metrics M1 to M7. A difficulty was to decide whether a particular interaction should be counted for one of these. To gain a consistent data set, we counted every verbal interaction that discussed subject-specific content. Hence, private conversations were excluded.

3.3.3 | Data analysis

We analyzed the gained data based on the applied techniques of shadowing and GQM.

Shadowing

To analyze the gathered data, we used the technique of *FLOW Maps*. A FLOW Map is a specialized FLOW model³¹ that provides a notation to visualize participants, activities, documents, and information flows within a project. The resulting FLOW Map for each Product Owner identified the communication activities as well as the involved roles.

TABLE 4 GQM plan

GOAL	PURPOSE ISSUE OBJECT VIEWPOINT CONTEXT	Understand Communication activities Product Owners Objective Large-scale project in system-development environment
Question	Q1	To what extent is the PO engaged in formal meetings?
Metric	M1	Quantity per day
	M2	Minutes per day
Question	Q2	To what extent is the PO engaged in informal meetings?
Metric	M3	Quantity per day
	M4	Minutes per day
	M5	Percentage quantity $((M3/M3 + M1) * 100)$
	M6	Percentage minutes $((M4/M4 + M2) * 100)$
Question	Q3	How often does a PO talk to each role?
Metric	M7	Quantity per day

Goal-Question-Metric

We defined the metrics by the goal and the question in a top-down manner before measuring. After measuring, we used the quantitative data to answer the question and eventually reach the goal bottom-up. Therefore, we used the method of descriptive statistics.

3.3.4 | Threats to validity

According to Yin,⁴² there are three tests for evaluating the quality of our case study: construct validity, external validity and reliability.

Construct validity

The validity of the construction can be ensured by using multiple sources of evidence. This has been achieved through the shadowing of the Product Owners in three different sprints. Additionally, we used the GQM framework to track the number of interactions and involved roles rather than just interviewing Product Owners and relying on their input solely.

External validity

The external validity can be achieved through replication of studies. In our study, we included insights from three different Product Owners who work in the same company. Hence, the results must not be overgeneralized and may not be correct for Product Owners in another domain or in a company that is smaller/larger than BHGE. Consequently, replications of our study are required to draw more reliable conclusions.

Reliability

We developed reliability through the use of a predefined spreadsheet, where we tracked the communication regarding the predefined metrics. This helps to ensure consistency in the data collection.

4 | RESULTS

For the systematic mapping study, we considered a total amount of 30 papers that have been published over the last 15 years. There has been an increased interest in the matter of Product Owner/On-Site Customers in 2007, 2008, and 2009. However, the most attention was gained in 2017 and 2018 as can be seen in Figure 4.

In the following, we present the results of the systematic mapping study and the case study according to the research questions described in Section 3.1.

4.1 | RQ 1: What topics and methods regarding the Product Owner role in industry are addressed in research?

Our first research question aimed to provide an overview of the addressed research topics regarding the Product Owner role in industry and the research methods applied to answer them.

We categorized the addressed questions and identified seven topics. They are addressed in the context of Scrum, XP, or for agile methodologies in general. Also, we identified seven applied research methods. Unfortunately, in three contributions, we were not able to determine the research method as it has not been described sufficiently.

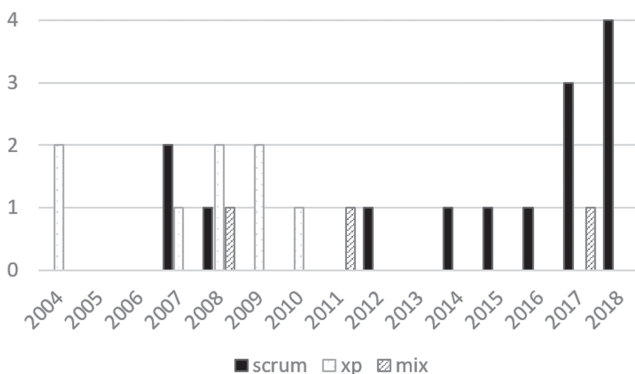


FIGURE 4 Publications by year

Most publications are addressing the *Functions/Challenges & Responsibilities* (21), compared *Theory vs. Practice* (17) and reported *Success Factors* (11) of Product Owners and On-Site Customers. The least attention was paid to the topic of *Requirements Engineering* (1) practices of Product Owners/On-Site Customers. An overview of the topics is visualized in Figure 5.

Most of the researchers collected their data with a case study (27%), conducted semi-structured interviews (18%), or shared their own experiences in an experience report (18%).

To get a comprehensive overview of what methods have been used to answer the research questions to the corresponding topics, we mapped the results in Figure 6.

Table 5 maps the references in regard to the addressed agile practices and research topics. It visualizes that the research topics “scaling Product Owner role” and “requirements engineering” are considered in Scrum only, while “theory vs. practice” as well as “collaboration/involvement” mostly consider XP practices. Three contributions considered agile practices as a whole and did not specify any framework. They are summarized in the “mix” category.

4.2 | RQ 2: What insights about Product Owners are presented in research?

After having identified what research topics are addressed in current literature, we were interested in the answers they provide.

(1) **Scaling Product Owner role.** When scaling the role of the Product Owner to large projects, some publications (e.g., previous studies^{15,16,39,44}) report the concept of Product Owner teams as helpful. However, the roles and hierarchical structures within the Product Owner teams differ.

FIGURE 5 Identified research topics and number of publications

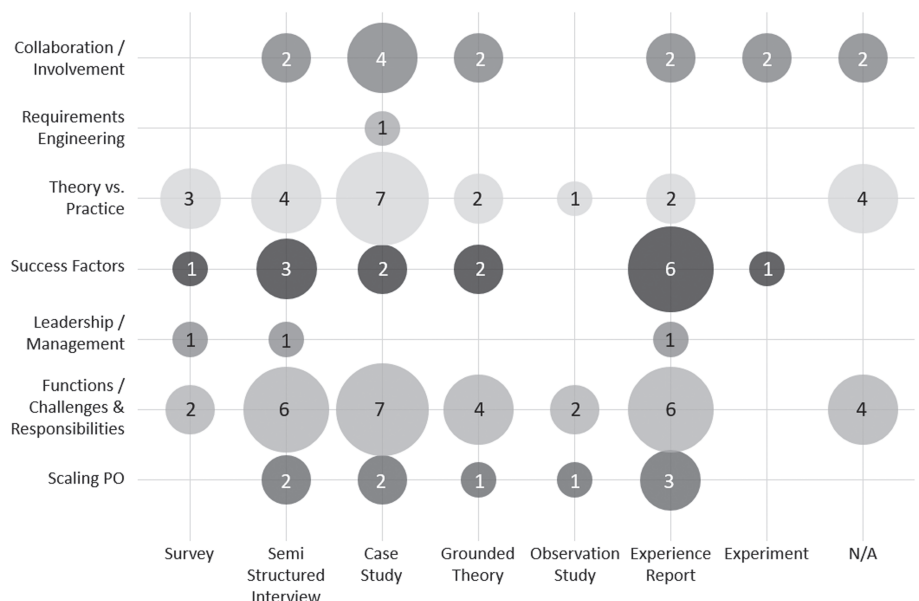
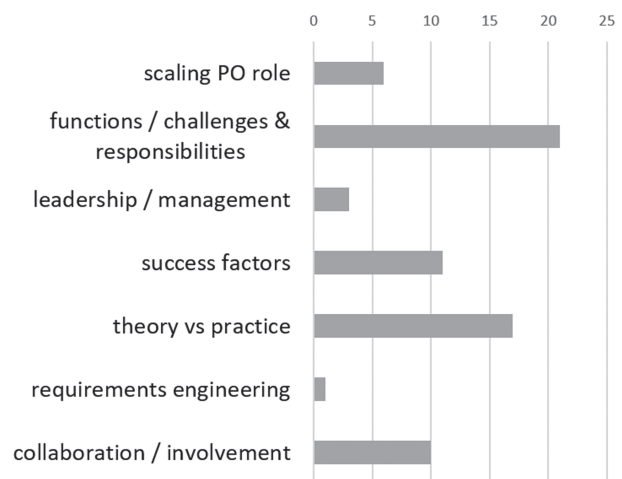


FIGURE 6 Systematic map of research questions 1.1 and 1.2

TABLE 5 Publications by research topic and methodology

TOPIC	SCRUM	XP	Mix
Scaling PO Role	15,17,39,43-45		
Functions/Challenges & Responsibilities	15-18,23-25,44-47	10,21,48-54	22,55
Leadership/Management	24		22,56
Success Factors	15,39,44-47	10,53,54,57	22,55
Theory vs. Practice	17,18,23,24,47,58	21,48-50,52-54,59,60	56
Requirements Engineering	58		
Collaboration/Involvement		10,21,49,51,54,57,59,61	22,55

While Bass et al^{15,16} basically distinguish between technical and governance Product Owner roles, Paasivaara et al³⁹ report hierarchical structures containing one Main/Chief Product Owner (CPO) and multiple Area Product Owners (APO) or Proxy Product Owners (PPO). They distinguish customer-focused and technically-focused Product Owner roles. And yet Croix and Easton⁴⁴ defined their Product Owner teams consisting of more diverse roles (such as customers, designers, analysts, security experts, and operations experts).

Rather than forming formal Product Owner teams, other researchers highlight the importance of a working communication structure within various roles to support the Product Owner: Gupta et al⁴³ report good experiences in using “Obeya Wall” to communicate and define focus areas of Project Managers/Scrum Masters and Product Managers/Product Owners, while Lowery and Evans⁴⁵ propose one Product Owner for the bigger picture, who is supported by multiple in-team Subject Matter Experts (SMEs).

When it comes to smaller companies, Bass et al¹⁷ identified the concept of a Product Owner team as not feasible.

Takeaway: In large scale projects, the Product Owner role is a group effort.

- (2) **Functions, Challenges, & Responsibilities.** When describing the tasks of Product Owners, some authors categorized them as a function or responsibility while others emphasized them as a challenge for the Product Owner. To improve readability, here we summarize them simply as activities. In total, 21 different activities of Product Owners were mentioned in the considered literature. The most frequently named activity of Product Owners is *Communication*.^{15-18,21-24,46}

An overview of all identified activities and the references is presented in Table 6.

Takeaway: Product Owner role is a communicator role.

- (3) **Leadership/Management.** The aspect of leadership and management in regard to the Product Owner was only considered in three publications. Shastri et al⁵⁶ discovered that—in practice—the project manager is still in place in large projects, although this role should be replaced by the Scrum Master or Product Owner. Beside the formal role descriptions, Sverrisdottir et al²⁴ as well as Judy and Krummins-Beens²² report that the understanding of the role and responsibility of the Product Owner is quite different between organizations but seldom in perfect conformance with the official Scrum method.

Takeaway: The Product Owner management role has no generally accepted definition.

- (4) **Success Factors.** The most frequently named success factors for Product Owners are the relationship between the Product Owner and the development team as well as the stakeholders. Although Koskela and Abrahamsson⁵⁹ identified that only 21% of the On-Site Customers' time was required for assisting the development team in the actual development work, having local Product Owner representatives^{23,39,57} or a Subject Matter Expert,^{45,54} on-site is considered as the main differentiator when it comes to clearly communicate responsibilities^{39,44} and priorities.³⁹ Working closely with the team establishes a partnership of trust and teamwork, which is considered as a success factor.^{22,45,47,54}

Takeaway: Relationship management is key.

- (5) **Theory vs. Practice.** When researchers explicitly compared a Product Owner role to the description of another publication or analyzed real-world scenarios against theoretical definitions regarding the Product Owner role, we categorize this as “theory vs. practice.” With regard to the topic of *functions, challenges, & responsibilities*, for example, Bass et al¹⁷ compared their own findings of the Product Owner role in large enterprise settings¹⁵ to the Product Owner role in small companies. Unger-Windeler and Klünder¹⁸ compared the tasks described by Bass et al¹⁵ to the tasks of Product Owners in a system development environment. Sverrisdottir et al²⁴ compared general descriptions of the Product Owner role to actual role description in industry. In regard to the topic of *leadership and management* in agile software development, Shastri et al⁵⁶ analyzed to what extent the Project Manager role is still encountered in the agile industry although it is officially replaced by the Scrum Master or Product Owner role.

However, regardless of the topic, the result of every comparison was always the same: it did not match. A possible explanation for this is that the settings of the two objects of comparison were not equal, which in turn would be an indication for the importance of the environment to properly describe the Product Owner role in industry.

TABLE 6 Activities of product owners

Activities	Reference
Communication	15-18,21-25,46
Acceptance tester	16,17,47,48,54
Customer relationship manager	16,17,23,25
Writing user stories	15,16,54
Traveller	15-17
Intermediary person	15-17
Prioritize the backlog	15-17
Mastering the releases	15-17
Technical architect	15,16
Technical governor	15,16
Risk assessor	15,16
Visionary	22,25
Managing expectations	24,50
Planning	24,50
Gate keeper	17
Political advisor	48
Super secretary	48
Accountability	22
Teamwork	23
Expert trainer	54
Critical decision maker	51

Takeaway: No Product Owner role is like another.

- (6) **Requirements Engineering.** We only found one publication that discussed the Product Owner role related to Requirements Engineering. Heikkila et al⁵⁸ describe the requirements flow from strategy to release in a large-scale agile development environment and described the definition of the Product Owner role as insufficient and, thus, as problematic for the process. However, this publication does not provide insights in the requirements engineering practices of Product Owners.

Takeaway: Real insights in Product Owners requirements engineering practices are absent.

- (7) **Collaboration/Involvement.** The results regarding the collaboration/involvement of Product Owners or On-Site Customers are closely related to the *success factors*. Hoda et al⁵⁵ studied the impact of insufficient customer involvement on self-organizing agile teams. They identified problems in gathering and clarifying requirements, problems in prioritizing requirements, problems in securing feedback, loss of productivity, and in extreme cases, business loss. Supporting this, Wojciechowski et al⁵⁷ report that On-Site Customer practice has substantial positive influence on quality of communication and speed of software production. Hence, adequate involvement and collaboration is necessary. However, although it is stated that most of the Product Owner's time on-site is idle,^{21,59} the absence of a Product Owner role is identified as cause for lack of involvement.⁵⁵ Hence, the collaboration needs to be designed more efficiently⁴⁹

A solution for this is provided by Williams et al.⁵⁴ They report extreme success as they have representatives on-site for a while in order to establish a close relationship between the customer and the development team so that the collaboration continues even though the customer is absent again. In turn, these reports go along with the success factor of relationship management

Takeaway: The better the relationship, the better the collaboration.

4.3 | RQ 3: What external circumstances of the Product Owners' environment have been analyzed in research?

This research question aims to provide an overview of the consideration rate of the Product Owners environment in terms of team dimension and location as well as company size and its organizational structures. Surprisingly, the external circumstances for a Product Owner are barely considered.

4.3.1 | Teams

Overall, 60% of the publications (18 out of 30) mention the dimensions of the team the Product Owner/On-Site Customer is working with. Out of this, 16 publications mention large teams. While seven of them consider globally distributed teams, only three report of co-located teams. The remaining six publications do not mention the location of the teams at all. An overview is presented in Figure 7.

4.3.2 | Company

The recognition of the Product Owner's external circumstances in terms of the company and its organization is sparse in current literature as only 33% (10 out of 30) consider these factors at all. While as much as 27% mention the size of the company (7 large, 1 small), only 17% mention the organizational structure (2 top-down, 2 flat, 1 matrix) of the Product Owner's environment. The references are mapped in regard to the addressed organizational structure and the company size in Table 7.

4.4 | RQ 4: What communication activities does a Product Owner engage during a sprint?

For the data analysis of the case study, we categorized the communication activities as meetings. Furthermore, we distinguished between formal and informal meetings. Whenever a conversation between the shadowed Product Owner and another person took place, although it was not planned and hence had no agenda, we categorized it as an informal meeting. Furthermore, we grouped the formal meetings based on the number of attending Product Owners as well as the purpose of the meeting. Consequently we identified four categories of communication activities: one informal meeting category and three formal meeting categories. In addition, we mapped the actual meeting titles. The classification of the meetings is summarized in Figure 8.

4.4.1 | Informal meetings

The informal meetings are mainly perceived as short interruptions in the office, where the Scrum Master or a developer had a short question to the respective Product Owner. These interruptions were face-to-face, via chat or telephone. Each of the Product Owners was engaged in such informal meetings.

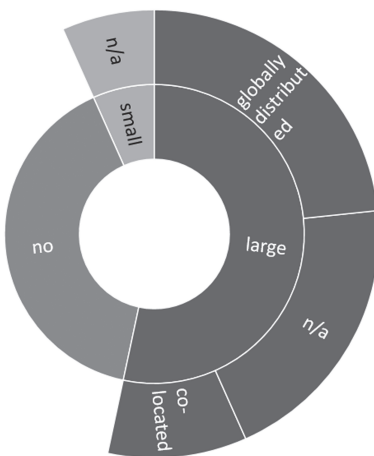


FIGURE 7 Publications consider team dimensions

TABLE 7 Publications consider external circumstances

Organization size	Top-down	Flat	Matrix	N/A
Small		17		
Medium				
Large	18		43	15,16,25,39,58
N/A	50	22		10,21,23,24,44-46,48,49,51-61

4.4.2 | Formal meetings

General formal meetings

The *General Formal Meetings* are neither official Nexus nor team-based meetings. However, all of the identified meetings in this group were attended by all of the Product Owners at the same time and served the purpose of synchronizing and aligning their work. We identified the title of these meetings as *Quarterly PO Meeting, Delivery Group Meeting, Bug Triage Meeting, and All Hands Meetings*.

Nexus formal meetings

As the Software Group is following a slightly tailored Nexus approach, we identified some of the applied official Nexus events and hence labeled them *Nexus Formal Meetings*. These meetings serve the purpose of streamlining the agile process of large-scale Scrum. All three Product Owners attend the Nexus formal meetings at the same time and were identified as *Nexus Sprint Planning, Nexus Sprint Review, Nexus Retrospective, and Nexus Daily*.

Team-based formal meetings

The remaining meetings were attended by only one individual Product Owner and discussed team-based topics. Thus, we called them *Team-based Formal Meetings*. However, although all of these meetings were called differently by each of the Product Owners, most of the meetings have the same purpose and were identified as follows: *Sprint Planning, Refinement (incoming), Refinement (outgoing), Review*. While they basically match the Nexus events, they take place on the team level. Additionally, we identified different flows of information in the individual refinement meetings.

The *Refinement (incoming)* meetings describe the flow of information from the SME (Subject Matter Expert) to the Product Owner. Hence, this meeting aims to refine the requirements so that the Product Owner understands them properly. This communication activity could be compared with the requirements analysis phase in the requirements engineering process. On the other hand, the *Refinement (outgoing)* meetings describe the flow of information (analyzed requirements) from the Product Owner to the Scrum team.

Furthermore, we identified some slight differences on the level of the team-based formal meetings. Here, the individual Product Owner added some more meetings to support the work of their team. We labeled them as *Individual*. Examples for these meetings are the *Daily Scrum*: here, the Product Owners attend them either regularly, sporadically or not at all; *Backlog Prioritization*: here, one Product Owner conducts this tasks with the team, while others do this on the Nexus level.

Finding: During a sprint (2 weeks), a Product Owner is engaged in informal and formal meetings. The informal meetings serve the purpose of **solving issues issues for the team**. The formal meetings serve the purpose of **synchronizing and aligning the work of the Product Owners, streamlining the agile process of large-scale Scrum and discuss team-based topics and provide the team with the necessary requirements for the product under development**.

4.5 | RQ 5: How much time does a Product Owner spend on these activities?

Based on the results of research question 4, we structure the answer to this question by formal and informal meetings.



FIGURE 8 Meeting categories. The meeting titles marked with an asterisk (*) identify that these meetings are beyond the regular Nexus meetings

4.5.1 | Formal meetings

Despite the qualitative analysis method to identify formal meetings, we were able to extract quantitative data due to the inclusion of the GQM approach.

With Question Q1 and its respective metrics M1 and M2 (see GQM plan in Table 4), we assessed the quantity of formal meetings per day for each day of the sprint. As represented in Figure 9, the quantity depends on the day of the sprint cycle.

On days 1, 2, and 3, the sprint starts. Here, formal communication occupies almost all days. While the Product Owners typically have 5 to 6 meetings per day in median, they spend between 200 to 300 min in median (3.3 to 5 h) with this kind of communication per day.

On days 9 and 10, the sprint ends. Here, the amount of formal meetings is quite high (4 in median), although they only take up to 130 to 190 min in median (2.2 to 3.2 h). In the meantime, formal communication was happening as well, but less time consuming than at the start and end of the sprint.

According to the results of RQ 4, these results identify that during a sprint, Product Owners spend 32 h to synchronize their work, streamline the agile process and work with their teams. Considering that the Product Owners work 70 h per sprint (35 h per week), formal communication takes up 45% of their time.

4.5.2 | Informal meetings

Question Q2 and its respective metrics M3 and M4 (see GQM plan in Table 4) allowed to quantify informal meetings for each day of the sprint. The results represented in Figure 10 can be related to the results from Q1. While on days 1, 2, and 3, where formal communication is high, informal communication is not very present. However, in the middle of the sprint (starting from day 6), the Product Owner gets involved in more informal communication. On days 9 and 10, where the sprint ends, the Product Owners communicate about 30 to 40 times informally. On day 9, the informal communication takes up the most time (150 min per day).

Furthermore, the metrics M5 and M6 allowed us to assess the time spent in meetings percentage-wise. Summarizing, we can say that although 68% of the Product Owners meetings are informal (M5), only 31% of their overall time spent in meetings are spent on informal ones (M6).

According to the results of RQ 4, these results identify that during a sprint Product Owners spend 14 h to solve upcoming issues addressed by their teams. Considering that the Product Owners work 70 h per sprint (35 h per week), informal communication takes up 20% of their time.

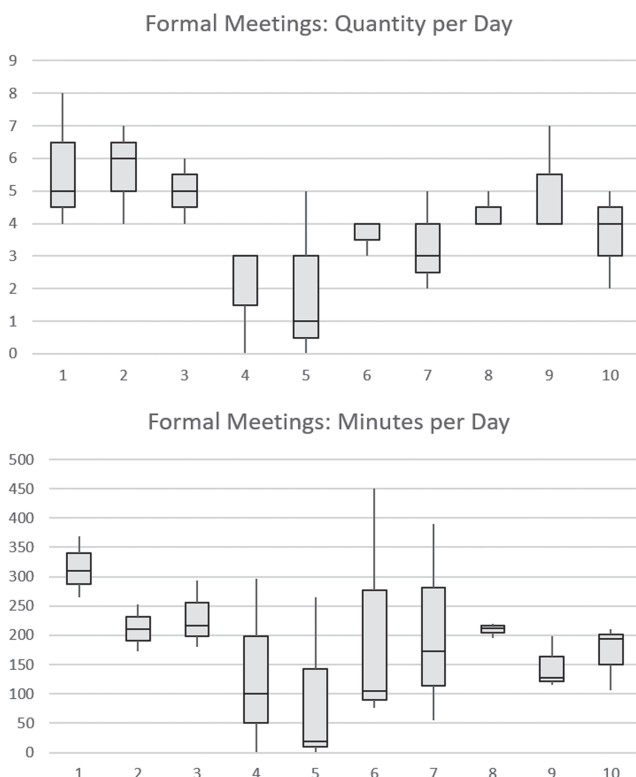
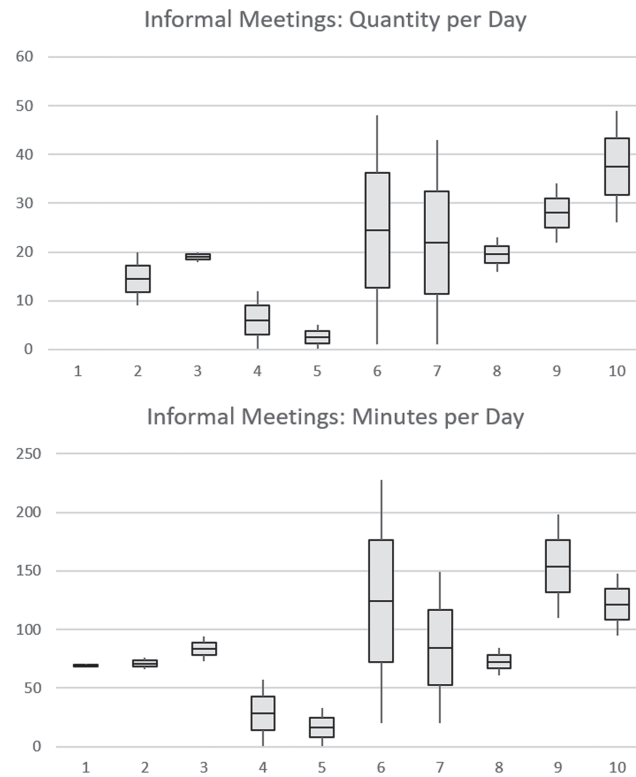


FIGURE 9 Quantification of formal meetings

FIGURE 10 Quantification of informal meetings



Finding: During a sprint (2 weeks), Product Owner spends 65% of their entire time in formal and informal meetings. Forty-five percent of the time is spent to synchronize their work, streamline the agile process and work with their teams (formal meetings). Twenty percent of the time is spent to solve issues for their teams (informal meetings).

4.6 | RQ 6: What roles are involved in these communication activities?

Our data provide qualitative as well as quantitative answers to this question.

4.6.1 | Qualitative results

The qualitative analysis of the notes taken during the shadowing revealed that the Product Owner interacts with a total number of 18 different roles from three different departments: Management, Engineering/Operations (we combined these two groups and refer to it from now on as “Subject Matter Expert (SME) Group”), and Software. These three groups can be seen as individual stakeholder groups within a large-scale project in the context of a systems-development environment.

Software Group: Developer, Tester, Scrum Master, Chief Product Owner, Quality Assurance Manager, Configuration Manager, UI/UX Designer

Management Group: Software Director, Skill Pool Manager, Project Manager, Project Management Office, Product Manager

SME Group: Firmware Developer, System Architect, Engineer, System Engineer, Technical Support, Reliability Manager

Figure 11 depicts the roles a Product Owner communicates with. Some of these roles are represented by multiple individuals such as the Scrum master role. Roles represented by multiple individuals are represented by a twin-circle in Figure 11.

4.6.2 | Quantitative results

With the predefined Questions and Metrics (see Table 4), we captured the number of interactions with each role.

Table 8 summarizes the results and shows that most communication happens among the Product Owners, respectively, with other roles from the Software Group. The left column summarizes the ranking of the contacted roles. However, the roles of the ranking 2 to 4 are considered as the Scrum team. Within the Scrum Team, the Product Owners communicate more often to the roles of the developers and testers than to the

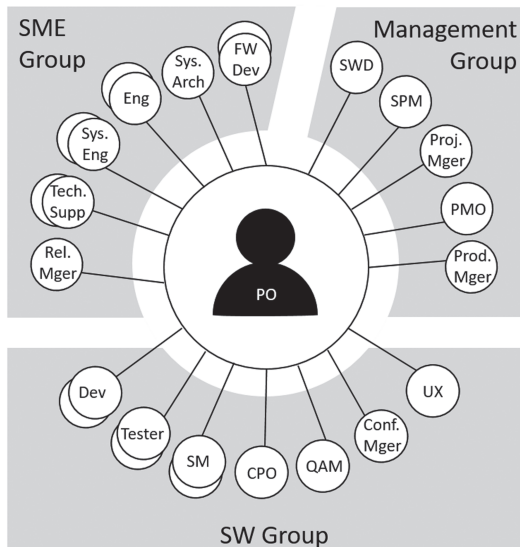


FIGURE 11 Product owner communication partners. Roles represented by multiple individuals are represented by a twin-circle

FW Dev Firmware Developer	Dev Developer	SWD Software Director
Sys. Arch System Architect	SM Scrum Master	SPM Skill Pool Manager
Eng Engineer	CPO Chief Product Owner	Proj. Mger Project Manager
Sys. Eng Systems Engineer	QAM Quality Assurance Manager	PMO Project Management Office
Tech. Supp Technical Support	Conf. Mger Configuration Manager	Prod. Mger Product Manager
Rel. Mger Reliability Manager		

Scrum Master. The ranking of the groups identified that Product Owners communicate most with members of the software group (rank # 1), second most with members of the management group (rank # 2), and least often with members of the subject matter expert group (rank # 3).

Finding: During a sprint (2 weeks), a Product Owner gets in contact with 15 different roles, while some of the roles are represented by multiple persons. The most frequently contacted roles are members of the software group (rank # 1), the management group (rank # 2) and members of the subject matter expert group (rank # 3).

5 | DISCUSSION

Product Owners and On-Site Customers have an important role in the agile software development process. While this role is supposed to maximize the value of the product under development, there seemed to be several scattered results on how the Product Owner achieves this, as well as what actually constitutes this role in practice. To close this gap, we conducted a multi-method research approach spanning two sub-studies.

The first sub-study was a systematic mapping study on the Product Owners in industry, which resulted in the identification of the following 7 research topics and its takeaway messages:

- (1) Scaling the Product Owner role: In large-scale projects, the Product Owner role is a group effort.
- (2) Functions, Challenges, & Responsibilities: The Product Owner role is a communicator role.
- (3) Leadership/Management: The Product Owner management role has no generally accepted definition.
- (4) Success Factors: Relationship management is key.
- (5) Theory vs. Practice: No Product Owner role is like another.
- (6) Requirements Engineering: Real insights in Product Owner requirements engineering practices are absent.
- (7) Collaboration/Involvement: The better the relationship, the better the collaboration.

While all of the above topics are important, the topic regarding the *Functions, Challenges & Responsibilities* has been addressed the most in the considered literature. Its takeaway message states that *The Product Owner role is a communicator role*. We consider this takeaway message as the

TABLE 8 Interactions over the course of a sprint

	Role	PO1	PO2	PO3	∑	Rank
Software Group	PO	64	65	103	232	1
	Developer	28	56	105	189	2
	Tester	23	47	43	113	3
	Scrum Master	16	44	46	106	4
	CPO	21	12	19	52	5
	Quality Assurance Manager	17	13	13	43	6
	Config. Manager	4	18	5	27	7
	UI/UX Designer	1	2	9	12	11
				774	1	
Management	SW Director	1	13	7	21	8
	Skill Pool Manager	4	11	4	19	9
	Project Manager	0	10	3	13	10
	Project Management Office	0	2	0	8	14
	Product Manager	0	1	0	1	16
				62	2	
SME Group	Firmware Developer	0	18	9	27	7
	System Architect	11	5	6	13	11
	Engineer	3	3	3	9	12
	System Engineer	0	1	5	6	13
	Tech Support	0	0	2	2	15
	Reliability Manager	1	0	0	1	16
				58	3	
	∑ Interactions	191	321	382		
	Network Size (Roles)	14	17	15		

key statement of this research as it spans across multiple topics. So are the statements regarding the “Success Factors” (*relationship management is key*), the “Collaboration / Involvement” (*The better the relationship, the better the collaboration*), as well as the “Scaling of the Product Owner role” (*Product Owner role is a group effort*) directly linked to the topic of communication.

Therefore, we think that it is particularly important to understand this statement. However, what is missing is a thorough description of Product Owners' communication activities, a quantification of these activities as well as a clear identification of the roles they communicate with. To take a step forward in this direction, we conducted the second substudy.

The second substudy was a case study on the communication activities of Product Owners in a hybrid development environment. This environment has been chosen as it can be considered as state-of-the art according to the results of the HELENA-study⁸ but have been neglected in the considered literature of the systematic mapping study.

Due to the applied shadowing technique, the researcher was able to immerse into the professional life of three Product Owners. With this, we experienced the communication activities of this role first hand. Noticeable was the constant turmoil in the shared office space of the Product Owners. In general, all of the Product Owners spent very little time at their desk. The quantitative data revealed that a Product Owner spends 46 h in meetings each sprint. Considering that a sprint has 10 work days and a work day has 7 h (as in the setting of the research site), the Product Owner got 70 working hours. Hence, the Product Owner role spends 65% of his time just in meetings (formal or informal). Our research support the findings by Perry et al.⁶² While he reported that about an average of 75 min per day are spent in unplanned interpersonal interactions, we identified an average of 85 min per day in respect to the Product Owner role.

Furthermore, the quantity as well as the category of communication activities follows a pattern over the course of the sprint. The quantity of formal meetings is especially high at the beginning of a sprint while it is quite low in the middle of a sprint. The formal meetings served the purpose of synchronizing and aligning the work of the Product Owners, streamlining the agile process of large-scale Scrum and discuss team-based topics and provide the team with the necessary requirements for the product under development.

The shadowing also revealed that most of the informal meetings in the middle of a sprint served the purpose of solving upcoming issues addressed by the Scrum team. This might be due to the rigorously followed sprint schedule. Here, in the beginning of a sprint, all project members

are busy with the formal Scrum meetings, planning the sprint and distribute tasks. Hence, it seems natural that questions arise after a couple of days or every time a developer starts to work on a task.

6 | CONCLUSION

The results of the systematic mapping study stated that the Product Owner role is a communicator role. We support that statement by providing qualitative as well as quantitative data gained from a case study in a hybrid environment in the oil and gas industry. We identified that during a sprint a Product Owner spends 65% of his time in meetings. The purposes of these meetings are to synchronize and align the work of the Product Owners, streamline the agile process of large-scale Scrum, discuss team-based topics, provide the team with the necessary requirements for the product under development, as well as to solve upcoming issues addressed by the team. During these meetings, the Product Owner communicates to 15 different roles.

The communication activities have been assessed in a case study with three different Product Owners of whom all work at the same company. Hence, the results must not be over-generalized and may not be correct for Product Owners in another domain or in a company that is smaller/larger than the research site. Consequently, replications of our study are required to draw more reliable conclusions. However, such detailed data from an industry context are scarce and, hence, provide novel insights.

Also, the gained data and insights provide a great starting point for future analysis of Product Owners communication such as their communication via email, instant messengers, or the level of activity in an agile requirements engineering tool.

Overall, we are convinced that this research as well as future analysis contribute to a thorough description of the important but yet complex role of the Product Owner.

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ORCID

Carolin Unger-Windeler  <https://orcid.org/0000-0002-1392-8882>

Jil Ann-Christin Klünder  <https://orcid.org/0000-0001-7674-2930>

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APPENDIX A

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